

Open access

2,053 | 5

Views

0

CrossRef citations to date | Altmetric

Listen

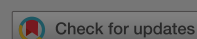
Research Article

Water exchange traded funds: A study on idiosyncratic risk using Markov switching analysis

Gurudeo Anand Tularam ✉ & Rajibur Reza | Caroline Elliott (Reviewing Editor)

Article: 1139437 | Received 20 Oct 2015, Accepted 05 Jan 2016, Published online: 28 Jan 2016

Cite this article https://doi.org/10.1080/23322039.2016.1139437



Full Article

Figures & data

References

Citations

Metrics

Licensing

Reprints & Permissions

View PDF

Abstract

Formulae display: ☒ MathJax ?

We investigate the relationship between idiosyncratic risk and return among four water exchange traded funds—PowerShares Water Resources Portfolio, Power Shares Global Water, First Trust ISE Water Index Fund, and Guggenheim S&P Global Water Index ETF using the Markov switching model for the period 2007–2015. The generated transition probabilities in this paper show that there is a high and low probability of switching

About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click “Settings”. For further information about the data we collect from you, please see our [Privacy Policy](#).

Accept All

Essential Only

Settings

Public Interest Statement

Water is essential for life and has been studied to some extent but not as much in terms of major investments and their associated risks. The issues related to climate change has increased the risk of even more people in the world living with lack of adequate water for drinking. To remove this crisis, water investments in a number of areas are urgently needed. This study provides impetus for further study of the financial aspects of the water industry and its related risks. In particular, this paper contributes by increasing the investor’s understanding of the idiosyncratic risk of water investments. The results and findings will guide investors’ in decision-making.

1. Introduction

Although water is essential for life, it is in severe shortage around the world (Tularam & Properjohn, [2011](#)). Water covers about two-thirds of the earth’s surface (Roca & Tularam, [2012](#); Tularam & Marchisella, [2014](#)). Recent statistics suggest that more than 2.6 billion people of the world are living with lack of adequate water for drinking (Jin, Roca, Li, Wong, & Cheung, [2015a](#); Roca, Tularam, & Reza, [2015](#); Tularam & Marchisella, [2014](#)) and the number has been increasing daily in that 3.9 billion persons could be reached by 2030 (Jin, Li, Roca, & Wong, [2015b](#); Organisation for Economic Co-operation & Development, [2008](#); Roca et al., [2015](#)). Presently, more than one billion people are in acute drinking water availability problems in many developing countries including Bangladesh, Pakistan, and much of Africa (Jin et al., [2015b](#); Organisation for Economic Co-operation & Development, [2009](#); Roca et al., [2015](#); Tularam & Illahee, [2008](#); Tularam & March

As the g and there
will be a eade
sanit Tularam &
Keeler, 2 ial impacts
of climat ture will
compou y developing

appear to present much important information on the values, benefits, and costs of investing in water (Roca et al., [2015](#); Tularam, [2014](#)).

Clearly, if the water shortages are to be addressed, the existing global water industry needs to examine the rapidly changing market (Jin et al., [2015b](#); Roca & Tularam, [2012](#); Roca et al., [2015](#)). There is a major drinking water crisis worldwide and therefore investments in water are urgently needed (Jin et al., [2015a](#); Roca et al., [2015](#)). The rapidly changing dynamics of the modern world suggest that water investing can be increasingly popular to investors (Roca & Tularam, [2012](#); Tularam, [2014](#)). Investing in water companies and water stocks has been the most commonly adopted approach as alternative to direct investment it seems (Jin et al., [2015a](#)). If the water sector expands and the market being rather economically resilient, investments in this industry should lead to fruitful financial returns. Investors could also gain better diversification benefits by involving investments in water within their portfolios (Roca et al., [2015](#)).

In recent times, the development of the water market has led to the development of water exchange traded index funds (ETFs). Water EFTs, are baskets of water-related shares aimed at replicating the performance of the water market. They offer investors the flexibility of buying or selling in the whole water market with a single transaction (Roca et al., [2015](#)). For example, the American Stock Exchange (AMEX) introduced the Palisades Water Index (ZWI) in 2003, with a starting value of 1,000 points. And from August 2005, they started publishing this index on a regular basis. The ZWI is an equally weighted index comprised of companies engaging in the fundamental activities of the global water industry such as distribution, filtration, pumps and pipes, and treatment (Geman & Kanyinda, [2007](#); Jin et al., [2015b](#); Roca et al., [2015](#)). Following the publication of the ZWI, two exchange traded funds (ETFs), namely, Power Shares Water Resources (PHO) and Power Shares Global Water (PIO) were successively introduced to investors to assist them to keep track of companies included in the ZWI (Wong, Roca, & Tularam,

Since Ma
Water In
exan
Global
Index (A
indices g



About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click “Settings”. For further information about the data we collect from you, please see our [Privacy Policy](#).

- Accept All
- Essential Only
- Settings

ASDAQ OMX
investors, for
on the S&P
E Water
these water
products or


these water ETFs can be defined as pure water funds (Kearney, [2008](#); Roca et al., [2015](#)).

To the best of our knowledge no study has investigated the relationship between idiosyncratic risk and return of ETFs in the water sector using Markov switching model. More importantly, in terms of the motivation of this study, none of studies reported appear to have investigated the changes of the idiosyncratic risk and risk-return relationship of the water ETF across different regimes. Therefore, this study contributes to investor's understanding of the idiosyncratic risk of water investments. The results will guide investors' in decision-making. Since the research on idiosyncratic risk of ETF is generally lacking, our study therefore aims to fill in this important gap. The main aim of this article was to investigate the relationship between idiosyncratic risk and return among four water exchange traded funds—PowerShares Water Resources Portfolio (PHO), PIO, First Trust ISE Water Index Fund (FIW), and Guggenheim S&P Global Water Index ETF using the Markov switching model for the period 2007–2015. In particular, we examine the effect of water exchange traded funds regimes on water investment using the Markov switching model.

The rest of this paper is organized as follows. In Section 2, we review the related literature. Section 3 outlines the data and methodologies employed in the study. Section 4 discusses the empirical results followed by the conclusion in Section 5.

2. Literature review

Much literature has focused on the issue of idiosyncratic risk. However, many researchers' performed studies identifying the stock market unsystematic risk premium. For example, Aaker and Jacobson ([1987](#)), Cox and Griepentrog ([1988](#)), Barber ([1994](#)), and others have contributed to this body of research. More recently, a study by [redacted] and [redacted] (2003) found that the market risk premium is significantly higher for firms with high idiosyncratic risk.



About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click “Settings”. For further information about the data we collect from you, please see our [Privacy Policy](#).


Accept All

Essential Only

Settings

In this article

Angelidis and Tassaromatis ([2009](#)) perform regressions analysis of the monthly value weighted excess market return on lagged value (equally) weighted idiosyncratic volatility. The absence of a relation using value weighted idiosyncratic volatility is consistent with Bali et al. ([2005](#)) and Wei and Zhang ([2005](#)) research. However, in the case of equally weighted idiosyncratic volatility, it is noted that there is strong evidence of a positive relation only when the stock market is in the low volatility state. While the relation between returns and risk is positive it is not statistically significant in the high volatility state. Huimin, Cheung, and Roca ([2010](#)) also find a positive relationship between the idiosyncratic risk and return during low and medium volatility states. Their results are consistent with that of Tang and Shum ([2007](#)) and Angelidis and Tassaromatis ([2009](#)); in the sense of the idiosyncratic risk premium under different market conditions.



About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click

Accept All

Essential Only

Settings



We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click “Settings”. For further information about the data we collect from you, please see our [Privacy Policy](#).

Accept All

Essential Only

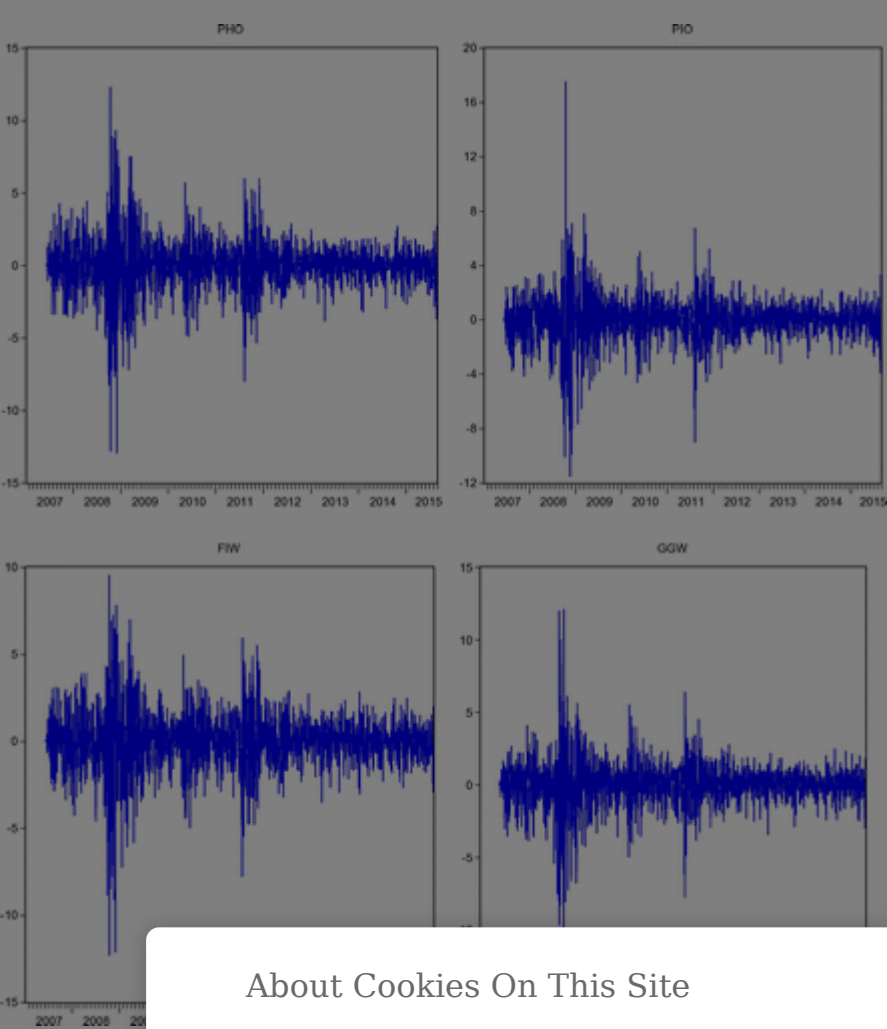
Settings

3. Data and methodology

3.1. Data

This study utilizes the PHO, PIO, First Trust ISE FIW and Guggenheim S&P Global Water Index ETF (GGW), all obtained from the Thomson Reuters DataStream database. The particular water exchange traded funds have been selected based on the completeness of data starting from the same date, 15 June 2007. The sample period is from 15 June 2007 to 31 August 2015. Daily data utilized is in the form of returns on the price indices; as calculated by the following formula: $R_t = \ln(\text{Price}_t / \text{Price}_{t-1} \times 100)$; the returns are in US dollars (Figure 1).

Figure 1. PHO, PIO, FIW, and GGW water exchange traded funds movement, 2007-2015



Display full

3.2.

Quandt (1973) point for

In this article

About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click "Settings". For further information about the data we collect from you, please see our [Privacy Policy](#).

Accept All

Essential Only

Settings

watching
ndt ([1973](#))



switching model. Hamilton ([1989](#)) proposed a multivariate generalization of the univariate Markov switching model. Particularly, we use Calice, Mio, Štěřba, and Vaříček ([2015](#)) and Calice, Ioannidis, and Miao ([2012](#)). According to them

$$\sigma_{12}=(1-S_{i,t})\sigma_{1h2}+S_{1,t}\sigma_{1l2},\sigma_{1h2}>\sigma_{1l2}$$

$$\sigma_{22}=(1-S_{i,t})\sigma_{2h2}+S_{2,t}\sigma_{2l2},\sigma_{2h2}>\sigma_{2l2}$$

When both $S_{1,t}$ and $S_{2,t}$ are zeros, the two components will be in the high volatility state as $\sigma_{12}=\sigma_{1h2}$ and $\sigma_{22}=\sigma_{2h2}$ similarly if $s_{1,t}$ $S_{1,t}$ and $S_{2,t}$ equal 1, the two components will be in the low volatility state since $\sigma_{12}=\sigma_{1l2}$ and $\sigma_{22}=\sigma_{2l2}$.

3.3. Transition probabilities

The regime generating process in Markov switching model is an ergodic Markov chain with a finite number of states which means that the current value of the process at time t depends only on its previous value at time $t - 1$ (Calice et al., [2012](#), [2015](#)) and Garcia ([1998](#)). The transition probabilities from one state to the other are shown below

$$y_{1t}=\alpha_0+\alpha_1S_{1,t}+\omega_1\varepsilon_{1t}$$

$$\phi_{1,00}=\Pr(S_{1,t}=0|S_{1,t-1}=0)$$

$$\phi_{1,11}=\Pr(S_{1,t}=1|S_{1,t-1}=1)$$

$$y_{2t}=\alpha_0+\alpha_2S_{2,t}+\omega_2\varepsilon_{2t}$$

$$\phi_{2,00}=\Pr(S_{2,t}=0|S_{2,t-1}=0)$$

The tran



Markov c

About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click “Settings”. For further information about the data we collect from you, please see our [Privacy Policy](#).

Accept All

Essential Only

Settings

$$\rho_{k,i,j} = \Pr(S_{k,t} = j | S_{k,t-1} = i) \text{ with } \sum_j \rho_{k,i,j} = 1, \forall i \text{ and } k = \{1, \dots, m\}$$

3.4. Regime probabilities

This procedure estimates the coefficient matrix, the variance–covariance matrix for each regime, the transition matrix, and the optimal inference for the regimes throughout the sample period. The latter is referred to as the regime probabilities $\hat{\psi}_{t/T}$ defined subsequently, where T denotes the end period for the estimation.

$$\hat{\psi}_{t/T} = \Pr(S_t = i) \text{ for } i = 1, \dots, m \text{ and } t = 1, \dots, T$$

Three types of regime probabilities are involved. However the choice depends on the differences in the existing results. The three types of regime probabilities are written as follows:

$$\hat{\psi}_{t/T, \zeta < t}$$

$$\hat{\psi}_{t/T, \zeta = t} \text{ filtered regime probabilities}$$

$$\hat{\psi}_{t/T, t < \zeta \leq T} \text{ smoothed regime probabilities.}$$

3.5. The relationship between idiosyncratic risk and return

We test the following Markov switching model by following the studies of Krolzig ([1997](#)), Roca and Wong ([2008](#)), Guidolin and Hyde ([2009](#)), and Huimin et al. ([2010](#)). We can regress that model as follows:

$$Y_t = \mu_{st} + \sum_k \beta_{k,st} Y_{t-k} + \varepsilon_t$$

where Y_t is a multivariate regime switching process driven by a common discrete state variable, μ is a vector of intercepts in states, β is the coefficient of market risk premium at lag k , and ε_t is a vector of error terms. The error terms are assumed to be jointly normally distributed.

Recently, we have implemented the Markov switching model to estimate the relationship between idiosyncratic risk and returns. The results show that the relationship between idiosyncratic risk and returns is not linear. The relationship between idiosyncratic risk and returns is nonlinear. The relationship between idiosyncratic risk and returns is nonlinear. The relationship between idiosyncratic risk and returns is nonlinear.

About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click “Settings”. For further information about the data we collect from you, please see our [Privacy Policy](#).

Accept All

Essential Only

Settings

$$R_t = \mu_0 + \beta_i \text{PHO} f_t \text{PHO} + \beta_i \text{PIO} f_t \text{PIO} + \beta_i \text{FIW} f_t \text{FIW} + \beta_i \text{GGW} f_t \text{GGW} + \varepsilon_{ti}$$

where R_t represents the returns on an investment of water ETFs; $i=1,2,\dots,N$ $\beta_i \text{PHO}$, $\beta_i \text{PIO}$, $\beta_i \text{FIW}$, and $\beta_i \text{GGW}$ are the time series regression coefficients of R_t ; $i=1,2,\dots,N$ in the equation to emphasize age returns across assets; $f_t \text{PHO}$, $f_t \text{PIO}$, $f_t \text{FIW}$, and $f_t \text{GGW}$ are the returns on the CAPM. μ_0 is the intercept and ε_{ti} is the error term.

Further, we test the following model to run a regression of the relationship between idiosyncratic risk and returns of water ETFs in regime t by following Angelidis and Tessaromatis (2009) and Huimin et al. (2010) by running OLS time-series regressions. According to them

$$R_t = \mu_0 + bX_t + \xi_t$$

where R_t represents the returns on an investment of water ETFs, μ_0 is the intercept, X_t is the idiosyncratic risk, and ξ_t is the error term.

4. Empirical results

4.1. Data preliminaries

From Table 1, it can be seen that stock returns are positive except PIO. The largest positive mean return (0.013%) is for FIW whereas the PIO has the lowest positive mean return (−0.009). The kurtosis values of all water stock exchange traded funds returns are higher than three, thus the returns distribution could be fat-tailed. As the skewness values are in general negative, the skewness values are the asymmetric tail. Since the Jacque-Bera results are statistically significant and reject the null hypothesis of a normal distribution for all stock returns. Nonetheless, our analysis is robust as models are usual

About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click “Settings”. For further information about the data we collect from you, please see our [Privacy Policy](#).

Accept All

Essential Only

Settings

Table

Do



4.2. Un

The presence of a unit root in the water ETFs returns are tested using both the augmented Dicky–Fuller (ADF) and Phillips–Perron (PP). Table 2 shows that ADF and PP testing procedures of the data PHO, FIW, and GGW at 1%; and PIO at 5% level of significance. Hence, the ADF and PP tests consistently reject the null hypothesis. Both unit root tests suggest the funds’ returns those of stocks are stationary. Consequently, the returns time series are used in the subsequent analysis without further differencing or testing for co-integration.

Table 2. Unit root tests results

Download CSV

Display Table



4.3. Regime and transition probabilities

Table 3 presents the corresponding probabilities and characteristics for each of the three regimes in the PHO, PIO, FIW, and GGW models. Table 3 shows the funds stayed most of the time; and the longest time in Regime 2. The three numbers in a particular row show the probability of a regime shifting into Regime 1, 2, and 3, respectively. For example, in row 1, the first number 96.44%, which indicates the probability of Regime 1 shifting into Regime 1, this means Regime 1 staying in itself; while the second number 1.63% shows the probability of Regime 1 switching to Regime 2; 21.37% shows the probability of Regime 2 switching to Regime 3. 30.52% is the probability of Regime 3 staying in itself (and therefore, 13.95%, 41.33%, and 44.71% probability of shifting to Regimes 1, 2, and 3, respectively). Hence, 29.90%, 39.56%, and 30.52% are probabilities of shifting to Regime 1, 2, and 3, respectively.

Table 3. Transition probabilities and characteristics of Markov regime switching models

Download

About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click “Settings”. For further information about the data we collect from you, please see our [Privacy Policy](#).

Accept All

Essential Only

Settings

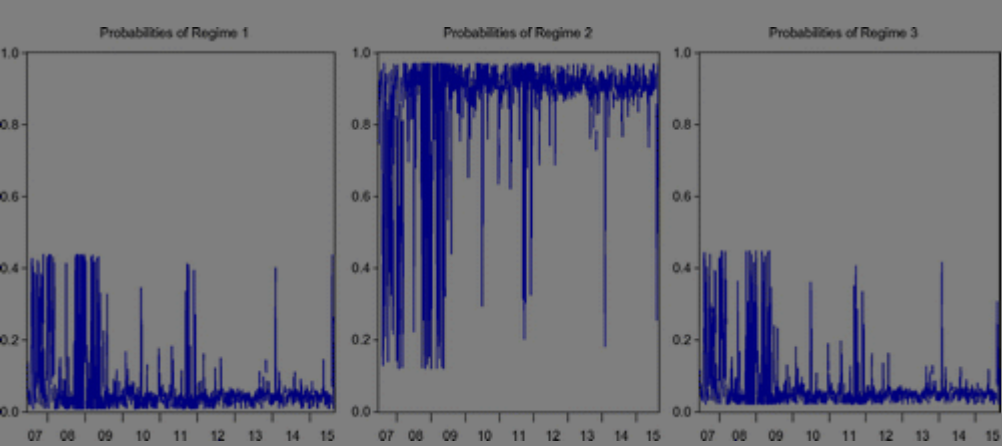


Similarly, for the FIW, the probability of staying in Regime 1 is 35.87% (therefore 45.68% probability of switching to Regime 2; and 43.46% probability of switching to Regime 3); and 20.2345% probability of Regime 3 staying in itself (95.1025.12% and 2.13% probabilities of shifting to Regime 2 and 1, respectively). Consequently, 43.46%, 02.75%, and 36.30% are probabilities of shifting to Regime 1, 2, and 3, respectively, as well. Again the probability of staying in Regime 1 of GGW is 08.81% (and therefore 39.50% probability of switching to Regime 2; and 51.68% 21.37%) and 02.09% in Regime 3. Consequently, 96.29% and 01.6041.43 are probabilities of shifting to Regime 2 and 1, respectively). Hence, 61.30, 26.94, and 11.75% are probabilities of shifting to Regime 1, 2, and 3, respectively, as well.

Thus, these figures show that there is a high and low probability of switching between Regimes 1 and 3. This means that these regimes are highly and lowly volatile, which further confirms that the water exchange traded funds with the water sector is characterized by more regime stability compared to the funds relationship with the equity market (Roca, Tularam, & Wong, [2011](#)).

A graphical representation of the regime probabilities is presented in Figures 2–4.

Figure 2. One-step ahead predicted regime probabilities.



Display full size

Figure 3.



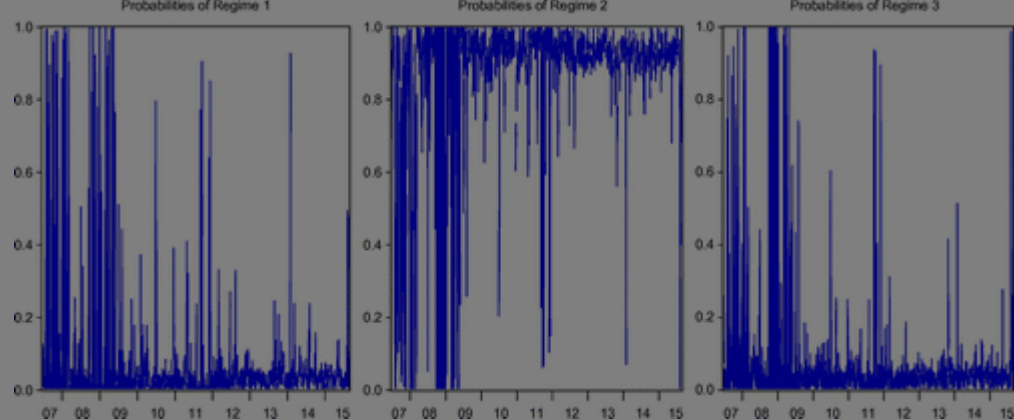
About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click “Settings”. For further information about the data we collect from you, please see our [Privacy Policy](#).

Accept All

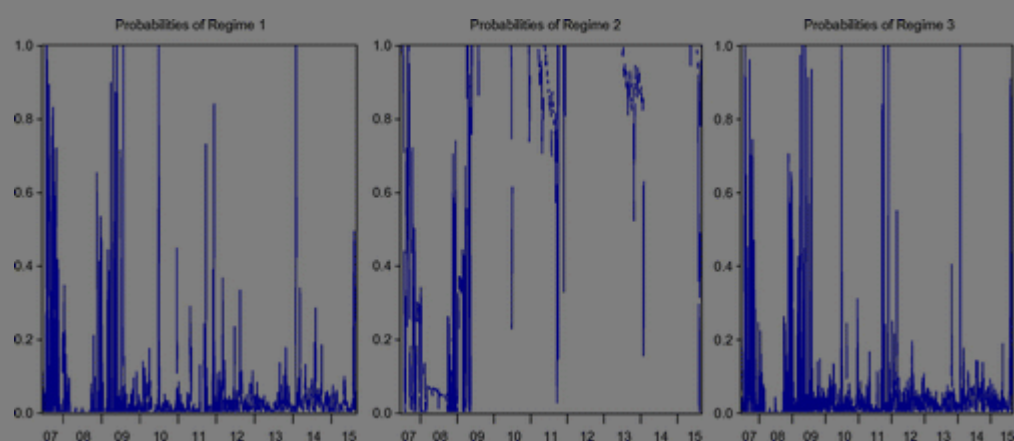
Essential Only

Settings



Display full size

Figure 4. Smoothed regime probabilities.



Display full size

4.5. Idiosyncratic risk

From Table 4, it can be seen that idiosyncratic risk for the four ETFs through the three regimes; i.e. SIGMA (σ) for regressions across regimes from the Markov switching model output. The SIGMA (σ) of these ETFs indicates that the movements of ETFs' returns are in a same direction to their benchmarks over one day. The idiosyncratic risk for most of the exchange traded funds move from low volatility (Regime 2) to very low volatility (Regime 1 and 3). In other words, SIGMA (σ) seems to be assessed in low volatility

About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click "Settings". For further information about the data we collect from you, please see our [Privacy Policy](#).

X

Accept All

Essential Only

Settings

their corresponding benchmark indices during different regimes because of the low volatility of four ETFs.

Table 4. Estimated idiosyncratic risk

[Download CSV](#) [Display Table](#)



4.6. The relationship between idiosyncratic risk and return

From Table 5 it can be seen that during Regime 1, the beta coefficients of four water ETFs are found to be positive. The Three ETFs (PHO, PIO, and FIW) are significant at the 1% level of significance. The beta coefficients are all positive for the four water ETFs at Regime 2 and Regime 3, respectively. All ETFs are significant at the 1% level of significance during Regime 2. However, three ETFs (PHO, FIW, and GGW) are significant at the 1% level of significance during Regime 3. Overall, the results show that water ETFs' beta coefficients' entire values are less than 1, which implies that water investment has a lower idiosyncratic risk which coincide with Angelidis and Tessaromatis (2009) and most of the beta coefficients are positive and significant at Regime 1, Regime 2, and Regime 3, respectively. The results indicate that idiosyncratic risk has a positive effect on the water ETFs returns during different regimes. Based on the time series data, as the beta coefficients are significant at the 1% level of significance, the results indicate that idiosyncratic risk has foretelling influence for the forthcoming returns. It is noted that the results of idiosyncratic risk and return are not constant during different regimes. Thus, Markov switching model involving time series analysis was suitable for this study.

Table 5. Empirical coefficients of unsystematic risk

[Display Table](#)



5. C

The obje

water in

return of the

babilities

About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click "Settings". For further information about the data we collect from you, please see our [Privacy Policy](#).

- Accept All
- Essential Only
- Settings

from the data-stream database based on the time series data (period 15 June 2004–31 August 2015). In so doing, the study has taken into account of the regime effects.

In this paper, the ADF and PP testing results show that PHO, FIW, and GGW at 1%; and PIO at 5% level of significance. Both unit root tests confirm that the ADF and PP tests consistently reject the null hypothesis and the funds' returns those of stocks are stationary.

The transition probabilities show that there is a high and low probability of switching between Regimes 1 and 3, respectively. The transition probabilities show that three regimes are both highly and lowly volatile. The Markov switching model results show that the idiosyncratic risk of the exchange traded funds (ETFs) are not constant across the three regimes and that the water ETFs appear to have little influence on the idiosyncratic risk. Moreover, the "standard error" terms for regressions across regimes outputs are rather low. In a similar manner, water ETFs affect the total risk. We also identify that the beta coefficients are positive and entire values are less than 1 at Regime 1, Regime 2, and Regime 3, respectively. It seems that water investment has a lower systematic risk and a positive effect on the water ETFs returns during different regimes. Thus, as the Markov switching model is changing when the regime either falls or rises, higher idiosyncratic risk of different regimes illuminating greater returns of water ETFs accordingly.

Due to the under diversification of the water investment form, the idiosyncratic risk of the water investment can play an important role in terms of the total risk and it can allow changes across three regimes. This study has important implication for the water investors and international institutions in decision-making need to include water investment in portfolio. Further, this research study can be extended along with a complementary investigation on the financial performance of the water ETFs' and their corresponding risk factors in different regimes.

About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click "Settings". For further information about the data we collect from you, please see our [Privacy Policy](#).

Accept All

Essential Only


Settings

Gurudeo Anand Tularam is a senior lecturer in Mathematics/Statistics in the Griffith Sciences-Science, Environment, Engineering and Technology, and a senior researcher at the Environmental Futures Institute, Griffith University, Australia. His research expertise in time series and stochastic calculus methods in business and finance applications such as investment, portfolio analysis, and risk assessment. He has published more than hundred papers in reputed international journals.

Rajibur Reza

Rajibur Reza is a PhD candidate at the Department of Accounting, Finance and Economics, Griffith Business School, Griffith University, Australia.

References

1. Aaker, D. A. & Jacobson, R. (1987). The role of risk in explaining differences in profitability. *Academy of Management Journal*, **30**, 277-296.10.2307/256274
 | [Web of Science ®](#) | [Google Scholar](#)

2. Angelidis, T., & Tessaromatis, N. (2009). Idiosyncratic risk matters! A regime switching approach. *International Review of Economics and Finance*, **18**, 132-141.10.1016/j.iref.2007.09.003

About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click “Settings”. For further information about the data we collect from you, please see our [Privacy Policy](#).

Accept All

Essential Only

Settings



3. Anton
poli
Jou
and public
ational

5. Bali, T., & Cakici, N. (2008). Idiosyncratic volatility and the cross section of expected returns. *Journal of Financial and Quantitative Analysis*, **43**, 29–58.10.1017/S002210900000274X

 | [Web of Science ®](#) | [Google Scholar](#)

6. Bali, T. G., Cakici, N., Yan, X., & Zhang, Z. (2005). Does idiosyncratic risk really matter? *The Journal of Finance*, **60**, 905–929.10.1111/jofi.2005.60.issue-2

 | [Web of Science ®](#) | [Google Scholar](#)

7. Barber, J. R. (1994). Mutual fund risk measurement and future returns. *Quarterly Journal of Business and Economics*, **33**, 55–64.

[Google Scholar](#)

8. Bollen, B., A., Skotnicki, A., & Veeraraghavan, M. (2009). Idiosyncratic volatility and security returns: Australian evidence. *Applied Financial Economics*, **19**, 573–1579. doi:10.1080/09603100902984327

 | [Google Scholar](#)

9. Buckland, R., & Fraser, P. (2000). Abnormal returns in the UK water industry since privatisation (Working Paper No. 00-10). Aberdeen Papers in Accountancy, Finance and Management. University of Aberdeen.

[Google Scholar](#)

10. Buckland, R., & Fraser, P. (2001). Political and regulatory risk in water utilities: Beta sensitivity in the United Kingdom. *Journal of Business Finance and Accounting*, **28**, 877–9

About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click “Settings”. For further information about the data we collect from you, please see our [Privacy Policy](#).

 Accept All

Essential Only

Settings



1. Bu
dist
Schoo
Retrie
- ly and
Business
re (AURA).

[Google Scholar](#)

2. Calice, G., Ioannidis, C., & Miao, R. H. (2012). A Markov switching unobserved component analysis of the CDX index term premium. Mimeo: University of Southampton.

[Google Scholar](#)

3. Calice, G., Mio, R., Štěřba, F., & Vašíček, B. (2015). Short-term determinants of the idiosyncratic sovereign risk premium: A regime-dependent analysis for European credit default swaps. *Journal of Empirical Finance*, **33**, 174–189. [10.1016/j.jempfin.2015.03.018](#)

[Web of Science ®](#) | [Google Scholar](#)

4. Campbell, J., Lettau, M., Malkiel, B., & Xu, Y. (2001). Have individual stocks become more volatile? An empirical exploration of idiosyncratic risk. *The Journal of Finance*, **56**, 1–43. [10.1111/jofi.2001.56.issue-1](#)

[Web of Science ®](#) | [Google Scholar](#)

5. Cheung, Y. L., & Wong, K. T. (1992). An assessment of risk and return: Some empirical findings from the Hong Kong stock exchange. *Applied Financial Economics*, **2**, 105–114. [doi:10.1080/758536014](#)

[Google Scholar](#)

6. Cox, L. A., & Griepentrog, G. L. (1988). Systematic risk, unsystematic risk, and property-liability rate regulation. *The Journal of Risk and Insurance*, **55**, 606–627. [10.2307/253140](#)

[Web of Science ®](#) | [Google Scholar](#)

About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click “Settings”. For further information about the data we collect from you, please see our [Privacy Policy](#).



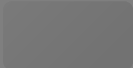


[Accept All](#)

[Essential Only](#)

[Settings](#)

7. Garcia, J. (2012). A Markov switching unobserved component analysis of the CDX index term premium. Mimeo: University of Southampton.

8. Gema, R. (2012). An empirical exploration of idiosyncratic risk. *The Journal of Finance*, **56**, 1–43. [10.1111/jofi.2001.56.issue-1](#)

19. Gilroy, B. M., Schrekenberg, H., & Seiler, V. (2013). Water as an alternative asset. (Working Paper No. 2012-09). Center for International Economic, Universität Paderborn. Retrieved March 16, 2014, from <http://groups.unipaderborn.de/fiwi/RePEc/Working%20Paper%20neutral/WP55%20-%202012-09.pdf>
 | [Google Scholar](#)
20. Goldfeld, S. M., & Quandt, R. E. (1973). A Markov model for switching regressions. *Journal of Econometrics*, *1*, 3-15.10.1016/0304-4076(73)90002-X
 | [Google Scholar](#)
21. Goyal, A., & Santa-Clara, P. (2003). Idiosyncratic risk matters! *The Journal of Finance*, *58*, 975-1007.10.1111/jofi.2003.58.issue-3
 | [Web of Science ®](#) | [Google Scholar](#)
22. Guidolin, M., & Hyde, S. (2009). What tames the Celtic tiger? Portfolio implications from a multivariate Markov Switching model. *Applied Financial Economics*, *19*, 463.
 | [Google Scholar](#)
23. Guo, H., & Savickas, R. (2003). Does idiosyncratic risk matter: Another look (Working Paper). Federal Reserve Bank of St. Louis.
[Google Scholar](#)
24. Hamilton, J. D. (1989). A new approach to the economic analysis of nonstationary time series and the business cycle. *Econometrica*, *57*, 357-384.10.2307/1912559
 | [Web of Science ®](#) | [Google Scholar](#)

25. Huimi
social
Econo
G
26. Jin, Y.,
Applie
- about yet illiquid.

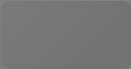
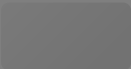
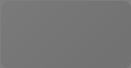


About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click "Settings". For further information about the data we collect from you, please see our [Privacy Policy](#).

Accept All

Essential Only

Settings

27. Jin, Y., Roca, E., Li, B., Wong, V., & Cheung, A. (2015a). Sprinkle your investment portfolio with water! *International Journal of Water*, **9**, 43–59.10.1504/IJW.2015.067445
 | [Google Scholar](#)
28. Kearney, H. (2008). Water, water, everywhere—But investors aren't in synch. *On Wall Street*, **18**, 20.
[Google Scholar](#)
29. Krolzig, H.-M. (1997). *Markov switching vector autoregressions. Modelling, statistical inference and application to business cycle analysis*. Berlin: Springer.
 | [Google Scholar](#)
30. Morana, C., & Sawkins, J. W. (2000). Regulatory uncertainty and share price volatility: The English and Welsh water industry's periodic price review. *Journal of Regulatory Economics*, **17**, 87–100.10.1023/A:1008105405621
 | [Web of Science ®](#) | [Google Scholar](#)
31. Organisation for Economic Co-operation and Development. (2008). *OECD environmental outlook to 2030*. Paris: Author.
[Google Scholar](#)
32. Organisation for Economic Co-operation and Development. (2009). *Private sector participation in water infrastructure: OECD checklist for public action*. Paris: Author.
[Google Scholar](#)
33. Quandt, R. F. (1958). The estimation of the parameters of a linear regression system obeying a Markov process. *Biometrika*, **45**, 253–263.10.2307/2334083
 | [Google Scholar](#)
34. Roca, E., & Li, B. (2015b). The estimation of the parameters of a linear regression system obeying a Markov process. *Biometrika*, **45**, 253–263.10.2307/2334083
 | [Google Scholar](#)

About Cookies On This Site

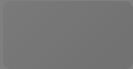

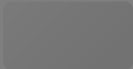
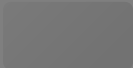
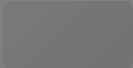
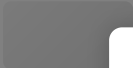
We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click "Settings". For further information about the data we collect from you, please see our [Privacy Policy](#).

Accept All

Essential Only

Settings



35. Roca, E., Tularam, G. A., & Reza, R. (2015). Fundamental signals of investment profitability in the global water industry. *International Journal of Water*, **9**, 395–424. doi:10.1504/IJW.2015.072155
 | [Google Scholar](#)
36. Roca, E. D., Tularam, G. A., & Wong, V. S. H. (2011). Markov regime switching modelling and analysis of socially responsible investment funds. *Journal of Mathematics and Statistics*, **7**, 302–313.
 | [Google Scholar](#)
37. Roca, E. D., & Wong, V. S. H. (2008). An analysis of the sensitivity of Australian superannuation funds to market movements: A Markov regime switching approach. *Applied Financial Economics*, **18**, 583–597. doi:10.1080/09603100601118292
 | [Google Scholar](#)
38. Tang, Y. N. G., & Shum, W. C. (2007). The risk-return relations: Evidence from the Korean and Taiwan stock markets. *Applied Economics*, **39**, 1905.
 | [Web of Science ®](#) | [Google Scholar](#)
39. Tularam, G. A. & Keeler, H. P. (2006). The study of coastal groundwater depth and salinity variation using time-series analysis. *Environmental Impact Assessment Review*, **26**, 633–642.
 | [Web of Science ®](#) | [Google Scholar](#)
40. Tularam, G. A. (2014). Investing in water for a green economy. *Australian Planner*, **51**, 372–373. doi:10.1080/07293682.2014.948987
 | [Google Scholar](#)

About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click “Settings”. For further information about the data we collect from you, please see our [Privacy Policy](#).

 Accept All

Essential Only

Settings



41. Tularam

separ

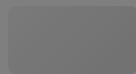
En

42. Tularam

In this article



380.10.3844/jmssp.2010.372.380

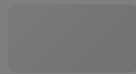


| [Google Scholar](#)

43. Tularam, G. A., & Krishna, M. (2009). Long term consequences of groundwater pumping in Australia: A review of impacts around the globe. *Journal of Applied Sciences in Environmental Sanitation*, 151–166.

[Google Scholar](#)

44. Tularam, G. A., & Marchisella, P. (2014). Securing water and wastewater systems. *International Practices for Protecting Water and Wastewater Infrastructure*. Springer.10.1007/978-3-319-01092-2



| [Google Scholar](#)

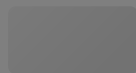
45. Tularam, G. A., & Properjohn, M. (2011). An investigation into water distribution network security: Risk and implications. *Security Journal*, 4, 1057–1066.

[Google Scholar](#)

46. Tularam, G. A., & Singh, R. (2009). Estuary, river and surrounding groundwater quality deterioration associated with tidal intrusion. *Journal of Applied Sciences in Environmental Sanitation*, 4, 141–150.

[Google Scholar](#)

47. Wei, S., & Zhang, C. (2005). Idiosyncratic risk does not matter: A re-examination of the relationship between average returns and average volatilities. *Journal of Banking and Finance*, 29, 603–621.10.1016/S0378-4266(04)00050-0



| [Web of Science ®](#) | [Google Scholar](#)

48. Wild, I. (2010). The future. *Zurich*.
<http://www.wild.ch>



About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click “Settings”. For further information about the data we collect from you, please see our [Privacy Policy](#).

[Accept All](#)

[Essential Only](#)

[Settings](#)

49. Wong, I. (2010). Do they make? 15th

[Google Scholar](#)

Bibliography

1. Roca, E., Wong, V., & Tularam, G. A. (2010). Are socially responsible investment markets worldwide integrated? Accounting Research Journal, 23, 281–301. Retrieved from <http://www.emeraldinsight.com/journals.htm?articleid=1896180&show=abstract>

[Google Scholar](#)

2. Tularam, G. A., & Hassan, O. M. (in press). Water availability and food security— Impact on people’s movement and migration in sub-Saharan Africa (SSA). NY: Taylor and Francis International.

[Google Scholar](#)

3. Tularam G. A. (in press). Water security problems in Asia and longer term implications for Australia Springer. Retrieved from http://link.springer.com/chapter/10.1007/978-3-319-12394-3_7

[Google Scholar](#)

4. Tularam, G. A., & Ilahee, M. (2011). Time series analyses of rainfall and temperature interactions in tropical catchments. In A. B. Nadykto, L. Uvarova, A. V. Latyshev (Ed.), Mathematical models of non-linear phenomena, processes and systems: From molecular scale to planetary atmosphere (400 p.). Albany, NY: State University of New York at Albany, Atmospheric Sciences Research Center. ISBN: 978-1-60876-994-0.

[Goog](#)

5. Tularam, G. A., & Ilahee, M. (2011). Time series analyses of rainfall and temperature interactions in tropical catchments. In A. B. Nadykto, L. Uvarova, A. V. Latyshev (Ed.), Mathematical models of non-linear phenomena, processes and systems: From molecular scale to planetary atmosphere (400 p.). Albany, NY: State University of New York at Albany, Atmospheric Sciences Research Center. ISBN: 978-1-60876-994-0.

[Goog](#)

[Goog](#)

About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click “Settings”. For further information about the data we collect from you, please see our [Privacy Policy](#).

Accept All

Essential Only

Settings

6. Tularam, G. A., & Ilahee, M. (2007). Environmental concerns of desalinating seawater using reverse osmosis, *Journal of Environmental Monitoring*, 9, 805–813. Retrieved from <http://pubs.rsc.org/en/Content/ArticleLanding/2007/EM/b708455m>
Google Scholar
7. Tularam, G. A., & Ilahee, M. (2007). Initial loss estimates for tropical catchments of Australia, *Environmental Impact Assessment Review*, 27, 493–504. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0195925506001521>
Google Scholar
8. Retrieved from <http://lifewater.org/articles-category/nutrition-children-wash/?gclid=CNSxzaK50MgCFQNxvAod9eMOOQ>
Google Scholar
9. Retrieved from http://www.un.org/waterforlifedecade/food_security.shtml
Google Scholar

Download PDF

Related research

People also read

Recommended articles

Cited by
5



About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click “Settings”. For further information about the data we collect from you, please see our [Privacy Policy](#).

Accept All 

Essential Only

Settings

Information for

Authors

R&D professionals

Editors

Librarians

Societies

Opportunities

Reprints and e-prints

Advertising solutions

Accelerated publication

Corporate access solutions

Open access

Overview

Open journals

Open Select

Dove Medical Press

F1000Research

Help and information

Help and contact

Newsroom

All journals

Books

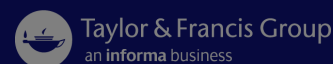
Keep up to date

Register to receive personalised research and resources by email

 Sign me up



Copyright © 2024 Informa UK Limited [Privacy policy](#) [Cookies](#) [Terms & conditions](#)



[Accessibility](#)

Registered in England & Wales No. 3099067
5 Howick Place | London | SW1P 1WG



About Cookies On This Site

We and our partners use cookies to enhance your website experience, learn how our site is used, offer personalised features, measure the effectiveness of our services, and tailor content and ads to your interests while you navigate on the web or interact with us across devices. You can choose to accept all of these cookies or only essential cookies. To learn more or manage your preferences, click “Settings”. For further information about the data we collect from you, please see our [Privacy Policy](#).

 Accept All

Essential Only

Settings