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Investigation of Socially Responsible Investment Markets (SRI) Using Dynamic Conditional Correlation (DCC) Method: Implications for Diversification

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Abstract: Problem statement: Over the last ten years there has been a phenomenal growth in the amount of funds placed in SRI globally estimated to be around US$6.5 trillion while around US$55 billion in the Australian market. Accurate knowledge of correlation of the Australian SRI market with other SRI markets overseas is crucially important for Australian (SRI) investors for international portfolio diversification since portfolio diversification theory posits that the lower (higher) the correlation between markets, the higher (lower) the gains to be made. The study examines the relationship of the Australian SRI market with fourteen other markets-Canada, Denmark, France, Germany, Hong Kong, Ireland, Japan, Netherlands, Norway, South Africa, Sweden, Switzerland, United Kingdom and the United States. **Approach:** The relationships of the Australian Socially Responsible Investment (SRI) market with other SRI markets worldwide during the period 1994-2009 are examined based on the dynamic conditional correlation multivariate GARCH model (DCC-MVGarch). In the DCC method, the multivariate conditional variance estimation is simplified by estimating univariate GARCH models for each market. Using the transformed residuals resulting from the first stage, the authors can estimate a conditional correlation estimator. The standard errors for the first stage parameters remain while the standard errors for the correlation parameters are modified. **Results:** Our results showed that the Australian market experienced a surge in correlation with all other markets during the global financial crisis. During the period of study, the correlation of Australia with Canada, Denmark, Norway and the United Kingdom increased over time while its correlation with other countries remained stationary. This implies that the Australian SRI market is becoming more integrated with those of Canada, Denmark, Norway and the United Kingdom. Therefore, these overseas markets provide less portfolio diversification benefits to Australian SRI investors while the other markets still offer some opportunities. **Conclusion/Recommendations:** This study examined the relationship of the Australian Socially Responsible Investment (SRI) market with other SRI markets worldwide during the period 1994-2009 based on dynamic conditional correlation multivariate GARCH model that provides accurate correlations over time that can be incorporated into portfolio models. Australian SRI market was analyzed with fourteen other markets around the world such as Canada, Denmark, France, Germany, Hong Kong, Ireland, Japan, Netherlands, Norway, South Africa, Sweden, Switzerland, United Kingdom and the United States. The results showed that the Australian market experienced a spike in correlation with the other markets during periods of market distress; for example, during the recent global financial crisis. In spite of the fluctuations in the correlations of Australian with the other markets the correlations generally remain below 1. Australia's correlation with Denmark, Norway and Japan increased while with others our market was more or less stationary except from 2007 onwards-global financial crisis. Clearly, it still pays for Australian investors to diversify internationally since the correlations are still less than 1. However, it pays less to diversify to such markets as Japan, Norway and Denmark while diversification benefits can be obtained from the other markets. Importantly, our results suggested that diversification to other SRI markets is less

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effective during periods of market distress. A number of other DCC models exist and it is possible to explore more of these that incorporate other influencing variables for more accurate portfolio analysis.

Key words: Socially responsible investment, integration, multivariate, GARCH, Dynamic Conditional Correlation (DCC), time series

INTRODUCTION

Socially Responsible Investment (SRI) funds integrate Environmental, Social and Governance (ESG) considerations, or purely ethical issues, into investment decision-making. SRI has experienced a phenomenal growth around the world. According to the Social Investment Forum, the professionally managed assets of SRI portfolios including retail and, more importantly, institutional funds (for example, pension funds, insurance funds and separate accounts), in 2007, reached US$6.3 trillion worldwide; US$2.7 trillion in the US (Woll, 2008); US$3.6 trillion in Continental Europe and US$1.18 trillion in the UK (UKSIF, 2008). In 2008, SRI in Canada amounted to $607.9 billion, while in Australia, it was US$55.4 billion (Social Investment Organization, 2008; Walsh, 2009).

Over the past decade, a number of national governments in Europe have passed a series of regulations on social and environmental investments and savings. For instance, the United Kingdom was the first country to regulate the disclosure of the social, environmental and ethical investment policies of pension funds and charities. The Amendment to the 1995 Pensions Act requires the trustees of occupational pension funds to disclose in the Statement of Investment Principles "the extent (if at all) to which social, environmental and ethical considerations are taken into account in the selection, retention and realization of investments." This has contributed considerably to the growth of the SRI industry. Some emerging economies such as South Korea, Malaysia and South Africa are beginning to invest in ethical funds. In Europe, at January 1, 2006, 96% of the SRI market was dominated by institutional investors, but individual investors' market share is on the rise.

SRI involves four main types of players: (1) individual and institutional investors, who increasingly consider Environmental, Social and Governance (ESG) criteria in their investment decisions, while also seeking profitability; (2) asset management firms that create and manage portfolios for investors; (3) providers of specific information on corporate responsibility (notably ratings agencies) and (4) invested companies; the consideration of non-financial criteria while seeking performance satisfies both the need to include qualitative concerns linked to social responsibility and to reduce risks taken in the medium and long term (for example: anticipate the risks linked to fossil fuel scarcity, poverty, climate change and so on). In addition to these players, countries and international organizations can also promote SRI, or not, through regulation. Consumers can encourage companies and investors to change their practices by demanding greater transparency, as well as NGOs that criticize companies through major advertising campaigns.

While SRI in Australia in terms of total value is still way below that of the other developed countries such as the US, UK and those in Europe, it registered the fastest growth over the last decade, according to the Responsible Investment of Association of Australia report in 2007. It is the second largest SRI market (next to Japan) in the Asian region and is the fastest growing market. From 2000-2006, SRI managed portfolios grew from $325 million to $11.98 billion, representing an increase of 3,587%, according to a report prepared by Walsh (2006) for the Ethical Investment Association of Australia. Although total SRI managed portfolios amounted to $11.98 billion, as reported by Walsh (2006), the total amount in managed portfolios was about $1 trillion. There is very strong interest in SRI in Australia, as documented by Mercer Consulting and a number of studies (Vyvyan *et al*., 2007). Furthermore, among the developed countries, Australia is one of those leading countries with legislation to encourage SRI through provisions that require trustees to consider extra-financial issues, such as environmental, social and governance factors that materially affect the performance of the investment portfolio. Australian institutional investors also participate in such organizations that promote SRI as the UN Principles of Responsible Investment, UN Global Compact, UN Carbon Disclosure, among others. The numbers of investment portfolios which are dedicated to SRI have grown very fast over the past decade, particularly superannuation or pension portfolios.

Given the significant size of SRI markets worldwide, Australian SRI investors now have the opportunity to diversify into international SRI markets to achieve additional benefits. The size of the benefits from international diversification, however, depends crucially on the correlation of the Australian SRI market with those of other markets. International portfolio diversification theory posits that the lower

(higher) the correlation of the Australian market with the overseas market, the bigger (smaller) the diversification benefit to be obtained.

The extent of correlation between markets also provides an indication of the extent of integration between these markets. The issue of integration, by itself, is very important. If markets are integrated, then this creates the specter of contagion risk-that is, volatility in one market being transmitted to the other market. Integration implies equality of price or risk-adjusted returns. It also implies co-movements in prices; as argued by Kenen (1976) and Kenen and Meade (2006) "integration refers to the degree to which participants in any market are enabled and obliged to take notice of events occurring in other markets. They are enabled to do so when information about those events is supplied into the decision making processes of recipients. They are obliged to do so when it is supplied in ways that invite them to use it in order to achieve their own objectives". This definition implies information spill-over. The extent of integration, based on this approach, may be measured therefore in terms of the degree of the co-movement in prices between markets. The higher the movement of prices in response the response of prices to the movements of prices in the other market, the greater the degree of integration (Roca, 1999).

Unfortunately, there are no studies yet which provide information on the extent of correlation of the Australian SRI market with other SRI markets. We therefore address this important gap in the literature. We calculate and analyze the correlation of the Australian SRI market with significant SRI markets around the world represented by Canada, Denmark, France, Germany, Hong Kong, Ireland, Japan, Netherlands, Norway, South Africa, Sweden, Switzerland, UK and US. We base our examination on the dynamic conditional correlation multivariate GARCH model developed by Engle (2002). As mentioned, this study contributes to the SRI and international financial integration literature. Its results would be very beneficial to Australian SRI investors as well as to Australian regulators in terms of containing contagion risk.

Brief review of the literature: We provide a brief review of the relevant literature in relation to SRI, financial market integration and the use of the DCC method in the analysis of financial market interactions. We show from this review that the study of the interactions between SRI markets based on the use of the DCC method has not been done yet and thus, this study contributes to the literature in the three areas.

In terms of the SRI literature, there are now a number of studies on SRI which have investigated the following aspects of SRI-performance (Luther *et al*., 1992; Hamilton *et al*., 1993; Gregory *et al*., 1997; Russo and Fouts, 1997; DiBartolomeo and Kurtz, 1999; Statman, 2000; Orlitzky *et al*., 2003; Bauer *et al*., 2005; 2007; Kreander *et al*., 2005; Hong and Kacperczyk, 2006; Edmans, 2007), ratings (Angel and Rivoli, 1997; Lee and Ng, 2002; Guenster *et al.*, 2010) and screenings (Guerard, 1997). In the Australian context, there are relatively few studies such as those of (Bauer *et al*., 2006; Tippet, 2001; Cummings, 2000) which show that the performance of SRI is not significantly different with conventional investments while other studies (Jones *et al*., 2008) found SRI to be underperforming in the Australian context. None of these studies, however, have focused on the linkages or spill-over between SRI markets.

With regards to the international integration literature, there are now a voluminous number of studies which have examined the issue of international integration among equity, bonds and money markets (Panopolou and Pantelidis, 2009; Chi *et al*., 2006; Click and Plummer, 2005; Roca, 1999). However, there is no consensus among these studies as to whether markets are integrated or not. Some studies have found that markets are integrated while other studies found the opposite depending on the type of market studied and the time period and data used. Furthermore and more importantly, in terms of the motivation of this study, none of these studies on financial integration have focused on the SRI market.

The dynamic conditional correlation model has been used in the literature to investigate relationships among markets. Several papers have found the possibility of dynamic conditional correlations across assets, such as those of Joy *et al*. (1976) and Longin and Solnik (1995). The BEKK model of Engle and Kroner (1995) also implies time-varying conditional correlations. The DCC model of (2002) investigates the conditional correlations in stock, bond and foreign exchange markets in USA and France. The model has been applied in several asset interactions, such as the conditional correlations across stock markets by Billio *et al*. (2006); across stock and foreign exchange markets by Kuper and Lestano (2007) and across bond and stock markets by Dean and Faff (2001). These authors find evidence of time-varying conditional correlations. Tse and Tsui (2002) provide evidence of time-varying conditional correlations between stock and foreign exchange markets using the Varying Conditional Correlation (VCC) model. Using the recently proposed GARCC model, McAleer *et al*.

(2008) find evidence of dynamic conditional correlations, both between the US and Japan stock markets and between the US and Hong Kong stock markets.

Still further, Bautista (2003) examines interest rate-exchange rate interaction using Dynamic Conditional Correlation (DCC) analysis, a multivariate GARCH method proposed by Engle (2002). Weekly Philippine data from 1988-2000 are used in the study. The results show that the correlation between these variables is far from constant. Lafuente and Ordonez (2009) investigate the dynamic nature of financial integration for the main Eurozone member countries (Germany, France, Spain and Italy) and the UK. The authors used the DCC-MVGARCH model estimate conditional correlations between stock index returns during the sample period 1993-2004. They found that the potential benefits of international diversification from European portfolios have declined.

Li (2009) analyses the co-movement dynamics between the US and EM markets under various volatility regimes using DCC-MVGARCH. The study indicates that the US-EM market correlations increase relatively more when both the US and EM markets simultaneously experience a high variance condition. Moreover, the situation of both the US and EM stock markets at a high volatility state is associated with a minimum risk reduction benefit and a maximum cross-market correlation. Asai and McAleer (2009) investigate the structures can be used for purposes of determining optimal portfolio and risk management strategies through the use of correlation matrices. The study examined Nikkei 225 Index, Hang Kong Index and Straits Times Index returns and found significant dynamic correlations were found.

The brief review shows that DCC is clearly an important tool in financial calculations and decision making but in spite of the many applications mentioned, the DCC method or approach has not been used in the examination of the relationships between SRI markets. Thus, this study contributes to the SRI literature and additionally, to the financial integration literature.

MATERIALS AND METHODS

The multivariate GARCH model proposed assumes that returns from k assets are conditionally multivariate normal with zero expected value and covariance matrix H_t. The returns can be either mean zero or the residuals from a filtered time series:

$$r_t \mid F_{t-1} \sim N(0, H_t)$$

and:

$$H_t \equiv D_t R_t D_t \quad (1)$$

Where:

D_t = The k × k diagonal matrix of time varying standard deviations from univariate GARCH models with $\sqrt{h_{it}}$ on the i^{th} diagonal

R_t = The time varying correlation matrix

The log-likelihood of this estimator can be written:

$$\begin{aligned} L &= -\frac{1}{2}\sum_{t=1}^{T}(k\log(2\pi) + \log(|H_t|) + r_t' H_t^{-1} r_t) \\ &= -\frac{1}{2}\sum_{t=1}^{T}(k\log(2\pi) + \log(|D_t R_t D_t|) + r_t' D_t^{-1} r_t R_t^{-1} r_t D_t^{-1} r_t) \\ &= -\frac{1}{2}\sum_{t=1}^{T}(k\log(2\pi) + 2\log|D_t| + \log|R_t|) + \epsilon_t' R_t^{-1} \epsilon_t) \end{aligned} \quad (2)$$

where, $\epsilon_t \sim N(0, R_t)$ are the residuals standardized by their conditional standard deviation.

We propose to write the elements of D_t as univariate GARCH models (Tularam, 2010), so that:

$$h_{it} = \omega_i + \sum_{p=1}^{p_i} \kappa_{ip} r_{it-p}^2 + \sum_{q=1}^{q_i} \lambda_{iq} h_{it-p} \quad (3)$$

for i = 1, 2,..., k with the usual GARCH restrictions for non-negativity and stationarity being imposed, such as non-negativity of variances and $\sum_{p=1}^{p_i}\alpha_{ip} + \sum_{q=1}^{q_i}\beta_{iq} < 1$. The subscripts are present on the individual p and q for each series to indicate that the lag lengths chosen need not be the same. The specification of the univariate GARCH models is not limited to the standard GARCH (p,q), but can include any GARCH process with normally distributed errors that satisfy appropriate stationarity conditions and non-negativity constraints (Tularam and Ilahee, 2010). The proposed dynamic correlation structure is:

$$\begin{aligned} Q_t &= (1 - \sum_{m=1}^{M}\alpha_m - \sum_{n=1}^{N}\beta_n)\bar{Q} + \sum_{m=1}^{M}\alpha_m(\epsilon_{t-m}\epsilon_{t-m}') + \sum_{n=1}^{N}\beta_n Q_{t-n} \\ R_t &= Q_t^{*-1} Q_t Q_t^{*-1} \end{aligned} \quad (4)$$

where, $\bar{Q}$ is the unconditional covariance of the standardized residuals resulting from the first stage of the estimation process and:

$$Q_t^* = \begin{bmatrix} \sqrt{q_{11}} & 0 & 0 & \cdots & 0 \\ 0 & \sqrt{q_{22}} & 0 & \cdots & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & \cdots & \sqrt{q_{kk}} \end{bmatrix} \quad (5)$$

So that Q_t^* is a diagonal matrix composed of the square root of the diagonal elements of Q_t. The typical element of R_t will be of the form $p_{i j_t} = \frac{q_{ij_t}}{\sqrt{q_{ii} q_{jj}}}$. The immediate implication is that R_t will necessarily be a correlation matrix by the Cauchy-Schwartz inequality. The results from linear algebra further show that the necessary conditions exist for R_t to be positive definite matrix and thus an appropriate correlation matrix (Engle and Sheppard, 2001)

Data: The data covers the period 7 January 1994 to 25 December 2009. This period is selected due to the completeness of data and its richness with financial market events such as, the Asian crisis and the surge in the US bond prices in 1997, Russian crisis in 1998, Dotcom boom in 1999 followed by its collapse in 2000, September 11 attacks in 2001, Enron bankruptcy in late 2002, the WorldCom and Delphia bankruptcy in 2003, the US sub-prime crisis in 2007, leading to the recent Global Financial Crisis. This thesis utilizes weekly data in order to avoid noise, non-synchronous trading and the day of the week effects associated with daily data. The returns from the indices are calculated using the continuous returns formula of $R_t = \ln(price_t/price_{t-1}) \times 100$ (the continuous return formula is used as it is well-known to provide more accurate measure of return compared to the discrete formula (Brailsford *et al*., 2003). Other studies evaluating funds performance have used the same way of measuring returns (Sawicki and Ong, 2000; Benson and Faff, 2003; Bohl *et al*., 2009)). There are 836 weeks during the study period.

The study utilises the Dow Jones Sustainability Index (DJSI) data for 15 countries, including: Australia, Canada, Denmark, France, Germany, Hong Kong, Ireland, Japan, Netherlands, Norway, South Africa, Sweden, Switzerland, the UK and the US. The study first analyses the correlation, risk and returns characterises for the 15 countries mentioned above and then the study will filter which of these 15 countries are suitable to maximise the portfolio's returns. Finally, the remaining of the best returns from the 15 countries will be put into a portfolio consisting of stocks and bonds.

RESULTS AND DISCUSSION

As shown in Table 1 the descriptive statistics revealed that Demark (0.240) has the highest return among the other SRI markets, followed by Ireland (0.170) and Canada (0.137); while Japan (-0.011) has the lowest return, followed by Netherlands (0.019) and the UK (0.036). The country with the highest risk is Hong Kong (5.078), followed by South Africa (4.496) and Ireland (4.201). The country with the lowest risk is UK (2.362), Australia (2.687) and US (2.713). Almost all markets have a negatively skewed distribution, except Hong Kong, Ireland and Japan, which have positive skew-ness. Canada has a peaked distribution, as a kurtosis statistic is positive. All returns do not follow a normal distribution. The results from both ADF and PP unit root test suggest that all returns are stationary.

The Dynamic Conditional Correlation Multivariate GARCH (DCC-MVGARCH) model by Engle (2002) is used to examine the correlation between SRI markets (Table 2). The SIC model is employed to determine the optimal DCC-MVGARCH specifications. The SIC results in Table 3 show that the lowest SIC value correspond to DCC-MVGARCH(1,1) specifications. Hence, the thesis will adopt the DCC-MVGARCH(1,1) specifications.

Table 1: Descriptive statistics

Country	Mean	SD	Skew-ness	Kurtosis	Jacque-Bera*	ADF*	PP*
Australia	0.067	2.687	-0.179	7.311	630.144	-28.526	-28.538
Canada	0.137	3.763	-1.034	13.357	3755.256	-30.264	-30.232
Denmark	0.240	3.164	-0.332	4.769	120.127	-30.323	-30.379
France	0.111	3.396	-0.225	4.776	112.997	-31.356	-31.282
Germany	0.061	3.200	-0.084	3.901	28.282	-29.405	-29.382
Hong Kong	0.068	5.078	0.091	6.518	417.774	-28.632	-28.628
Ireland	0.170	4.201	0.016	5.223	166.474	-30.878	-30.824
Japan	-0.011	2.961	0.094	4.151	45.822	-31.919	-31.731
Netherlands	0.019	3.103	-0.648	6.116	383.557	-28.643	-28.637
Norway	0.114	3.531	-0.497	4.741	135.300	-29.701	-29.689
South Africa	0.119	4.496	-0.166	7.112	572.855	-30.957	-30.820
Sweden	0.083	3.762	-0.144	4.882	121.979	-28.713	-28.712
Switzerland	0.107	2.810	-0.330	7.834	801.334	-28.634	-28.625
UK	0.036	2.362	-0.017	4.883	119.395	-31.572	-31.585
US	0.064	2.713	-0.144	3.791	23.857	-31.408	-31.407

Note: *: The Jarque-Bera shows all significant; ADF and PP refers to unit root tests-Augmented Dickey Fuller and Phillip Perron, unit root tests shows the series are stationary

Table 2: Unconditional correlation between Australia and other markets

Country	AUS	CAN	DEN	FRA	GER	HKG	IRE	JAP	NET	NOR	SAF	SWE	SWIT	UK	US
AUS	1.000	0.277	0.152	0.245	0.259	0.121	0.152	0.201	0.347	0.416	0.361	0.335	0.176	0.337	0.159
CAN		1.000	0.238	0.509	0.481	0.266	0.137	0.236	0.346	0.369	0.331	0.435	0.350	0.408	0.531
DEN			1.000	0.365	0.380	0.121	0.292	0.226	0.367	0.327	0.243	0.335	0.383	0.405	0.319
FRA				1.000	0.752	0.337	0.418	0.317	0.595	0.426	0.398	0.583	0.597	0.647	0.574
GER					1.000	0.327	0.419	0.283	0.647	0.399	0.403	0.654	0.605	0.655	0.586
HKG						1.000	0.152	0.275	0.216	0.115	0.172	0.208	0.211	0.285	0.296
IRE							1.000	0.210	0.431	0.268	0.295	0.409	0.376	0.424	0.356
JAP								1.000	0.281	0.210	0.188	0.241	0.278	0.297	0.314
NET									1.000	0.477	0.366	0.586	0.595	0.730	0.537
NOR										1.000	0.354	0.479	0.378	0.463	0.283
SAF											1.000	0.399	0.350	0.404	0.271
SWE												1.000	0.466	0.549	0.482
SWIT													1.000	0.588	0.487
UK														1.000	0.579
US															1.000

Table 3: Optimum GARCH (p,q) specifications

	p,1	p,2	p,3	p,4
1,q	70.691*	70.755	70.825	70.921
2,q	70.778	70.849	70.976	71.024
3,q	70.859	70.932	71.055	71.085
4,q	70.959	71.041	71.073	71.162

Note: *: The lowest SIC model, which is the MS-VAR model that will be used for the study

Table 4: Univariate GARCH Model Estimates

Country	ω_i	K_i	λ_i
Australia	0.215** (0.011)	0.139*** (0.002)	0.834*** (0.004)
Canada	0.125*** (0.001)	0.139*** (0.000)	0.861*** (0.000)
Denmark	0.597*** (0.006)	0.066*** (0.000)	0.876*** (0.001)
France	0.335*** (0.001)	0.168*** (0.000)	0.821*** (0.000)
Germany	0.763** (0.011)	0.236*** (0.002)	0.723*** (0.002)
Hong Kong	0.517*** (0.005)	0.151*** (0.001)	0.842*** (0.001)
Ireland	0.548*** (0.002)	0.153*** (0.000)	0.825*** (0.000)
Japan	0.857*** (0.009)	0.168*** (0.001)	0.739*** (0.002)
Netherlands	0.355*** (0.002)	0.216*** (0.001)	0.769*** (0.001)
Norway	1.915** (0.024)	0.150*** (0.002)	0.692*** (0.003)
South Africa	0.878*** (0.006)	0.124*** (0.001)	0.813*** (0.001)
Sweden	0.517*** (0.001)	0.180*** (0.001)	0.787*** (0.001)
Switzerland	0.612*** (0.001)	0.302*** (0.001)	0.666*** (0.000)
UK	0.199*** (0.001)	0.174*** (0.001)	0.806*** (0.001)
US	0.145*** (0.002)	0.135*** (0.001)	0.853*** (0.001)

Note: Standard errors are presented in parenthesis; *: Significant at the 10% level; **: Significant at the 5% level; ***: Significant at the 1% level

Table 5: DCC parameters-DCCMVGARCH(1,1)

Parameters	Estimates	Significance
α	0.017	(0.000)
β	0.923	(0.000)

The univariate GARCH(1,1) based on Eq. 3 estimation results are reported in Table 4. The ω_i coefficients for most of the SRI markets are highly significant at 1% level, while only Australia, Germany and Norway are significant at 5% level. Norway has the highest coefficient (1.915), followed by South Africa (0.878) and Japan (0.857). The significant K_i coefficients for all SRI markets are suggesting persistence of volatility and a high coefficient for asymmetric volatility for the SRI markets, which could indicate potential spillovers in volatility from other markets that was absorbed by other SRI markets. The λ_i coefficient for all SRI markets indicates a high asymmetric effect implying that the SRI markets are reacting to different sources of news from different markets and adjust their portfolio accordingly. The DCC parameters are shown in Table 4, both parameters are significant indicating the correlation in this study are dynamic.

Table 5 shows that the parameters of the DCC in Eq. 4 are significant. Thus, we can therefore interpret the results from this equation in terms of time varying correlations for Australia and the other markets.

The time-varying correlation between Australia and other SRI markets are presented in Fig. 1. Correlation for Australia-Australia is not plotted. The correlations between other markets are very similar to the Fig. 1, therefore to conserve space, the study only present this while the actual empirical analysis will take into all the correlations into consideration. A simple investigation across all the correlation graphs show spikes at a similar point in time. These spikes started to build up around 2001 and late 2008.

The co-movement of the different markets with the Australian market has similarities. For example, we can see that most of the graphs have captured spikes during the financial distress periods i.e., US bond crisis in 1997, Russian crisis in 1998, dotcom boom in 1999 and its collapse in 2000, September 11, 2001 attaches, Enron bankruptcy in late 2002, WorldCom and Delphia bankruptcy in 2003, US subprime crisis in 2007 and the ensuing global financial crisis. It is also noticeable from Fig. 1 that the correlations between Australia and the other markets increased starting in 2007 at the onset of the US real estate market leading to the global financial crisis afterwards. These two observations are even more clearly seen in Fig. 2 which superimposes all the DCCs of the different markets. During these periods therefore, the benefits from diversifying into other markets would be less.

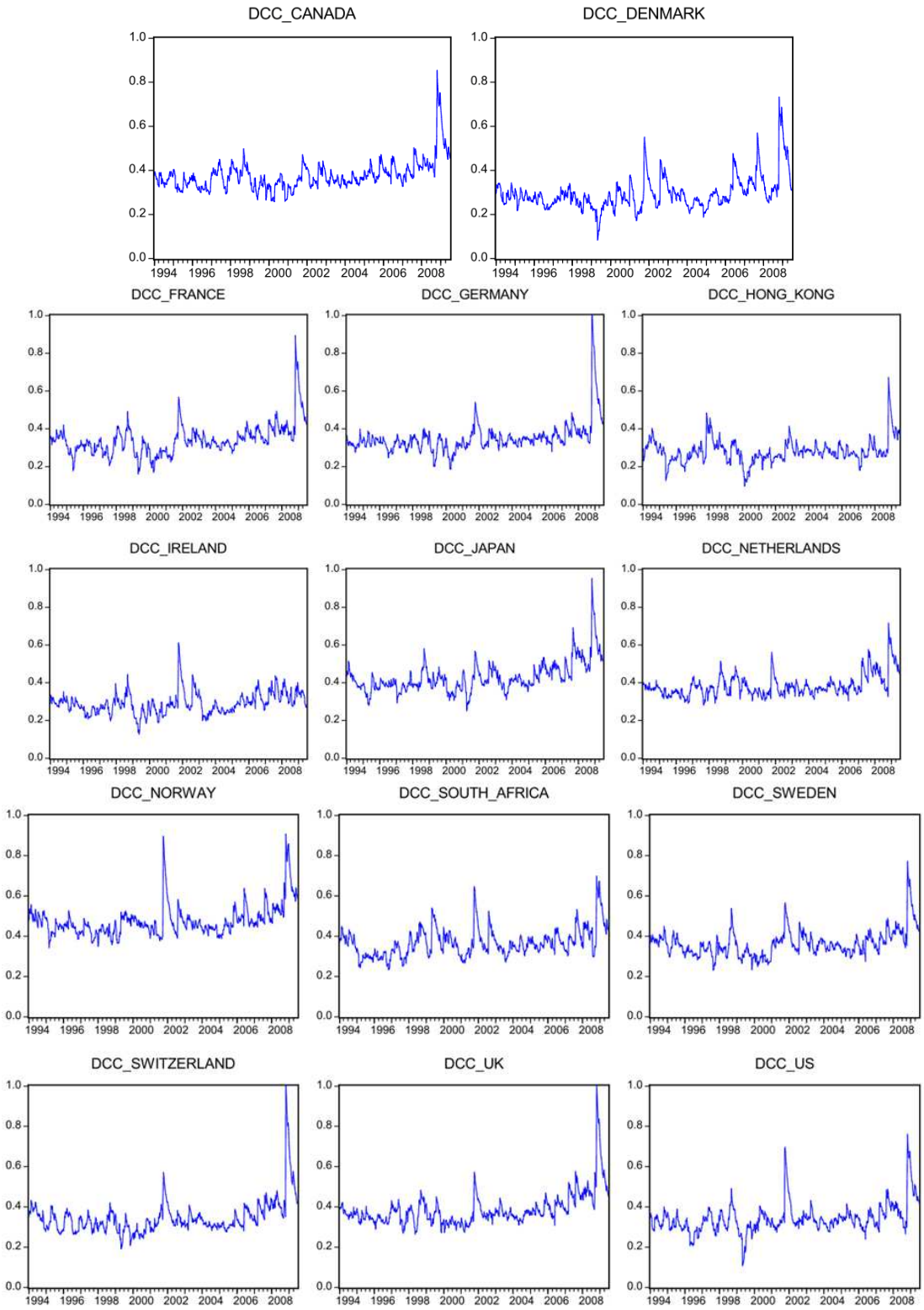

Fig. 1: DCC-MVGARCH individual countries' time-varying correlations with Australia

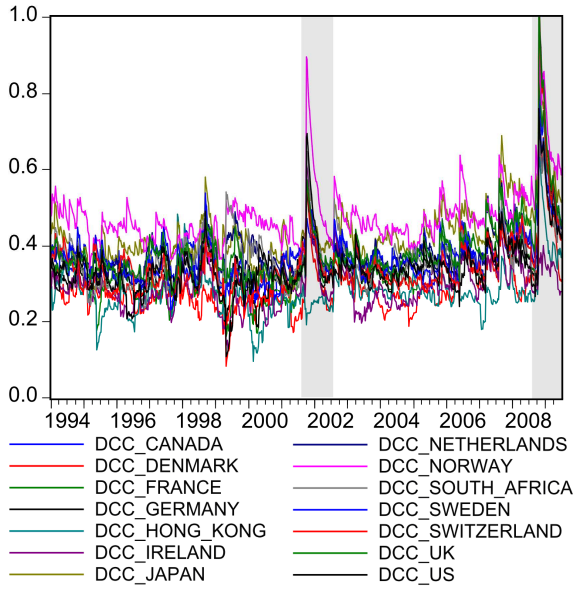

Fig. 2: DCC-MVGARCH combined time-varying correlations

It is noticeable from Fig. 1 and 2 that although the correlation between Australia and the other markets fluctuate, they are still generally less than 1. The theory of portfolio diversification posits that as long as the correlation between the markets is less than, there are still benefits to be gained. Some markets, however, provide less portfolio diversification benefits to Australian investors over time. These are the markets in which Australia experienced increasing correlation. From Fig. 1, we can see that this is the case with France, Norway and Denmark. Australia and these other countries are very active in the SRI investment space-they take the lead in a number of SRI activities worldwide. Hence, there may be increasing commonalities among them in terms of the way investors behave in these markets. The increasing correlation implies fewer benefits for Australian investors if they diversify to these other markets. Other countries, more or less, have more or less, stationary correlations with Australia, except during the period starting from 2007. These other markets therefore provide better avenues for Australian SRI aficionados to internationally diversify.

CONCLUSION

This study examined the relationship of the Australian Socially Responsible Investment (SRI) market with other SRI markets worldwide during the period 1994-2009 based on the dynamic conditional correlation multivariate GARCH model (DCC-MVGarch, Engle, 2002). The study analyzed the dynamic correlation of the Australian SRI market with fourteen other markets-Canada, Denmark, France, Germany, Hong Kong, Ireland, Japan, Netherlands, Norway, South Africa, Sweden, Switzerland, United Kingdom and the United States. Our results show that the Australian market experienced a spike in correlation with the other markets during periods of market distress, such as for instance during the recent global financial crisis. The study also finds that, in spite of the fluctuations in the correlation of Australia with the other markets over time; the correlations generally remain below 1. Australia's correlation with Denmark, Norway and Japan increased while it remain, more or less, stationary with the other markets, except from 2007 onwards when the global financial crisis occurred. These results imply that it still pays for Australian SRI investors to diversify internationally since the correlations are still less than 1. However, it pays less to diversify to such markets as Japan, Norway and Denmark. It seems that more diversification benefits can be obtained from the other markets. Finally, our results also indicate that diversification to other SRI markets is less effective during periods of market distress.

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