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Are REITS hedge or safe haven against oil price fall?

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ABSTRACT

This paper studies the hedge against falling oil prices and the safe haven properties of fourteen major country-specific real estate investment trusts (REITs) indices for the Asian, American, European, and worldwide geographies. Our analyses are performed from both, returns and conditional volatility perspectives. Our sample spans from January 2016 until August 2022, covering the COVID-19 pandemics and the ongoing Russia-Ukraine military conflict. We find that during COVID-19, only the Japan REITs, in terms of both returns and volatility, act as a hedge for oil whereas the only hedge during the Russia-Ukraine conflict is the Netherland REITs. In addition, we document diverse degrees of safe-haven and diversifiers properties for REITS from diverse geographies along the full sample and the respective sub-samples for both bearish conditions and elevated volatility in the oil market. Our results imply that market regulators should focus on controlling volatility in crude oil and REITs markets, especially throughout times of financial distress, as daily return volatility monitoring is a pivotal requirement for optimized investment management. Our study provides important knowledge for investors, policymakers, and market regulators.

1. Introduction

Over the recent years, Real Estate Investment Trusts (REITS) have been attracting a growing attention from academic community because of their expanding usage by diverse types of investors in search for portfolio diversification (Abuzayed et al., 2020; Akinsomi et al., 2017; Anglin et al., 2021; Bossman et al., 2022; Boudry et al., 2020; Bouri et al., 2020; Durkay, 2022; Lesame et al., 2021; Liow, 2022; Liow & Huang, 2018; Marfatia et al., 2017; Marfatia et al., 2021; Raheem et al., 2022). One of the drivers of this trend is the

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securitization of the highly expensive real estate assets overcoming an inherent illiquidity of the real estate market and, hence, turning REITS into exchange traded instruments. Being accessible to investors independently of the size of their portfolios, the REITS have been attracting the augmenting capital investments. Moreover, as the financialization of the real estate promotes a growing interdependence between the real estate and REIT markets with other capital markets, such as stock, commodity, and energy exchanges, the interrelations between the REITS and the other financial markets turn to be of increasing relevance for investment communities. Therefore, the connectivity, spillovers and contagion studies, involving the REITS sector across different geographies have been proliferating due to the expected interest from scholars and market regulators (Marfatia, et al., 2017; Gupta & Marfatia, 2018; Liow & Huang, 2018; Gupta et al., 2019; Abuzayed et al., 2020; Bouri et al., 2020; Del Giudice et al., 2020; Ling et al., 2020; Tanrıvermis, 2020; Grybauskas et al., 2021; Hoesli & Malle, 2021; Milcheva, 2021; Toro et al., 2021; Chong & Phillips, 2022; D'Lima et al., 2022; Mensi et al., 2023; Salisu et al., 2023).

However, the primary focus of the academic research on the REITS interactions with other markets initially has centered at the influence the macroeconomic and monetary shocks on the real estate investments (Adrangi et al., 2004; Gupta et al., 2019; Gupta & Marfatia, 2018; Liow, 2022; Liow & Huang, 2018; Marfatia et al., 2017; Raheem et al., 2022). Moreover, due to the cross-market integration and financialization of capital markets, the interdependencies with other markets have been appearing at the radar of academic researchers. In this context it is worth mentioning the emphasis that has been always maid on the impacts originated in the crude oil market (Aziz et al., 2022; Bedowska-Sojka et al., 2022; Das et al., 2021; Katsampoxakis et al., 2022; Li et al., 2021; Sim & Zhou, 2015; Umar et al., 2021, 2022). In particular, a special attention have been paid to the interconnectivity and risk spillovers between the REITa and commodities, with emphasis on the crude oil market (Nazlioglu et al., 2016, 2020; Bonato et al., 2021; Gupta et al., 2021; Sheng et al., 2021; Mensi et al., 2022a, 2022b; Stenvall et al., 2022). These papers provide evidence that the duly consideration of the interactions between the REITS and energy commodities allows elaborating more profitable and resilient asset allocation strategies applicable to a vast variety of investment portfolios.

During economic crises and financial turmoil, investors are especially concerned about resilience of their portfolio vis-à-vis downside risk and engage in rebalancing their exposure to different asset classes (Bedowska-Sojka et al., 2022; Gubareva & Borges, 2022; Gubareva, Umar, Teplova, & Vo, 2023). These is why a considerable strand of the recent literature has been dedicated to the COIVID-19 influence on the real estate market, in general, and the REITS' performance during initial phases of the still ongoing pandemic, in particular (Del Giudice et al., 2020; Ling et al., 2020; Tanrıvermis, 2020; Anglin et al., 2021; Grybauskas et al., 2021; Hoesli & Malle, 2021; Lesame et al., 2021; Milcheva, 2021; Toro et al., 2021; Bossman et al., 2022; Chong & Phillips, 2022; D'Lima et al., 2022; Liow, 2022; Mensi et al., 2022a, 2022b, 2023; Salisu et al., 2023). However, to the best of our knowledge, there is no research which addresses the effects of the Russia-Ukraine military conflict on the REITS sector of financial industry. Our paper fills this void. As the time span of our sample covers both, the COVID-19 pandemic and the Russia's special operation in Ukraine, it allows us, on the one hand, to compare our outcome against previous research regarding the COVID-19 effects on REITS, and, on the other hand, to advance the knowledge frontier further in time by incorporating the impact of the Russia-Ukraine military conflict in our analysis of REITS performance.

Our motivation for analyzing the non-linear interdependence between regional REITS exposures and global crude oil market during the COVID-19 pandemic and the Russia-Ukraine conflict is that we aspire to provide a broader and more relevant knowledge of the diversification attributes of REITS, based on comparison of their performance during the global severe health crisis transversal to practically all markets with the recent economic difficulties and market turbulences caused by the relatively more localized geopolitical Russia-Ukraine tensions. Throughout the recent history of crises and other cataclysmic events such as collapses of oil prices, market regulators and investors are always keen to more deeply comprehend the driving factors behind the behavior of real estate and REIT markets, and the sooner, the better. Given the globalized nature of contemporary financial markets, for policy makers, market regulators, and investment communities it is important to reach a profound understanding of how the REITS exposures from each of Asian, American, European, and worldwide geographies respond to changes in the price of crude oil. Such knowledge will allow designing more resilient policy solutions, improving market regulation and financial stability, and broadening investment and diversification horizons of crude oil and REITS investors. A more profound comprehension of the asymmetries inherent to the dynamic interdependence between the regional REITS indices and the global crude oil market is also helpful in what concerns the design of the all-whether portfolios, consisting of diverse asset classes.

To explain our motivation in more detail, we duly justify below why it is important to study the REITS in terms of their hedge and safe-haven capacities against oil price fall. There are several strong reasons. First, through the prism of portfolio management both, the oil and the REIT market are attracting a growing interest from investors and portfolio managers. Second, the oil in known to play a dominant role across a vast spectrum of the sectors of economic activity, including REITS. Third, knowledgeably, the oil price is more volatile that the real estate prices, resulting in a natural choice for investors aspiring to enhance the design and diminish the overall volatility of their portfolios. Fourth, there exist a lack of recent evidence of whether after the pandemic crisis, REITS still exhibit hedge and safe haven properties vis-à-vis pronounced negative movements in oil prices. All the above corroborates the motivation for our research and qualifies it as timely and potentially insightful for researchers and market practitioners. It is especially so, as we investigate the REITS hedge and safe-have properties against downtrends in crude oil market on both worldwide and country-specific basis.

Our motivation is fueled by a lack of evidence regarding the interrelation of REITs and oil markets, in general, and, in particular, of whether REITS may act as a hedge or a safe haven for oil during both the periods of bearish oil market conditions and the times of elevated volatility in oil prices. We expand the literature on spillovers between oil and REIT markets, complementing this strand with a more practical consideration of hedge, safe haven and diversifier attributes of international REITs exposures vis-à-vis crude oil prices, allowing us to provide relevant implications for investors and policy makers.

In this paper, we analyze REITS from Australia, Belgium, Canada, Germany, France, Hong Kong, Italy, Japan, Netherlands, New Zealand, Singapore, UK, US, and the Global REITS index. It is investigated whether REITS are hedge or safe haven against falling oil prices, studying the non-linear interdependence between the major country-specific real estate markets, proxied by the respective REITS indices, and the crude oil market, described by the WTI spot price. From the diversification-benefit perspective, we analyze the REITS safe-haven and hedge attributes from the prism of both, returns and conditional volatility. We find that during specific periods of geopolitical tensions, such as the Russia-Ukraine military conflict, the REITS could possess safe-haven and/or hedge properties that could increase resilience of the portfolios vulnerable to crushes of crude oil prices. Our research method is aligned with the already tested methodology, which has been being applied by several researchers. Following the methodology of Baur and Lucey (2010), Low et al. (2016), Abuzayed et al. (2020), and Hanif et al. (2022), we perform the regression of the REITS time series on three dummy variables representing extreme oil prices moves in the lower 10-th, 5-th, and 1-st quantiles of the return distribution of oil prices and in the upper 90-th, 95-th, and 99-th quantiles of volatility representative of an extreme uncertainty in the crude oil market.

Our contribution to the state-of-the-art is three-fold. First, we present the statistically significant and innovative results regarding the hedge or safe-haven properties of REITS exposures from the Asian, American, European, and worldwide geographies for oil investments at the bearish conditions and elevated volatility in the oil market. Second, we find that during COVID-19, only the Japan REITs, in terms of both returns and volatility, act as a hedge for oil whereas the only hedge during the Russia-Ukraine conflict is the Netherland REITs. In addition, we document diverse degrees of safe-haven and diversifiers properties for REITS from diverse geographies along the full sample and the respective sub-samples for both bearish conditions and elevated volatility in the oil market. Third, our results provide important and timely insights for investors, policymakers, and market regulators, as the safe-haven and hedge-wise interrelations between crude oil and REITS are highly relevant for both markets. In particular, our results imply that market regulators should focus on controlling volatility in crude oil and REITs markets, especially throughout times of financial distress, as daily return volatility monitoring is a pivotal requirement for optimized investment management.

The remaining part of the article is structured in the following manner. Section 2 surveys the relevant literature closely linked to the topics of our study. Section 3 examines the data and comments of the sample statistics. Section 4 presents the employed methodology. Section 5 discusses the results and their implications. Section 6 concludes the paper.

2. Literature review

In this section we discuss a few publications, related to the state-of-the-art in the domains closely linked to our research. This discussion allows to position our paper vis-à-vis the recent and contemporary literature as well as highlight its novelty and contribution in the advancement of the knowledge frontier in the corresponding research areas. We structure our brief literature survey along the line of research focused on the effects of the oil prices on the REITS performance, given their importance in efficient portfolio management.

The interdependence of changes in the price of crude oil and variations in the performance of REITS investments has received a reasonable coverage in the literature. E.g., several studies address the causality relationships between oil prices and REITS as well as analyze volatility transmission between these two asset classes, trying to uncover diversification attributes which would be appealing for investors searching to enhance the resilience of their energy-intensive portfolios against eventual collapses of the crude oil market. In addition, it is also worth mentioning previous research focused on REIT investments and hedging against inflation and climbing interest rates.

We start with one of the pioneering papers on the subject by Adragi et al., 2004. The Authors investigate the linkages between real estate investment trust returns and inflation. They try to answer whether securitized real estate investments provide a reliable inflation hedge. Their regression estimates demonstrate that real REIT returns are negatively correlated with the unexpected component of inflation. Hence, they conclude that REIT investments may not offer a safe haven during inflationary periods. In addition, the authors provide evidence of a decoupling of REITs from the general stock market for more recent intervals and find that the negative relationship between REITs and inflation is symptomatic of a positive relationship between REITs and real economic activity. However, the authors find no support for this hypothesis.

In the more recent time, Nazlioglu et al., 2016, examine the role of oil price shocks and volatility on six sub-sectoral REIT categories: residential, hotel, healthcare, retail, mortgage and warehouse/industrial REITS for the 2005–2013 period. These sub-sectoral REITS are evaluated against the dynamics of the price of crude oil. The authors gauge the interdependencies making use of causality and volatility spillover approaches. A novel econometric model by means of the performed causality tests based on mean spillover provides empirical evidence of unidirectional causality running from oil prices to all REITS, except for the mortgage REITS, for which the reversed causality is observed. Additionally, the causality-in-variance tests demonstrate that there is bidirectional transmission of volatility between the crude oil and all REITS. Justifiably, these results reveal relevant insights for REIT investors and portfolio managers.

In their turn, Akinsome et al., 2017 investigate the effect of gold market speculation on REIT returns in South Africa. Their study caters important insights to the dynamics of herd behavior during crisis periods by relating the time-variation in investor herding to speculation in gold, an asset traditionally considered a safe haven during market crises. The authors provide evidence that, during 2008–2011, higher level of speculation in gold substantially contributes to herding in the South African real estate investment trust market. Akinsome et al., 2017 argues that the evidence of herding in this market is in contrast to the static and two-regime model specifications that fail to detect herding, highlighting the significance of econometric specifications that directly track the time-variation in herd behavior. Their outcomes indicate that speculative activities in the gold market contain valuable information regarding market fundamentals that drive investor behavior in the REIT market.

Bouri et al., 2020, study nonlinear contagion between international stock and real estate markets resorting to a local Gaussian correlation approach. The authors use the daily frequency data on REITs and stock markets of nineteen countries over the twenty-year-long period, from 1998 to 2018. Their research covers the dot-com crisis, global financial crisis, European sovereign debt crisis as well as the Brexit-triggered stresses. The local Gaussian correlation method allows not only avoiding the bias of the conditional correlation, but also permits to describe any nonlinear structure in dependence and the deviation from global normality. The authors report strong evidence of nonlinear within-the-country contagion between stocks and REITs for both, developed and developing economies, especially during the global financial crisis and European sovereign debt crises. Bouri et al., 2020 also study contagion between the US REITs and the REITs from other geographies as well as between the US REITs and the stock markets of the remaining eighteen countries, and report contagion patterns similar to those of within-the-country contagion. The authors claim that their outcomes provide relevant insights to policy makers and investors.

In parallel, Nazlioglu et al., 2020, investigate the price and volatility linkages between international REITs and oil markets. Authors analyze the price and volatility transmissions between nineteen country-specific REITs and the oil markets over the 1989–2018 period. Their study covers a vast spectrum of the developed and developing countries. The authors conclude that, in the developed countries, the oil prices predict REITs prices in mature REITs markets, but the statistical significance is rather weak. In what concerns volatility, the results provide strong evidence of bidirectional transmission for a major part of the analyzed markets. The results are in general robust to shortening sample period and, hence, have important implication for market practitioners and further research.

Amplifying the scope of the research on the oil-REITs interactions, Bonato et al., 2021, try to answer the question whether oil-price shocks can predict the US REITs realized variance. Working with sectoral and aggregate and US data covering the 2008–2020 period, the authors estimate various versions of the heterogeneous auto-regressive realized variance model, both at conditional mean and quantiles. They report exhaustive studies of in-sample and out-of-sample predictability. The performed out-of-sample tests reveal the significant predictive capacity of demand-driven and risk-driven shocks in the price of oil for the US REITs realized variance, in general, and its upward counterpart, in particular, at a short, medium, and long forecasting horizon. The results corroborate an existence of possible economic benefits of using disentangled oil shocks for realized-variance forecasting of the US REITs.

Gupta et al., 2021, analyze the effects of crude oil supply, crude oil consumption demand, and crude oil inventory demand-driven shocks on US state-level real housing returns over the years 1975–2019. The authors conclude that positive oil production shocks increase real housing returns while positive oil-specific consumption and inventory demand-driven shocks result in increasing oil prices and, thus, reduce the U.S. state-level real housing returns. It is also found that the strongest impact comes from the global demand-driver shocks. Moreover, the authors find that the degree of oil dependency, which is oil consumed minus oil produced as a ratio of oil consumed, does not affect the nature of the effects of the analyzed oil shocks on real housing returns. However, the degree of the impacts is attenuated by the low-oil dependence, especially in the case of the oil inventory demand shock. The results of this research provide relevant insights for policy makers regarding the role of oil dependence in real housing returns.

Also contributing to the literature regarding the interactions between the oil prices and real estate returns in the US, Sheng et al., 2021 analyze the effects of crude oil shocks on housing price movements across the US during the period 1975–2020. The authors employ a Bayesian dynamic factor model to decompose the house price movements into national, regional, and state-specific factors. It is found that oil supply-driven and oil consumption demand driven shocks are the most important factor on the national scale. The authors present empirical evidence that the effects of these two shocks on housing prices are asymmetric as they are relatively stronger in a bearish rather than a bullish housing market. The reported results appear to be potentially useful for designing enhanced policy solutions in this sector of economic activity.

One of the recent contributions to the literature on the oil-REITs interactions is the paper of Mensi, Nekhili, and Kang (2022). During the period from September 2016 to October 2021, the authors study quantile connectedness and quantile return spillovers between oil and major international REIT markets from thirteen developed countries of American, Asian, and European geographies. To study transmission mechanisms, the authors employ the quantile connectedness method. They find that the oil-REITs interconnectivity is heterogeneous and asymmetric and provide an evidence that the return spillovers are stronger at lower quantiles. In addition, it is documented that the oil market plays a role of a net transmitter of return spillovers to the analyzed REITs during market downsides while becomes a net spillover receiver within periods of market upsides. The hedging strategy during COVID-19 is found expensive, with the highest hedging effectiveness offered by oil exposures for the Hong Kong REITs.

Continuing this line of research, Mensi, Reboredo, et al. (2022) analyze effects of switching connectedness between REITs, oil, and gold, for the period from September 2016 to January 2022. To uncover the mechanisms behind the spillover transmissions, the authors employ a two-regime Markov-switching vector auto-regression model. For a major part of the analyzed markets, the authors report a positive effect of gold and oil on all REITs, especially under highly volatile market conditions. Both, oil and gold are found to be net transmitters of spillovers to REITs in a regime of low volatility, while at high volatility conditions the role of net transmitters is played by the analyzed REITs, from the thirteen above mentioned geographies plus the world REIT index. The authors provide empirical evidence that price spillovers are vary along the time and substantially augment during the initial expansion of the COVID-19 pandemic and in January of 2022.

Stenvall et al., 2022, investigate non-linear tail dependence between the energy and housing markets. This article studies the quantile interactions between oil, coal, and gas, on the one hand, and the real housing returns of the nine US census divisions, on the other hand, during the years from 1991 to 2019. A cross-quantilogram approach and quantile regression method are employed. The authors document that all analyzed commodities are, generally speaking, negatively associated with real returns of the considered housing markets. The authors report that significant correlations occur more frequently when the returns of the oil and housing markets are in similar percentiles. The regional variation in the oil effect on housing returns is also discussed.

Finally, we mention the work of Salisu et al., 2023, who, by means of a GARCH-MIDAS approach, test the forecasting power of global economic conditions for the volatility of international REITs. The authors examine the nexus between global economic conditions and REITs returns. Their outcomes provide evidence of forecast gains in the model that accommodates global economic conditions and demonstrate significant in-sample forecasting ability, especially as improvements in global economic conditions are found to lower the risk associated with the international REITs, specifically in the emerging markets and the US. The authors observe that higher REITs returns can be achieved by exploiting the information contents of global economic conditions. Therefore, they argue that monitoring the global economic dynamics is crucial for optimal investment decisions in REITs markets.

Having briefly surveyed the recent literature on the interaction between the oil and real estate markets, we infer that the above papers are mostly focused on connectedness, spillovers and the transmission mechanisms. However, except for the solely one work of Mensi, Nekhili, and Kang (2022), the questions regarding the cost and effectiveness of the oil-REITs hedges remain unaddressed. This characterizes our work as the timely and highly awaited from the prism of hedge strategies design, as it helps bridging this gap, existing both in the literature and in academic research.

Moreover, finalizing the literature review section, we spend some ink on describing our contribution to previous studies. In this regard, we mention the added value and suitability of the applied methods in the context of the paper. Although diverse econometric techniques have been previously employed by several authors to study the REITs returns and their interrelation with the oil markets, as evidenced by the above-reviewed papers, to the best of our knowledge, no study has employed the asymmetric DCC-GARCH model (Glosten et al., 1993) accompanied by the dynamic conditional correlation (DCC) technique (Engle, 2002). Our methodological choice

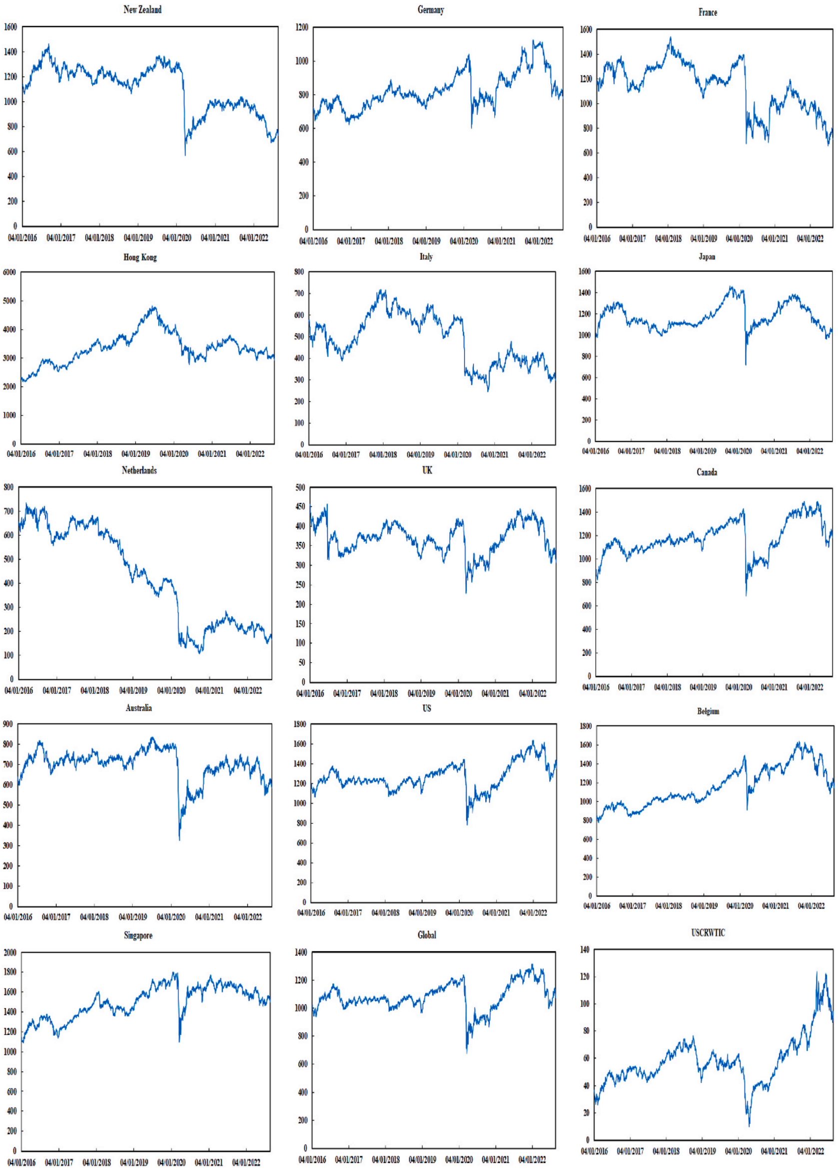

Fig. 1. Price dynamics of REITs and Oil.

allows us to bring together the DCC investigation and the hedge and safe-haven analysis. Therefore, our research provides important practical insight to the market practitioners and regulators in what concerns the interrelations between the REITs and oil markets and provides the answer to the very relevant question whether REITs are hedge or safe haven against oil price fall. In this way, our paper complements the existing knowledge on the related topics addressed in the discussed-above studies.

3. Data and summary statistics

We use daily price series for WTI (spot price) and international Real Estate Investment Trusts (REITs) from the time span from January 04, 2016, to August 24, 2022, including the COVID-19 and the Russia-Ukraine conflict periods. We select March 11, 2020, and February 24, 2022, as the start dates of the world COVID-19 pandemic announced by World Health Organization (WHO) and the first attack of Russia on Ukraine, respectively. Our focus is on the impact of COVID-19 and Russia-Ukraine conflict on the interrelation between the REITs and oil market performance. Thus, this sample period provides a unique opportunity to study the hedge and safe-haven features of REITs for oil prices during the most recent events transversal to financial markets.

We analyze REITs from the fourteen following geographies: New Zealand, Germany, France, Hong Kong, Italy, Japan, Netherlands,

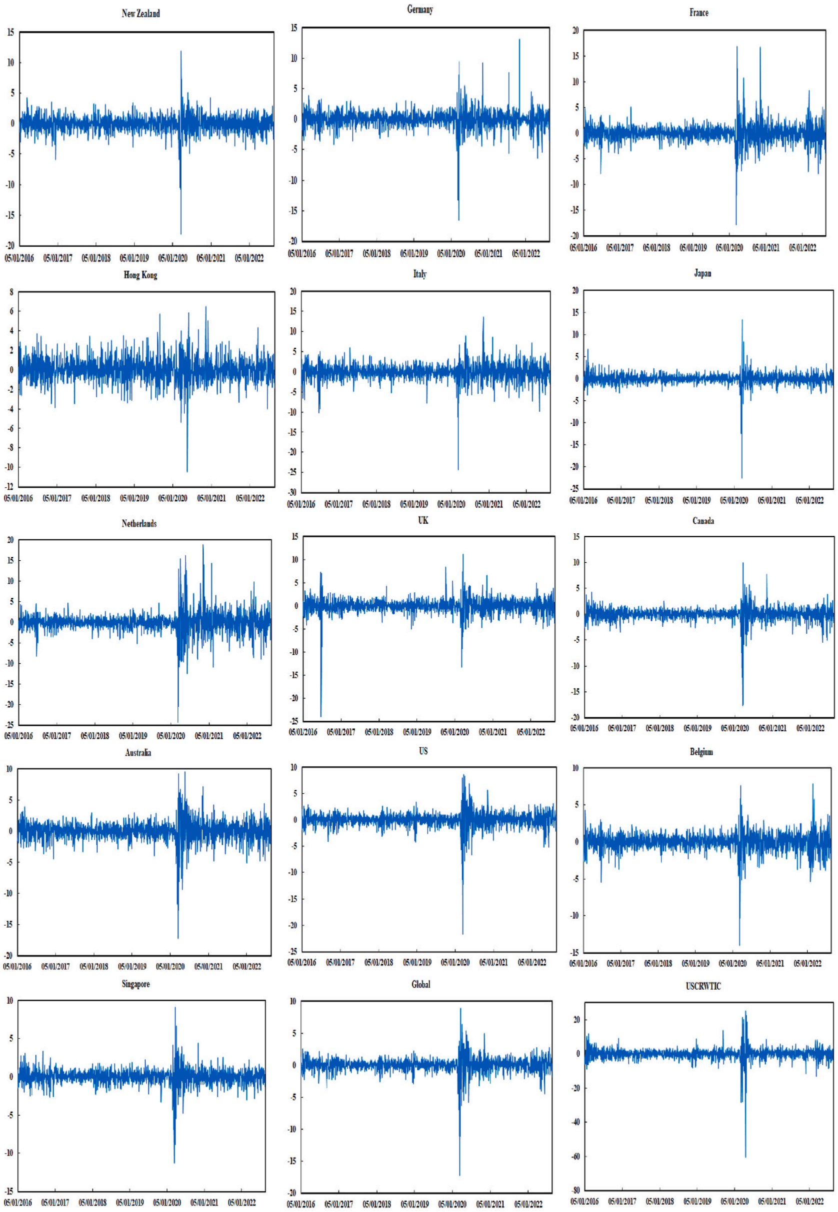

Fig. 2. Returns of REITS and oil.

Table 1
Descriptive statistics for REITs and Oil returns.

	Mean	St. Dev	Median	Minimum	Maximum	Skewness	Kurtosis	ADF	KPSS	JB	Correlation with WTI
Panel A: Full sample											
New Zealand	−0.027	1.406	0.037	−17.960	11.829	−1.668	23.896	−11.287[a]	0.125	40,496[a]	0.078
Germany	0.004	1.442	0.024	−16.532	13.113	−0.779	22.669	−11.811[a]	0.054	35,918[a]	0.172
France	−0.031	1.832	0.021	−17.662	16.854	0.289	17.808	−11.964[a]	0.095	22,085[a]	0.188
Hong Kong	0.013	1.198	−0.007	−10.452	6.510	−0.069	5.549	−13.098[a]	0.356	2145.500[a]	0.099
Italy	−0.039	2.026	−0.003	−24.123	13.587	−1.069	15.534	−12.236[a]	0.077	17,106[a]	0.157
Japan	0.000	1.339	0.008	−22.499	13.362	−2.091	66.944	−12.776[a]	0.092	312,905[a]	−0.028
Netherlands	−0.084	2.523	−0.027	−24.199	18.693	−0.038	16.071	−11.087[a]	0.074	17,968[a]	0.202
UK	−0.024	1.640	0.024	−23.947	11.078	−2.340	34.970	−11.584[a]	0.048	86,584[a]	0.162
Canada	0.015	1.371	0.062	−17.685	9.882	−2.840	42.120	−11.711[a]	0.065	125,641[a]	0.309
Australia	−0.006	1.680	0.015	−17.143	9.503	−1.538	17.740	−11.289[a]	0.051	22,552[a]	0.145
US	0.009	1.477	0.069	−21.679	8.559	−2.449	36.332	−11.553[a]	0.028	93,480[a]	0.225
Belgium	0.018	1.251	0.084	−13.874	7.841	−1.328	16.394	−11.984[a]	0.117	19,190[a]	0.150
Singapore	0.017	1.077	0.045	−11.256	9.013	−0.690	19.085	−12.169[a]	0.100	25,472[a]	0.122
Global	0.004	1.204	0.065	−17.205	8.912	−2.558	38.038	−11.340[a]	0.030	102,458[a]	0.236
USCRWTI	0.057	3.474	0.223	−60.168	24.887	−3.031	65.831	−12.177[a]	0.052	303,963[a]	
Panel B: COVID-19											
New Zealand	−0.029	1.869	0.096	−17.96	11.829	−1.832	22.545	−12.157[a]	0.089	10,706[a]	0.078
Germany	0.044	1.935	0.043	−16.532	13.113	−0.269	18.074	−9.332[a]	0.039	6711.9[a]	0.211
France	0.006	2.512	−0.032	−12.075	16.854	1.266	10.292	−9.054[a]	0.042	2307.8[a]	0.219
Hong Kong	−0.034	1.391	−0.036	−10.452	6.510	−0.388	8.509	−9.155[a]	0.084	1501[a]	0.102
Italy	0.030	2.439	−0.084	−7.794	13.587	0.572	2.793	−7.677[a]	0.035	188.07[a]	0.134
Japan	−0.011	1.974	0.021	−22.499	13.362	−2.213	46.301	−16.985[a]	0.063	44,374[a]	−0.073
Netherlands	0.000	3.861	−0.146	−20.394	18.693	0.492	5.161	−8.394[a]	0.081	568.47[a]	0.240
UK	0.053	1.776	0.146	−9.255	11.078	0.068	5.612	−9.826[a]	0.058	648.77[a]	0.195
Canada	0.053	1.975	0.140	−17.685	9.882	−2.762	30.132	−11.935[a]	0.064	19,254[a]	0.299
Australia	0.022	2.480	0.055	−17.143	9.503	−1.354	10.468	−11.431[a]	0.049	2401.8[a]	0.134
US	0.072	2.099	0.099	−21.679	8.559	−2.300	26.87	−10.898[a]	0.037	15,247[a]	0.228
Belgium	0.031	1.511	0.121	−10.300	7.589	−1.036	8.850	−9.507[a]	0.208	1697.9[a]	0.173
Singapore	−0.006	1.530	0.047	−11.256	9.013	−0.541	13.647	−12.459[a]	0.048	3848.9[a]	0.066
Global	0.054	1.717	0.071	−17.205	8.912	−2.196	26.193	−10.861[a]	0.046	14,473[a]	0.231
USCRWTI	0.223	4.976	0.331	−60.168	24.887	−3.219	50.119	−7.786[a]	0.030	52,370[a]	
Panel C: Russia-Ukraine conflict											
New Zealand	−0.155	1.222	−0.243	−3.344	2.835	−0.142	−0.135	−3.759[a]	0.181	0.4679	0.200
Germany	−0.229	1.595	−0.126	−6.338	3.763	−0.947	1.948	−4.399[a]	0.065	40.261[a]	−0.003
France	−0.28	2.557	−0.332	−7.842	8.195	−0.186	0.756	−5.709[a]	0.046	4.1816	−0.052
Hong Kong	−0.047	1.097	−0.016	−3.945	4.345	0.192	2.311	−4.871[a]	0.210	30.485[a]	0.167
Italy	−0.281	2.264	−0.148	−9.809	4.629	−0.910	2.306	−5.928[a]	0.049	47.133[a]	0.061
Japan	−0.077	1.110	−0.161	−3.198	3.379	−0.049	0.835	−4.533[a]	0.069	4.2095	0.056
Netherlands	−0.274	2.829	−0.123	−8.797	9.684	−0.301	1.633	−5.006[a]	0.065	17.000[a]	−0.143
UK	−0.236	1.770	−0.178	−4.867	3.727	−0.262	−0.315	−5.281[a]	0.060	1.8323	−0.013
Canada	−0.145	1.539	−0.104	−5.426	3.855	−0.587	1.295	−4.156[a]	0.080	16.919[a]	0.161
Australia	−0.128	1.669	−0.054	−4.786	4.353	−0.364	0.180	−4.446[a]	0.076	3.0843	0.156
US	−0.077	1.510	−0.019	−5.218	3.126	−0.659	1.282	−4.552[a]	0.104	18.64[a]	0.003
Belgium	−0.165	1.671	−0.187	−3.754	5.743	0.234	0.432	−4.765[a]	0.093	2.3951	−0.040
Singapore	−0.032	0.839	0.033	−2.820	2.169	−0.349	0.146	−4.257[a]	0.093	2.7743	0.214
Global	−0.092	1.246	−0.049	−4.467	2.775	−0.553	1.165	−4.210[a]	0.098	14.314[a]	0.024
USCRWTI	0.026	3.597	0.407	−12.927	8.024	−0.535	0.870	−6.062[a]	0.122	10.553[a]	

Notes: This table shows the descriptive statistics of the returns. ADF unit root test of Dickey-Fuller, (1979) and KPSS stationary test of the Kwiatkowski et al. (1992).
[a] Indicates significance at the 1% level, respectively.

UK, Canada, Australia, US, Belgium, Singapore, and the Global REITS index. The WTI spot price is proxied by the USCRWTIC index. The daily returns are calculated by taking the difference in the logarithm percentage of the two consecutive prices. All the data series are sourced from Bloomberg.

As per the plots of Fig. 1, we see an abrupt drop for all time-series by the end of the first quarter of 2020, corresponding to the severe advancement of the Covid-19 pandemic and, hence, to the apogee of the Covid-19-triggered general meltdown in financial markets, registered on March 23, 2022 (Gubareva, 2021). In addition, we note that contrary to a reasonable recovery observed in Australia, Singapore and the US, the recovery of the REIT prices in other geographies has less prominent because of the elevated levels of uncertainty regarding the socio-economic perspectives, especially in European countries. The latter, in the first half of 2022, have been affected by the Russia-Ukraine military conflict and its consequences, adversely influencing international trade, business environment and financial stability.

As per the plots of Fig. 2, we see a high volatility of all REITS and crude oil returns in the first half of 2020, coinciding with the pandemic-triggered economic slowdown. It is worth noting that in line with the discussion of Fig. 1, the volatility of returns for the European REITS appears as superior to that of the other geographies. This happens, among other factors, due to the impact of the Russia-Ukraine military conflict, which is still ongoing in the time of writing. Therefore, as expected we can clearly observe clustering of the volatility of returns, namely, we see the two principal clusters; one around the Covid-19 triggered economic slowdown in the first half of 2020, and another, corresponding to the first half of 2022, which we ascribe to the influence of the ongoing military tensions between Russia and Ukraine.

Table 1 presents the sample statistics of the REITs and crude oil return series. For the full sample, we observe that the majority of the mean returns are positive, except for the negative figures for New Zealand, France, Italy, Netherlands, UK, and Australia. Null value is registered for Japan. The two highest values are registered for Belgium and Singapore, 0.018 and 0.017, respectively. The two lowest means are observed for Netherlands and Italy, −0.084 and −0.039, correspondingly. As could be inferred form the comparison of the standard deviations, the REITs returns in Singapore (1.077) and Hong Kong (1.198) are the least volatile, while those in Netherland (2.523) and Italy (2.026) are by far the most volatile. Figs. 1 and 2 also corroborate with these conclusions. As per skewness figures, all return series are asymmetric. As per kurtosis figures, they are also leptokurtic. All times-series, with the only exception constituted by France, present negative skewness values. In contrast, for France we observe that the respective time series is positively skewed, indicating a distortion of the respective return distribution in an opposite direction vis-à-vis all other time series. All REITs and oil returns are leptokurtic, as may be concluded based on the kurtosis figures above 3. The hypothesis of normal distribution is rejected at 1% level of significance by the performed Jarque-Bera tests for all data series. The same conclusion regarding the non-normality of the distributions also holds for the subsamples, covering the Covid-19-fueled slowdown and the Russia-Ukraine military conflict. In what concerns the correlation analysis, for the full sample and for the Covid-19 subsample, the only REITs returns negatively correlated with the crude oil returns are those of Japan. However, for the subsample covering the Russia-Ukraine military conflict we observe negative correlation coefficient for five European countries, namely Belgium, France, Germany, Netherlands and UK. We ascribe this phenomenon a heavy dependence of these economies on importing energy resources. Such dependence explains why the pronounced hikes in the oil prices, observed since the beginning of the Russia-Ukraine military dispute, adversely affect the above economies, in general, and the performance of the respective REITs, in particular.

4. Methodology

4.1. Asymmetric DCC-GARCH model

The asymmetric time varying conditional correlations between REITs and oil returns are estimated through the ADCC-GARCH model of Glosten et al. (1993) and the DCC technique of Engle (2002). The estimation process follows two steps. In first step, the GARCH model is estimated for all returns series. In second step, the time varying conditional correlations are estimated by incorporating the ADCC process. To estimate the time-varying estimates of the conditional correlation between REITs and oil price returns, our study uses the following framework.

$$r_t|I_{t-1} \sim (0, H_t) \quad (1)$$

$$H_t = D_t R_t D_t \quad (2)$$

$$\varepsilon_t = H_t^{1/2} z_t \quad (3)$$

$$R = \left[diag Q_t^{-1/2}\right] Q_t \left[diag Q_t^{-1/2}\right] \quad (4)$$

$$Q_t = (1 - \theta_1 - \theta_2)\overline{Q} + \theta_{1} z_{t-1} z'_{t-1} + \theta_2 Q_{t-1} \quad (5)$$

Where $r_t = [r_{t1}, r_{t2}]$ is the 2×1 vector of returns for REITs returns and oil market return at conditional information I_{t-1}. H_t is the conditional variance matrix of return r_t. D_t is the diagonal matrix for conditional standardized residuals computed from the univariate GARCH model. $R_t = [\rho_{ijt}]$ is conditional correlation matrix. $\varepsilon_t = [\varepsilon_{t1}, \varepsilon_{t2}]$ is the 2×1 vector of residuals at information I_{t-1}. z_t follows the normal distribution Q_t is the conditional correlation matrix of standardized residuals. The parameters θ_1 *and* θ_2 are non-negative scalars assuming that $\theta_1 + \theta_2 < 1$.

Next, we estimate the elements of H_t by using the asymmetric GARCH model of Glosten et al. (1993), called GJR-GARCH model and ADCC model as:

$$h_{i,t} = \omega_i + \alpha_i \varepsilon_{i-t}^2 + \beta_i h_{i,t-1} + \gamma_i \varepsilon_{i,t-1}^2 I_{i,t-1}(\varepsilon_{it-1}) \tag{6}$$

Where $h_{i,t}$ is the conditional variance of the returns. ω_i is a constant term. α_i and β_i show the ARCH and GARCH effects which estimate the volatility persistence. γ_i indicates the asymmetric effects. The indicator function $I_{i,t-1} = 1$. If $\varepsilon_{it-1} < 0$ and indicator function equal to zero otherwise. To ensure the positivity in stationary process, the parameters ω, α , β, and γ satisfy the conditions $\omega > 0$, $\alpha, \beta, \gamma \geq 0$ and $\gamma + \frac{\alpha+\beta}{2} < 1$.To capture the asymmetric effects, we follow the ADCC model (Cappiello et al., 2006) in to modify Eqs. (4) and (5) as:

$$Q_t = (\overline{Q} - A'\overline{Q}A - B'\overline{Q^-}B - G'\overline{Q}G) + A'^{z_{t-1}z'_{t-1}} + G'^{z^-_{t-1}z'^-_{t-1}}G + B'Q_{t-1}B \tag{7}$$

where $\overline{Q}$ and $\overline{Q^-}$ are unconditional correlation matrices. The matrices A, B and G are measured by parameters, β, and γ in ADCC model. Finally, the setting provided by ADCC-GARCH model, the dynamic conditional correlation matrix is provided as:

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1} \tag{8}$$

Where Q_t^* is a diagonal matrix with a square root of the i-th diagonal Q_t on its diagonal position.

4.2. Hedge and safe-haven analysis

We further test, whether REITs a hedge or safe haven asset for oil price fall by using the regression analysis in which we regress the REITs returns on oil returns. Following the work of Mensi et al. (2021), we utilize the pairwise asymmetric dynamic conditional correlations estimated from ADCC model (ρ_{ijt}) are regressed on the dummy variables is extreme quantiles of return distribution.

$$\rho_{ijt} = b_0 + b_1 D\left(r_{i,tq_{10\%}}\right) + b_2 D\left(r_{oil,tq_{5\%}}\right) + b_3 D\left(r_{oil,tq_{1\%}}\right) + \varepsilon_t \tag{9}$$

Where r_i is the return of oil market. ε_t is the error term. REITs are diversifier If b_0 is significantly positive. If b_0 is zero, then REITs are week hedge and, a strong hedge if b_0 are negative. If the quantile coefficients of b_1, b_2 and b_3 are insignificantly different from zero, then REITs are week haven assets and strong haven for oil returns under certain market conditions, if these quantiles coefficients are negative. The $q_{10\%}$, $q_{5\%}$, $q_{1\%}$ are at 10%, 5% and 1% quantiles of the returns at time t, respectively.

We also estimate the second regression equation by choosing the lagged extreme conditional volatility oil asset which is used as a proxy for oil market uncertainty following Low et al. (2016) and Hanif et al. (2022). The similar method to Eq. (9) is to regress $ADCC_t$ on the lagged extreme conditional volatility of oil market. The conditional volatility of the oil market is estimated from GJR-GARCH model (Eq. (6)), the equation for uncertainty measure is as:

$$ADCC_{ijt} = b_0 + b_1 D\left(v_{oil,q_{90\%},t-1}\right) + b_2 D\left(v_{oil,q_{95\%},t-1}\right) + b_3 D\left(v_{oil,q_{99\%},t-1}\right), \tag{10}$$

Where b_1, b_2 and b_3 are dummy variables which are equal to 1 if the conditional volatility exceeds the 90%, 95% and 99% quantiles at $t-1$. This allows is to investigate whether REITS scan be counted as a hedge or safe haven asset during extreme uncertainty in oil market.

Table 2
Dynamic conditional correlations between REITs and oil.

	Full sample	COVID-19	Russia-Ukraine conflict
New Zealand	0.092	0.175	0.147
Germany	0.166	0.182	0.145
France	0.174	0.178	0.155
Hong Kong	0.096	0.175	0.152
Italy	0.165	0.178	0.152
Japan	0.004	0.179	0.148
Netherlands	0.209	0.196	0.155
UK	0.144	0.190	0.173
Canada	0.268	0.191	0.186
Australia	0.135	0.184	0.188
US	0.200	0.186	0.194
Belgium	0.118	0.180	0.178
Singapore	0.126	0.180	0.194
Global	0.212	0.187	0.193

5. Results

5.1. Dynamics conditional correlations

Table 2 presents the average values of the pairwise dynamic conditional correlation (DCC) coefficients between REITs per geography and WTI oil market. All mean values of the DCC coefficients are positive without exception.

As per Table 2 all coefficients are, however, very closed to zero, allowing to characterize the REITs markets and oil prices as weakly correlated or almost uncorrelated. Therefore, according to Baur and Lucey (2010) classification of safe-haven, hedge, and diversifier properties, all these oil-REIT pairs should be classified only as diversifiers. In line with Baur and Lucey (2010) any positive but imperfect relationship, as in our case, makes the assets being eligible only for a diversifier role.

However, to get eventual deeper insights we indulge in plotting the dynamic DCC coefficients along the time in Fig. 3.

In Fig. 3 we observed several abrupt spikes in correlations. They coincide with the global COVID-19 triggered meltdown in March 2020 (Gubareva, 2021) and with the initial phase of Russia-Ukraine military conflict in February 2022 (Bossman & Gubareva, 2023; Bossman et al., 2023a, 2023b). However, their amplitude is low with only the oil-Germany and oil-Italy REITs pairwise coefficient climbing above the 0.3 level for a very short time window. The dynamic correlations between REITs and oil markets are predominantly

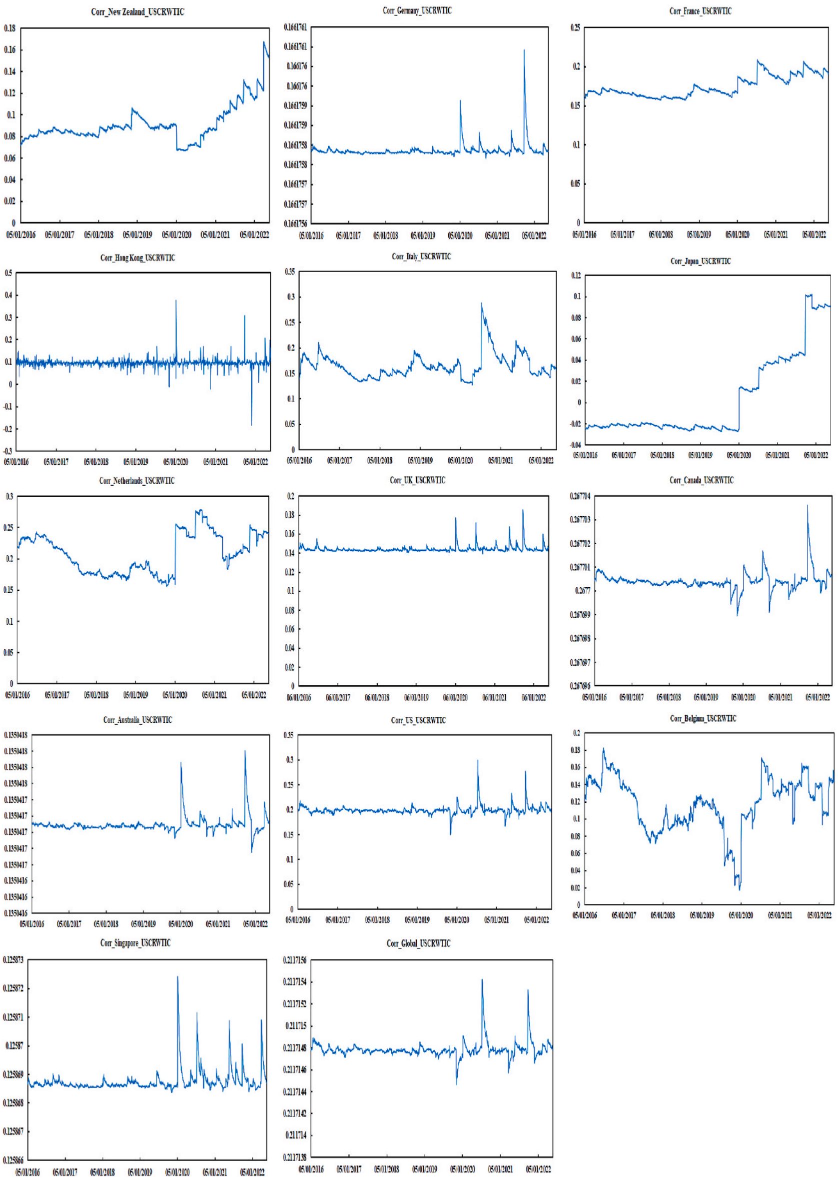

Fig. 3. Dynamic conditional correlations (DCCs) behavior over time.

Notes: This figure shows the dynamic conditional correlations between REITs and oil (WTI spot price) extracted from ADCC-GARCH Model.

low and always positive (except one negative spike observed for the oil-Hong-Kong pair at the beginning of the Russia-Ukraine conflict). This visual inspection of Fig. 3 corroborates and complements Table 3. We observe that the correlation coefficients between REITs indices and oil prices are weakly positive along the time, with abrupt but not substantial variations that do not permit reclassify them from diversifier category to any other independently of the geography of REITs markets. This signifies that the REITs exposures do not possess neither hedge nor safe-haven attributes against oil price fall. Although we observe some slightly differentiated patterns between oil-REITs pairs for distinct geographies, the only role the REITs may play vis-à-vis the oil market is the role of a diversifier.

5.2. Hedge and safe haven

This section presents the results, which shed light on whether a REITs exposure in a certain geography could represent a safe haven or hedge against the oil price movements. We gauge the hedge and safe-haven properties of the REITs for each the thirteen analyzed countries as well as on a global scale. Following the methodology of Baur and Lucey (2010), Low et al. (2016), Abuzayed et al. (2020), and Hanif et al. (2022), we perform the regression of the REITs time series on three dummy variables representing extreme oil prices moves in the lower 10-th, 5-th, and 1-st quantiles of the return distribution of oil prices. As per Equation (5), $D(\sigma_{oil,t-1}q_{90\%,t-1})$,

Table 3
REITs safe-haven and hedge properties.

	Hedge	Safe-haven quantiles		
	b_0	**b_1(10%)**	**b_2 (5%)**	**b_3(1%)**
Panel A. Full sample				
New Zealand	0.092***	−0.001	−0.002	−0.007
Germany	0.162***	0.000	0.000	0.000***
France	0.174***	0.001	0.001	0.009*
Hong Kong	0.096***	0.001	0.000	0.022***
Italy	0.165***	0.005*	−0.004	**−0.023***
Japan	0.003***	0.001	0.004	0.019
Netherlands	0.208***	0.007*	0.005	0.026**
UK	0.144***	0.001	0.001	0.005***
Canada	0.268***	0.000*	0.000	0.000*
Australia	0.135***	0.000	0.000	0.000***
US	0.194***	0.001	0.001	0.004
Belgium	0.117***	0.001	0.000	−0.007
Singapore	0.126***	0.000	0.000	0.000***
Global	0.212***	0.000	0.000	0.000
Panel B: COVID-19				
New Zealand	0.087***	−0.000	−0.000	0.000
Germany	0.230***	−0.000	0.000	−0.000
France	0.225***	−0.000	−0.000	−0.000
Hong Kong	0.111***	−0.003	0.016	−0.038
Italy	0.255***	−0.014	−0.036	−0.020
Japan	**−0.060***	−0.001	0.001	−0.002
Netherlands	0.349***	−0.015	−0.031**	−0.013
UK	0.178***	−0.001	0.001	−0.001
Canada	0.298***	−0.001	0.001	−0.001
Australia	0.149***	−0.001	0.001	−0.001
US	0.287***	−0.008	−0.011	0.026
Belgium	0.229***	−0.010	−0.021*	−0.004
Singapore	0.157***	−0.018*	−0.023	−0.027
Global	0.240***	−0.001	0.001	−0.001
Panel C: Russia-Ukraine conflict				
New Zealand	0.186***	−0.001	−0.002	0.001
Germany	0.002***	−0.000	−0.002	0.001
France	0.032**	0.044	0.000	−0.106
Hong Kong	0.133***	−0.011	0.008	0.009
Italy	0.157***	0.048	−0.028	−0.056
Japan	0.059***	0.000	−0.000	−0.000
Netherlands	**−0.080***	−0.009	0.019	−0.009
UK	0.019***	−0.003	−0.004	0.003
Canada	0.155***	0.000*	−0.000*	−0.000
Australia	0.086***	0.013	−0.025	−0.023
US	0.039**	0.031	−0.090	−0.049
Belgium	0.004	−0.002	−0.016	0.005
Singapore	0.217***	−0.000	−0.002	0.001
Global	0.073***	−0.015	−0.057	−0.069

Notes: This table presents the results of hedge and safe-haven analysis of REITs for daily oil extreme returns.
The symbols ***, ** and * indicate the level of significance at 0.01, 0.05 and 0.1, respectively.

$D(\sigma_{oil,t-1} q_{95\%,t-1})$ and $D(\sigma_{oil,t-1} q_{99\%,t-1})$ are but dummy variables equal to 1 if the extreme moves in the oil prices are in the lowest 10-th, 5-th, and 1-st quantiles of the distribution of negative returns or, otherwise, put equal to 0.

Table 3 provides the estimates of the regression for all the considered REIT indices. The coefficient b_1 gauges the hedge potential of the REITs under analysis, whereas the sum of the effects for each quantile, which is $b_1 + b_2$ (10%), $b_1 + b_2$ (10%) + b_2 (5%), and $b_1 + b_2$ (10%) + b_2 (5%) + b_2 (1%) for the 10%, 5%, and 1% quantiles, respectively, measures the corresponding safe-haven propensity. Statistical significance with respect to the last estimated coefficient is duly identified and indicated in Table 3.

Table 3 documents the results of the hedge and safe-haven properties of the analyzed REITs indices at bearish oil market conditions.

For the full sample, we do not identify that any REIT geography is able to act as a hedge against a fall in the oil prices as all hedge ratios b_0 in Table 3 are significantly positive. This implies that none of the REIT indices may be considered as a direct hedge for oil price fall during the studied period. The b_1 (10%) and b_2 (5%) coefficients for most of the REIT indices are positive and not significant, which indicates that the analyzed REIT indices may not be considered as a safe-haven asset against oil price fall at 10% and 5% quantiles. However, we observe that b_3 (1%) is negative (−0.023) and significant at 0.01 for the Italy REIT index, meaning that the Italian REITs exposures may act as a strong safe haven at the extreme bear market conditions proxied here by the 1% quantile.

During the COVID-19 period, the only candidate for the hedge role is the Japan REIT index with b_0 equal to −0.060, significant at 0.01. In what concerns the safe-haven attributes, we observe that b_1 (10%), b_2 (5%) and b_3 (1%) coefficients are predominantly

Table 4
REITs safe-haven and hedge properties during extreme uncertainty.

	Hedge	Safe Haven Quantiles		
	b_0	b_1 (90%)	b_2 (95%)	b_3 (99)
Panel A: Full Sample				
New Zealand	0.094***	**−0.016*****	−0.008**	−0.001**
Germany	0.166***	−0.000	0.000	0.000***
France	0.173***	0.016***	−0.006**	0.000
Hong Kong	0.096***	0.004*	−0.005	−0.004
Italy	0.164***	0.031***	**−0.044*****	**−0.017****
Japan	0.002*	0.023***	−0.011	−0.001
Netherlands	0.205***	0.050***	−0.005	0.001
UK	0.144***	−0.000	−0.001	0.001
Canada	0.267***	−0.000	0.000	0.000*
Australia	0.135***	0.000	0.000	0.000***
US	0.200***	−0.000	−0.000	−0.000
Belgium	0.117***	0.017***	**−0.021*****	−0.012
Singapore	0.126***	0.000***	−0.000**	0.000***
Global	0.212***	0.000**	−0.000	0.000
Panel B: COVID-19				
New Zealand	0.087***	−0.000***	−0.000	−0.000
Germany	0.230***	−0.000	0.000	0.000
France	0.225***	−0.000*	0.000	−0.000
Hong Kong	0.111***	0.012	−0.023	0.032
Italy	0.261***	**−0.083*****	−0.004	0.010
Japan	**−0.060*****	−0.002	0.000	−0.001
Netherlands	0.342***	0.025	0.013	0.009
UK	0.178***	−0.000***	0.000	0.000
Canada	0.298***	−0.001	0.000	0.000
Australia	0.149***	0.000	0.000*	0.000
US	0.290***	**−0.046*****	0.005	0.003
Belgium	0.230***	−0.022	−0.000	0.001
Singapore	0.151***	0.017	0.017	0.013
Global	0.240***	0.000	0.000	0.000
Panel C: Russia-Ukraine conflict				
New Zealand	0.186***	0.003*	0.000	−0.001
Germany	0.002***	0.003*	−0.000	0.000
France	0.037***	−0.044*	0.040	−0.071
Hong Kong	0.131***	0.005	0.012	−0.006
Italy	0.124***	0.009	−0.005	0.002
Japan	0.059***	−0.000***	0.000	−0.000
Netherlands	**−0.082*****	0.023	−0.008	−0.002
UK	0.017***	0.015**	−0.000	−0.000
Canada	0.156***	−0.000	0.000	−0.000
Australia	0.087***	−0.024**	0.014	−0.009
US	0.030*	−0.044	0.173*	−0.144
Belgium	0.001	0.024	−0.001	−0.000
Singapore	0.217***	0.004	0.001	−0.002
Global	0.058***	−0.026	0.168	−0.100

Notes: This table show s the estimates of regression with $b_1 + b_2$ (90%), $b_1 + b_2$ (90%) + b_2 (95%), $b_1 + b_2$ (90%) + b_2 (95%) + b_2 (99%) for quantiles at 90%, 95% and 99%, respectively. The symbols ***, ** and * indicate the level of significance at 0.01, 0.05 and 0.1, respectively.

negative although not significant with only three exceptions: Singapore −0.018 significant at 0.1 at 10% quantile, and Netherlands (−0.031) and Belgium (−0.021), significant at 0.5 and 0.1, respectively, at 5% quantile,. However, at the very extreme bear market conditions, proxied by 1% quantile, we do not observe statistically significant coefficients. Therefore, as all REITs, except the US and New Zealand, are characterized by the negative coefficients, they may be considered as a weak hedge, with the US and New Zealand REITs acting just as diversifiers.

During the Russia-Ukraine military conflict, the only candidate for the hedge role is the Netherlands REIT index with b_0 equal to −0.080, significant at 0.01. In what concerns the safe-haven attributes, we observe that b_1 (10%), b_2 (5%) and b_3 (1%) coefficients are predominantly negative although not significant with only exception for null coefficients for Canada at 10% and 5% quantiles, both significant at 0.1. Similarly to the COVID-19 period, at the very extreme bear market conditions, proxied by 1% quantile, we do not observe statistically significant coefficients. Therefore, for all three considered extreme quantiles, the REITs, characterized by the negative coefficients, may be considered as a weak hedge at the respective quantiles while the REITs indices, resulting in null or positive coefficients, represent quantile-dependent diversifiers.

Overall, we conclude that the analyzed REITs indices can be generally regarded as a weak safe haven for the extreme bearish returns of oil market. The portfolio implications, which could be derived from our results obtained for daily oil extreme returns, is that investors with exposure to oil may opt for investing also in international REITs for a possibility to harvest weak safe-haven benefits, potentially capturable at extreme bearish oil market conditions during severe financial stress events, transversal to financial markets, similar to the COVID-19 pandemic and Russia-Ukraine military hostilities.

In Table 4 we present the estimations of the regression models of Equation (5), applied to distinct degrees of conditional oil price volatility, which are considered to represent a fair approximation for uncertainty. Table 3 shows the estimation outcomes for b_1 and the sum of the impacts for each percentile, which is $b_1 + b_2$ (90%), $b_1 + b_2$ (90%) + b_2 (95%), and $b_1 + b_2$ (90%) + b_2 (95%) + b_2 (99%) for the 90%, 95%, and 99% percentiles, respectively. Statistical significance with respect to the last estimated coefficient is duly identified and indicated in Table 4.

Table 4 contains the uncertainty analysis results, which describe the hedge and safe-haven properties of International REITs within the time intervals characterized by elevated uncertainty in the oil market.

For the full sample, we do not identify that any REIT geography is able to act as a hedge for oil during the periods of elevated uncertainty in the oil prices, as all hedge ratios b_0 in Table 4 are significantly positive. This implies that none of the REIT indices may be considered as a direct hedge for oil during the studied full sample period. However, our outcomes for b_1 (90%) coefficients reveal that there exists one b_1 (90%) coefficient for the New Zealand REIT index, which is negative (−0.016) and significant at 0.01, meaning that the New Zealand REITs exposures may act as a strong safe haven at elevated uncertainty conditions in the oil market, namely above the volatility threshold of 90%. In what concerns b_2 (95%) coefficients, they are mostly negative implying weak safe-haven properties, with only two geographies eligible for the strong safe haven classification. They are Italy (−0.044) and Belgium (−0.021), both significant at 0.01, meaning that the Italy and Belgium REITs exposures may act as a strong safe haven at highly elevated uncertainty conditions in the oil market, namely above the volatility threshold of 95%. In respect of b_3 (99%) coefficients, they are mostly null or negative implying, respectively, diversifier or weak safe-haven properties, with only one Italy REIT index, which is negative (−0.017) and significant at 0.05 and, hence, is eligible for the strong safe-haven classification, meaning that the Italy REITs exposures may act as a strong safe haven at extremely elevated uncertainty conditions in the oil market, namely above the volatility threshold of 99%.

During the COVID-19 period, the only candidate for the hedge role is the Japan REIT index with b_0 equal to −0.060, significant at 0.01. In what concerns the safe-haven attributes, we observe that the outcomes for b_1 (90%), b_2 (95%) and b_3 (99%) coefficients are somewhat spotty and predominantly not statistically significant, with only two exceptions eligible for the strong safe-haven classification above the 90% threshold of volatility: Italy (−0.018) and the US (−0.046), both significant at 0.01.

During the Russia-Ukraine military conflict, the only candidate for the hedge role is the Netherlands REIT index with b_0 equal to −0.082, significant at 0.01. In what concerns the safe-haven attributes, we observe that the outcomes for b_1 (90%), b_2 (95%) and b_3 (99%) coefficients are somewhat spotty and predominantly not statistically significant, with the only coefficient (b_1 (90%)) significant at 0.01, which however is null.

Wrapping up, we infer that the considered REITs indices are more likely to be a weak safe haven or diversifier for oil during the time periods of the elevated uncertainty in the oil market.

As per Tables 3 and 4 we can infer that the analyzed REITs, in general, do not represent hedge opportunities, except for Japan (COVID-19) and Netherlands (Russia-Ukraine conflict), and mostly do not possess strong safe-haven attributes either against falling oil prices or during the period of the elevated volatility in the oil market. Concerning the safe-haven attributes in terms of returns, the exception is Italy, acting as a strong safe haven against oil price fall during the full period at the extreme bearish quantile (see Table 3). In respect of the elevated uncertainty in the oil market, the exceptions are Belgium and Italy, which act as strong safe havens for the whole period above the 90% threshold of volatility whereas Italy and the US act as strong safe havens during the COVID-19 period (see Table 4) above the 95% threshold of volatility.

In what concerns the key empirical findings and the respective conclusion regarding the hedging involving the volatility, they come out of our estimations of the regression models, applied to diverse degree of conditional oil price volatility. We conclude that the Japan REITS act as a hedge for oil during the COVID-19 pandemic and the Netherlands REITs do so during the Russia-Ukraine military. These results are in line with the finding from previous papers. For instance, the conclusion by Mensi et al., 2023, that the Italy and Japan REITs consistently play the role of net recipients in their interrelations with the global factors, including the crude oil price, corroborates our funding that during COVID-19 Japan is a hedge and Italy is a strong safe-haven for oil. In addition, the relatively low absolute net connectedness figures for Germany, Canada, and France always remaining near zero, as documented by Mensi et al., 2023, indicate that the idiosyncratic drivers for REITs from this cluster of countries are rather strong. In line with this conclusion, we also observe that the hedge and the safe-haven quantile-dependent coefficients dwell for these country-specific REITs in the vicinity of zero. Our results also corroborate the previous findings of Mensi, Reboredo, et al., 2022, showing that price spillovers from commodities to REITs and vice versa evolve over time, are crisis-dependent, and volatility regime-dependent. We provide a clear evidence that the hedge and safe-haven attributes of the international REITs vary along the time and depend upon the financial distresses experienced by the markets.

6. Conclusion

This research investigates the hedge and safe haven properties of the fourteen REITs indices during the periods of both, bearish oil market conditions and elevated volatility of the oil market. We analyze REITs from the following geographies: New Zealand, Germany, France, Hong Kong, Italy, Japan, Netherlands, UK, Canada, Australia, US, Belgium, Singapore, and the Global REITs index. Our sample spans from January 2016 until August 2022, covering the Covid-19 pandemics and the ongoing Russia-Ukraine military conflict. The applied methodology is consistent with that from previous works by Glosten et al. (1993), Engle (2002), Cappiello et al. (2006), Baur and Lucey (2010), Low et al. (2016), Abuzayed et al. (2020), Mesi et al., 2021, and Hanif et al. (2022).

We find that REITs, in terms of both returns and volatility, generally do not act as a hedge for oil, except for Japan (COVID-19) and Netherlands (Russia-Ukraine conflict). In addition, the analyzed REITs indices do not possess strong safe-haven attributes neither. Concerning the strong safe-haven properties we still document one quantile-dependent exception, namely Italy, for bearish oil market conditions, and Italy and the US, for the elevated volatility in the oil market. Moreover, we document the existing weak safe-haven and diversification opportunities. Therefore, we conclude that, in general, the REITs do not represent an appropriate hedge for oil, and especially so during severe and global market downturns, when the connectedness between oil and REITs is increased (Mensi et al., 2022a, 2022b).

The implications of our study reveal that if investors search reducing the downside risk of their crude oil investments throughout global financial crises, similar to the COVID-19 global economic meltdown, they may weight to enter in long Japan REITs positions, which worked as a hedge for oil during the COVID-19 pandemic. However, if investors are worried about more localized conflicts involving oil producing countries, such as Russia-Ukraine conflict, they ought to analyze acquiring Netherland REITs exposure, shown to act as a hedge during the Russian invasion of Ukraine.

The results, presented herein, provide important knowledge for investors, policymakers and market regulators, helping them to analyze market risk in crude oil and REITs markets throughout time intervals of financial turmoil and embrace forward looking actions in order to restore, maintain, and enhance business climate, economic environment, and financial stability. For instance, market regulators should focus on controlling volatility in crude oil and REITs markets, especially throughout the times of financial distress.

Our outcomes result in important policy implications for scholars, policymakers, portfolio managers and investing communities. For instance, the REITs and oil market investors must pay close attention to the performance of REITs per geography, as only a few of them may act as a hedge or strong safe haven, and, thus, such country-specific REITs exposures should be introduced into oil investment portfolios to hedge their downside risks, allowing for the improved hedging and portfolio management. Moreover, market regulators and investors should be aware that the role of the REITs exposures vis-à-vis oil investments may vary along the time, depending of the major stress events in the global financial markets. Hence, continuous portfolio rebalancing is highly advisable to account for major financial and economic stresses. Moreover, investors, portfolio managers, and market regulators should duly monitor evolving volatility of oil market, as daily return volatility monitoring is a pivotal requirement for optimized investment management as also highlighted in recent research (Salisu et al., 2023).

It is worth noting that high volatility of the crude oil price represents an indicative measure of elevated uncertainty in the market. We posit that oil market uncertainty episodes may be partly related to the increasing ESG consciousness and to the tightening of the regulatory requirements regarding sustainable development (Gubareva, Umar, Teplova, & Antonyuk, 2023). As the result of several measures undertaken by policymakers, the growing usage of greener technologies and renewable energy sources, may potentially threaten the role of the oil as major driving factor of the global economy. Henceforth, this line of research, in the next future, may include analyses of the interrelations between the REITs, green REITs, and the renewable energies.

Data availability

Data will be made available on request.

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