Executive Summary

In this group assignment, we seek to hedge our client's price risk exposure to Oman stocks. To do so, we obtained data on the futures contracts on 3 MSCI indices to construct our hedge. The 3 contracts we selected were: (1) the Qatar futures contract; (2) the United Arab Emirates (UAE) futures contract; and (3) the Saudi Arabia futures contract. These futures contracts were chosen based on how much each listed country's economy shared similar traits with Oman's economy. We experimented with 2 hedging strategies which were, namely, "naïve" hedging and optimal hedging.

- **"Naïve" hedging**: Finding the number of contracts that most closely match the dollar value of the portfolio on a given day. The number of contracts changes each day therefore, and is based on the formula $N_t = V_{A,t} / (Q_F * F_t)$.
- **Optimal hedging:** We used the hedge ratio formula instead of regression to come up with an estimated hedge ratio because we made use of a 260 trading day rolling window, which would have otherwise made regression highly repetitive and take up too much manual computational efforts within Excel. The optimal hedge ratio is the ratio of the hedge instrument position to the underlying asset position that minimizes the variance of the portfolio. In this case, the hedge instrument position is referring to the position we take with regards to the futures contracts. The hedge ratio h_t was derived using h_t = Correlation(Daily Change in Spot Price of Oman, Daily Change in Futures Price) * SD of Daily Change in Spot Price of Oman * SD of Daily Change in Futures Price / Variance of Daily Change in Futures Price. We used the Excel functions CORREL and STDEV to get our h_t value from the first trading day of 2022, to the last trading day of 2022, maintaining a rolling window of 260 trading days of past data throughout. The number of contracts changes each day, but is now based on the formula $N_t = h_t * Q_A / Q_F$, where Q_A and Q_F are fixed values that do not change with time.

Based on the "naïve" hedging strategy and optimal hedging strategy, both suggest that the best contract is the Saudi Arabia futures. Based on the optimal hedging strategy, the worst contract is the UAE futures contract, whereas based on the "naïve" hedging strategy, the worst contract is the Qatar futures contract.

Analysis Task 1: For each contract, state why you think this contract will offer the best hedge.

<u>*Contracts selected:*</u> Qatar, UAE, Saudi Arabia.

<u>*Justification:*</u> The contracts were chosen because they shared similar traits with Oman.

For Qatar, it is similar to Oman in the sense that both Qatar and Oman have ***substantial oil and natural gas reserves*** which act as key drivers for their economies. This is evident as ***oil and gas account for around 70% of Oman's government's revenue and 30% of its GDP*** (International Trade Administration, 2022). On the other hand, ***Qatar's oil and gas accounts for 37% of its GDP*** (International Trade Administration, 2022) ***and 50% of its government revenue*** (Enterprise Singapore, 2023). Moreover, both Qatar and Oman are ***major exporters of energy resources*** and both have ***oil contributing to a significant proportion of their exports as 60% of Oman's total exports comprise oil and gas*** (World Trade Organisation, n.d.) while ***Qatar's main export is oil at 90% of its total exports*** (International Trade Administration, 2022).

For UAE, is similar to Oman in the sense that ***both are energy exporters who contribute significantly to their economy*** as ***oil and gas account for around 70% of Oman's government's revenue and 30% of its GDP*** (International Trade Administration, 2022). UAE on the other hand has ***30% of its revenue derived from oil and gas*** (International Trade Administration, 2022) ***and 30% of UAE's GDP*** (International Trade Administration, 2022) comes directly from oil and gas. Both believe in ***economic diversification away from their heavy reliance on hydrocarbons*** to different sectors. ***60% of Oman's total exports comprise oil and gas*** (World Trade Organisation, n.d.) whereas, ***UAE largely has exports comprising oil and gas account for 13%*** (International Trade Administration, 2022).

For Saudi Arabia, it is similar to Oman in the sense that both have ***substantial oil reserves for oil and natural gas***. Both are ***energy exporters of energy*** with ***Oman having 60% of its exports coming from oil and gas*** while ***Saudi Arabia is at 60%*** (World Trade Organisation, n.d.). ***30% of Oman's GDP comes from oil and gas while that of Saudi is at 26.2%*** (World Trade Organisation, n.d.).

Analysis Task 2: What do you think explains the difference in the hedged portfolio returns of the best and worst hedging instruments?

DATA TASK 6

Disclaimer: Average and SD considers the period from 4 Jan 2022 to 30 Dec 2022. It ignores 3 Jan 2022, the first trading day of the year.

	Portfolio Returns Oman-UAE	Portfolio Returns Oman-Saudi Arabia	Portfolio Returns Oman-Qatar
Arithmetic Average	0.001177518	0.001167139	0.001230367
Standard Deviation	0.015894951	0.015156504	0.016719201

Therefore, the **best contract** to hedge Oman risk would be **Saudi Arabia** by lowest SD and closest average to zero.

The **worst contract** to hedge Oman risk would be **Qatar** by criteria of highest SD and furthest average from zero.

Fig 1: Naive Hedging suggests Saudi Arabia has the best contract and Qatar has the worst contract

We have defined our criteria based on the notion that daily average returns should oscillate around zero to reflect best practices of hedging strategies. The less volatile the oscillation, the more stable the trajectory of the net hedged portfolio value.

Best Hedged portfolio: Oman-Saudi Arabia

This is because it has an arithmetic average of 0.001167139 which is **closest to zero** comparing the 3 contracts, and also happens to have the **lowest standard deviation** of 0.015156504.

Worst Hedged portfolio: Oman-Qatar

This is because it has an arithmetic average of 0.001230367 which is the **furthest from zero** comparing the 3 contracts, and also happens to have the **highest standard deviation** of 0.016719201.

How we determined the best hedge was as follows: The portfolio must have its arithmetic average closest to zero and if possible, the portfolio should also have the lowest standard deviation as we seek to find a hedge that has the highest certainty.

The reason why Oman-Qatar could be the worst hedged portfolio among the 3 hedged portfolios, is because, the MSCI Qatar index has a ***more concentrated composition*** because the index is dominated by a ***small number of large companies***, and the total number of constituents stands at ***13***, versus the MSCI Saudi Arabia index's ***42***. This leads to ***higher volatility*** if those companies or sectors experience significant price swings from idiosyncratic- or sector-related risks. The MSCI Saudi Arabia index is ***more diversified*** (42 constituents), helping to ***spread risk and reduce volatility***.

INDEX CHARACTERISTICS

	MSCI Qatar
Number of Constituents	13
	Mkt Cap (USD Millions)
Index	59,966.77
Largest	19,538.60
Smallest	1,516.94
Average	4,612.83
Median	2,594.89

TOP 10 CONSTITUENTS

	Float Adj Mkt Cap (USD Billions)	Index Wt. (%)	Sector
QATAR NATIONAL BANK	19.54	32.58	Financials
QATAR ISLAMIC BANK	8.43	14.06	Financials
INDUSTRIES QATAR	5.70	9.50	Industrials
COMMERCIAL BANK OF QATAR	4.80	8.01	Financials
AL RAYAN BANK	3.42	5.70	Financials
QATAR FUEL CO	2.70	4.51	Energy
QATAR INTL ISLAMIC	2.59	4.33	Financials
QATAR GAS TRAN (NAKILAT)	2.55	4.25	Energy
OOREDOO	2.35	3.92	Comm Srvcs
MESAIEED PETROCHEMICAL	2.24	3.74	Materials
Total	54.33	90.60	

Fig 2: MSCI Qatar's index description

Source: MSCI website, 2023

INDEX CHARACTERISTICS

	MSCI Saudi Arabia
Number of Constituents	42
	Mkt Cap (USD Millions)
Index	269,968.68
Largest	35,484.81
Smallest	1,109.91
Average	6,427.83
Median	3,339.44

TOP 10 CONSTITUENTS

	Float Adj Mkt Cap (USD Billions)	Index Wt. (%)	Sector
AL RAJHI BANKING & INV	35.48	13.14	Financials
SAUDI NATIONAL BANK	25.71	9.52	Financials
SAUDI ARAMCO	24.84	9.20	Energy
SAUDI TELECOM CO	20.05	7.43	Comm Srvcs
SAUDI BASIC IND CORP	19.80	7.33	Materials
SAUDI ARABIAN MINING CO	13.90	5.15	Materials
RIYAD BANK	10.88	4.03	Financials
SAUDI BRITISH BANK	9.26	3.43	Financials
ALINMA BANK	8.73	3.23	Financials
SABIC AGRI-NUTRIENTS	8.27	3.06	Materials
Total	176.93	65.54	

Fig 3: MSCI Sadi Arabia's index description

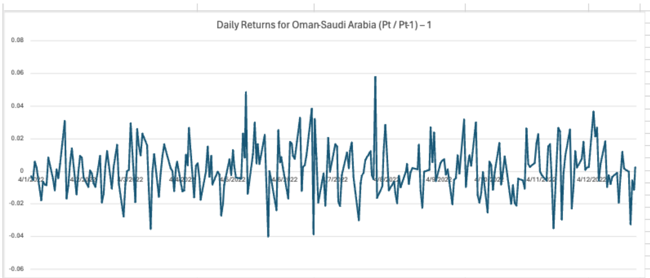
Source: MSCI website, 2023

Furthermore, the reason why Oman-Saudi Arabia could be the best-performing hedge is that ***Saudi Arabia shares a border of 676km with Oman*** (Confidus Solutions, 2018), making it ***more directly involved in Oman's security dynamics***. Qatar, on the other hand, is ***geographically separated from Oman by the United Arab Emirates*** (The World Factbook, 2022), which could make it ***less directly influential in Omani affairs***.

Additionally, ***Qatar has a higher level of political risk*** than Saudi Arabia. Qatar has been involved in a number of ***regional disputes*** in recent years, including the ***ongoing blockade by Saudi Arabia*** (Kabbani, 2021), the ***sanctions from the United Arab Emirates*** (United Nations, 2023), ***Qatar-Bahrain Rift*** (Gulf International Forum, 2022), and Egypt (ISPI, 2022). This ***political risk makes Qatari assets less attractive to investors***, and it can lead to ***increased volatility*** in the Qatari futures market.

Analysis Task 3: What explains the poor returns identified in Data Task 7?

We note that the worst performing days were 16 March, 25 May, and 21 June in 2022.



Date	Daily Returns for Oman-Saudi Arabia (Pt / Pt-1) – 1
25/5/2022	-0.039985606
21/6/2022	-0.038349104
16/3/2022	-0.035201495
11/11/2022	-0.035025733
27/12/2022	-0.032221504

Fig 4: Distribution plot of best performing Hedged Portfolio - Oman-Saudi

Fig 5: Table depicting worst performing days for Oman-Saudi hedged portfolio

16 Mar 2022:

The BBC published an article (BBC, 2022) addressing the controversy surrounding the decision to turn to Saudi Arabia as a source of oil. This choice comes as a response to the U.S., UK, and EU's joint announcement to reduce their reliance on Russian oil and gas due to Russia's invasion of Ukraine, resulting in a significant surge in oil prices. Saudi Arabia, being the largest producer within the OPEC oil cartel, possesses the spare capacity to stabilize prices by increasing its oil supplies. However, opting to buy oil from Saudi Arabia raises concerns as the nation has faced ***substantial criticism for its military involvement in Yemen***, leading to a ***severe humanitarian crisis***.

In 2015, a Saudi-led coalition intervened in Yemen following the rebels' takeover of a substantial part of the country, forcing the president to seek refuge abroad. The conflict has reportedly claimed the lives of over 100,000 people, with tens of thousands more succumbing to indirect consequences, including food shortages, inadequate healthcare, and infrastructure damage. This article has cast a ***negative spotlight*** on Saudi Arabia, which may ***impact its revenue from oil exports***, consequently affecting its overall economic and market performance. Such repercussions may have played a role in the poor performance of the hedged portfolio on March 16, 2022.

25 May 2022:

Growing diplomatic friction over jailed human rights activists (Cecco, 2018) (Baker, 2018). between Saudi Arabia and Canada has the potential to adversely affect their economic ties (Robertson, 2023). Trade and economic interests remain a vital aspect of Canada's bilateral relationship with Saudi Arabia. In 2022, ***Saudi Arabia stood as Canada's foremost trading partner*** in the Middle East and North Africa (MENA) region and ranked 23rd globally (Government of Canada, 2023). This ***escalating diplomatic tension*** may have contributed to market expectations of a ***deterioration in Saudi Arabia's economic conditions***, ultimately leading to a poor performance of the hedged position on May 25, 2022.

21 Jun 2022:

French President Emmanuel Macron's meeting with Saudi Crown Prince Mohammed bin Salman has come under ***criticism from ten non-governmental organizations***. They argue that this meeting may serve to ***obscure Saudi Arabia's troubling human rights record*** and could potentially ***contribute to further human rights abuses*** (European Saudi Organisation for Human Rights, 2023). These organizations are also urging France to reconsider its support for Saudi Arabia's bid to host Expo 2030. Holding Expo 2030 in Riyadh presents a significant opportunity for the Kingdom to showcase its remarkable economic and social transformation to an expected audience of 40 million visitors and over 1 billion virtual followers since the launch of its Vision 2030 on April 25, 2016. This event provides a platform to highlight the historical and cultural richness of the Kingdom and its capital, Riyadh.

Additionally, it serves as an excellent opportunity to underscore the city's political and economic significance, its exceptional geographical location, and its well-developed infrastructure, all of which make it well-suited to host major international events. Lastly, the exhibition will offer visitors the chance to explore Riyadh's prominent landmarks and significant projects, including Riyadh Sports Boulevard, King Salman Park, Diriyah Gate, and Qiddiya Amusement Park (Hafiz, 2023). Therefore, ***if Saudi Arabia were to fail in its bid*** to host Expo 2030, it could result in a ***loss of investor confidence in the country***. This, in turn, may have played a role in ***shaping market expectations of a weakened Saudi Arabian economy***, ultimately leading to a less favourable performance of the hedged position on June 21, 2022.

Analysis Task 4: What do you think explains the difference in the hedged portfolio returns of the best and worst hedging instruments?

DATA TASK 9

Disclaimer: Average and SD considers the period from 4 Jan 2022 to 30 Dec 2022. It ignores 3 Jan 2022, the first trading day of the year.			
	Portfolio Returns Oman-UAE	Portfolio Returns Oman-Saudi Arabia	Portfolio Returns Oman-Qatar
Arithmetic Average	0.000861554	0.000431394	0.000494246
Standard Deviation	0.009566366	0.01427022	0.013793165

Therefore, the **best contract** to hedge Oman risk would be **Saudi Arabia** by closest average to zero.

The **worst contract** to hedge Oman risk would be **UAE** by criteria of furthest average from zero.

Fig 6: Optimal Hedging suggests Saudi Arabia has the best contract and UAE has the worst contract

We will first list down the best and worst hedged portfolios, and then explain why below.

Best Hedged portfolio: Oman-Saudi Arabia

This is because it has an arithmetic average of 0.000431394 which is closest to zero.

Worst Hedged portfolio: Oman-UAE

This is because it has an arithmetic average of 0.000861554 which is the furthest from zero.

We determined that the best hedge in our case would be the portfolio that has its ***arithmetic average closest to zero*** as we seek to find a hedge that has the highest certainty. We were ***not able to rely on standard deviation*** (SD) in this case because that would lead to an indecision point with regards to choosing Oman-Qatar (O-Q) or Oman-Saudi Arabia (O-S) since O-Q has a lower SD compared to O-S.

MIN CORREL	MAX CORREL	
-0.1445726	0.08493302	**Oman-UAE**
0.01779183	0.16985314	**Oman-Saudi**
0.00680715	0.16131006	**Oman-Qatar**

Fig 7: Minimum and Maximum Correlation Values for the 3 Hedged Portfolios

Furthermore, the correlation between the underlying asset and the hedging instrument is such that ***the higher the correlation***, ***the more effective the hedging instrument will be in reducing risk***. As we can see from the figure above (refer to Fig 6), the best hedging instrument for Oman's risk is Saudi Arabia, which has a highest range of correlation with Oman (refer to Fig 7). The worst hedging instrument is the UAE, which has the lowest range of correlation with Oman.

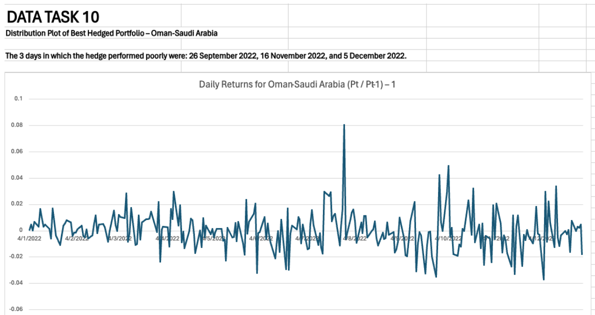
Trade and investment ties. Oman and Saudi Arabia have ***close trade and investment ties***. For example, Saudi Arabia is one of ***Oman's 5th largest trading partners*** trading goods worth $2.34B in 2021 (OEC, 2023) and in 2022, trade between the two nations surged by 123 per cent compared to the previous year, reaching $7.01 billion (Arab News, 2023). Additionally, ***Saudi Arabian investors intend to make significant investments in Oman's economy*** with Saudi Arabia's Sovereign Wealth Fund aiming for $5 Billion in Investments in Oman (Masood, 2023) and Saudi Arabia's Public Investment Fund (PIF) launched a new venture that will invest $3 billion in developing tourism and infrastructure (Yaakoubi et al., 2021). These ***close trade and investment ties*** mean that the two economies are closely linked.

Geographically, Saudi Arabia shares a border of 676km with Oman (Confidus Solutions, 2018) making it ***more geographically connected to Oman*** than the UAE which is separated from Oman by the Strait of Hormuz and the Gulf of Oman (NASA, 2022). ***Proximity can facilitate cross-border trade and financial transactions***.

The robust trade and investment connections between Oman and Saudi Arabia, coupled with their close proximity, may account for the Oman-Saudi Arabia portfolio having its arithmetic average closest to zero. In contrast, Oman and the UAE lack the same geographical proximity, potentially contributing to the relatively weaker performance of the hedged Oman-UAE portfolio in terms of having furthest arithmetic average from zero.

Analysis Task 5: What explains the poor returns identified in Data Task 10?

We note that the worst performing days were 26 Sep, 16 Nov and 5 Dec in 2022.



Date	Daily Returns for Oman-Qatar (Pt / Pt-1) – 1
5/12/2022	**-0.036850881**
26/9/2022	**-0.035080824**
16/11/2022	**-0.033026461**
19/9/2022	-0.032329721

Fig 8: Distribution plot of best performing Optimal Hedged Portfolio - Oman-Saudi

Fig 9: Table depicting worst performing days for Oman-Saudi hedged portfolio

26 Sep 2022: The Federal Reserve's efforts to ***combat inflation by raising interest rates*** (Cohen, 2022) in the United States are having ***far-reaching global consequences***. The ***strong dollar*** resulting from these rate hikes is causing ***economic turmoil in Saudi Arabian countries***, impacting trade, ***increasing the cost of essential imports***, and ***raising the risk of defaults*** in debt-ridden nations. The global economic repercussions of the strong dollar could ***increase uncertainty and economic instability***. Saudi Arabia may face ***challenges in attracting foreign investment and managing its fiscal and monetary policies*** due to the uncertain global economic environment. The strong dollar and rising interest rates may discourage foreign investment in emerging markets, including Saudi Arabia. Investors may ***favour the safety and higher returns in the United States***, leading to ***capital outflows from Saudi Arabia***. As a major oil producer, Saudi Arabia's economy is closely tied to oil prices. A ***strong dollar can put downward pressure on oil prices***, affecting Saudi Arabia's revenue and budgetary planning.

16 Nov 2022: Saudi Arabia, the world's largest oil exporter, is shifting its stance on climate change at COP27 (Bloomberg, 2022). The country is ***advocating for the coexistence of oil production and emissions reduction***, emphasising that it can continue to pump oil while reducing emissions. Saudi Arabia and the United Arab Emirates (UAE) have set ambitious targets to achieve net-zero emissions by 2060 and 2050, respectively, and are investing heavily in renewable energy. This shift in stance comes in the context of changing global dynamics, including the global energy crisis caused by Russia's invasion of Ukraine. This ***change in strategy may lead to a less favourable position in the Saudi Arabia hedge*** because ***the world is shifting towards renewable energy and reduced reliance on fossil fuels***. It could affect Saudi Arabia's long-term energy market strategies. Saudi Arabia's opposition to phasing down unabated coal power and its commitment to producing hydrocarbons until the end of the century may draw ***criticism from environmentally conscious nations and organisations***. This may ***undermine their returns for their oil*** which may affect revenues in the short-run.

5 Dec 2022:

Claudio Galimberti, the Senior Vice President of Analysis at the energy consultancy Rystad, mentioned to CNBC on December 2, 2022, that there have been ***rumours about OPEC+ contemplating a production cut due to concerns about weakening demand***, particularly in China, in recent days (Meredith, 2022). This speculation might have ***led the market to anticipate a decline in Saudi Arabia's oil export earnings*** and, as a result, a ***poor performance in the Saudi Arabian market***. Consequently, this could have had a ***ripple effect***, contributing to the poor performance of the Oman-Saudi Arabia hedged portfolio on December 5, 2022.

Analysis Task 6: How does the hedge using the hedge ratio compare to the hedge using a naive dollar-matching strategy?

Based on the optimal hedging approach, the MSCI Saudi Arabia futures contract is the most suitable for hedging, while the naïve dollar-matching strategy also selects the same contract. However, the optimal hedging approach finds the UAE contract to be the least effective for hedging, while the naïve hedging dollar-matching strategy finds the Qatar contract to be the least effective for hedging.

In general, the hedge ratio is a better hedging strategy than the naïve dollar-matching strategy as the hedge ratio considers the correlation between the underlying asset and the hedging instrument, as well as the volatility of each asset. Suppose an investor has a portfolio of stocks that is exposed to the risk of a decline in the stock market. The investor wants to hedge this risk by shorting futures contracts on a stock market index. The hedge ratio would tell the investor how many futures contracts to short or long (depending on whether the ratio is negative or positive) in order to minimise the risk of the portfolio. The naïve hedging dollar-matching strategy would simply tell the investor to go long or go short (position is taken based on logical conclusions via market research) a fixed dollar amount of the futures contracts. If the stock market declines, the value of the investor's stock portfolio will decline. However, the value of the futures contracts will increase. This will offset some of the losses in the stock portfolio. The hedge ratio will offset more of the losses in the stock portfolio than the naïve hedging dollar-matching strategy. This is because the hedge ratio takes into account the correlation between the stock market index and the futures contracts. As a result, the investor's portfolio will be less risky with the hedge ratio than with the naïve hedging dollar-matching strategy.

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