Analysis report on hedging for foreign exchange exposure risk

Weyland Yutani

Shiyu Hua

Introduction of the problem

The ordered robotic machinery we acquired costs for £ 23,000,000 in pounds sterling, and the payment is due one year from now on March 16, 2021. However, the payment is exposed to foreign exchange exposure risk. The currency market has high volatility during the last 12 months because of the uncertainty about the Brexit. Therefore, it should be discussed whether to hedge this payment or not to reduce the exchange exposure risk and avoid losses.

Analysis of different hedging alternative with valuations and risks /rewards

1. *Remain unhedged.*

Not all the risk worth the hedge. We can choose to remain unhedged for this payment. Depending on the different exchange rate, the dollar cost for the machinery differs. The cost for acquiring the machinery will increase as the exchange rate increases, meaning we will pay more for the machinery if the pound sterling gets stronger or the dollar depreciates against the pound. Table on the right shows the dollar cost for acquiring the machinery with each $/£ exchange rate.

$/£ exchange rate	$ Dollar Cost (for acquire the machinery)
1.15	$ 26,450,000.00
1.20	$ 27,600,000.00
1.25	$ 28,750,000.00
1.30	$ 29,900,000.00
1.35	$ 31,050,000.00
1.40	$ 32,200,000.00
1.45	$ 33,350,000.00
1.50	$ 34,500,000.00

2. *State street forward hedge.*

Another way to hedge is hedge through the forward contract. By entering a forward contract today at State Street Bank, we locks on the forward exchange rate to pay the pound cost. The bank will deliver the payment £ 23,000,000 at the maturity of the contract. And for now, we need to pay the dollar amount of the total payment at the forward exchange rate. Since our company is the market taker buying the forward contract, we can only take the least advantageous rate from the bank. Thus, the forward rate is *1.3127 $/£*, conducted by adding the forward premium point 0.0142 to the spot price 1.2985. The dollar cost of the machinery is *$ 30,192,100*.

$/£ forward contract exchange rate	1.3127
$ Cost (for acquire the machinery)	$ 30,192,100.00

3. Money market hedge.

We can also choose to hedge through money market. To hedge through money market, we need to borrow dollar amount today and exchange into pound sterling. Then, we put the pound in a deposit account in UK bank for a year to grow to the final payable amount £ 23,000,000. We also need to pay interest on the dollar amount borrowed. After careful calculation, we need to borrow $ 29,584,447.75 and exchange into £ 22,783,556.22 through the spot exchange rate 1.2985 $/£. We can earn interest on the pound for a year with an interest of 0.95%. We also need to pay interest of 1.99% on the dollar amount borrowed. We are the market taker so we can only take the less advantageous rates. Finally, the effective exchange rate would have to pay is **1.2853 $/£**, and the dollar cost of the machinery is **$ 30,173,178.26**.

Spot	GBP LIBOR	Account payable
£ 22,783,556.22	0.95%	£ 23,000,000.00
Spot exchange rate		Forward Exchange rate
1.2985 $/£		1.2853 $/£
Borrowing need	USD LIBOR	Dollar cost
$ 29,584,447.75	1.99%	$ 30,173,178.26

4. Futures

Futures hedge is also a method. We can exchange the FX futures at Chicago Mercantile Exchange group (CME group). Each contract is 62,500 British pounds so we need 368 futures contracts. We hedge through the futures to protect the company from strong pound sterling and expensive payment. Then we need to buy the 368 futures contracts for March 2021 today with the initial margin $2,970 to post. We hold the futures contracts for one year and keep the maintenance margin $2,700 with cash. Then we sell the futures contracts 2 business day before we need to pay the account payable for the machinery. Finally, we buy the spot pound sterling for £ 23,000,000. Even if the pound sterling gets stronger and we need to pay more dollars, we gain profit from selling the futures contract and that compensates for the expensive cost.

5. Options

We can also hedge the risk through option. We call the Bank of New York Mellon (BNYM) and ask for one year call option with a strike price of 1.3125$/£. The call premium asked by the bank is 5.67% of the dollar amount at the exercise price. No matter the option will be exercised or not, the call premium is the cost for choosing to hedge through option.

Using the Black-Scholes model, we calculate the implied volatility of the BNYM option premium to be **11.1%** (Appendix 1). We also found out the historical volatility of spot $/£ prices

over the past three months, six months, and past year. We gather the data from Yahoo Finance[1] and calculate the annualized historical volatility. The annualized volatility over past three months is **22.06%** (Appendix 2). The annualized volatility over past six months is **16.02%** (Appendix 3). The annualized volatility over the past year is **12.52%** (Appendix 4). Lastly, the current actual quotations for one year implied volatility is **16.27%** (Appendix 5), gathered from the BPVIX on Yahoo Finance[2].

Comparing the actual historical volatility and implied volatility with the BNYM option implied volatility, we found out that the volatility the BNYM call option is underpriced. The actual volatility is higher than expected due to the uncertainty around the world with the COVID-19. Thus the underlying option is relatively cheap, and attractive to long the call option.

Finally, we evaluate the overall hedged results using the call option. The call option will put the company in a losing situation if the exchange rate is lower than the strike price exchange rate 1.3125$/£. The call option will not be exercised and we still need to pay 5.67% of the dollar amount as call premium. The call option will benefit the company for paying less if the exchange rate exceeds the strike price exchange rate 1.3125$/£. The hedge strategy will works out if the exchange rate is relatively high. When the exchange rate is high, if we do not hedge with option, we need to pay a large amount of dollar amount for the machinery. But if we do hedge with the call option, the call option will be exercised when the exchange rate exceeds the strike price; and we will get option compensation. Therefore, when exchange rate is high as 1.50 $/£, it works out best for the company if we hedged with the call option. The spot exchange rate is much higher than the exercise price exchange rate. We gain a lot option compensation and reduce the dollar cost amount to as like paying for exchange rate at 1.3125$/£ plus a call premium. We saved $2,600,868.75. The following table shows the risk and reward under each exchange rate scenario:

$/£ exchange rate	Exercise call or not	$ cost before option	option compensation	call price	$ cost after exercising option
1.15	No	$ 26,450,000.00	$ -	$1,711,631.25	$ 28,161,631.25
1.2	No	$ 27,600,000.00	$ -	$1,711,631.25	$ 29,311,631.25
1.25	No	$ 28,750,000.00	$ -	$1,711,631.25	$ 30,461,631.25
1.3	No	$ 29,900,000.00	$ -	$1,711,631.25	$ 31,611,631.25
1.35	Yes	$ 31,050,000.00	$ 862,500.00	$1,711,631.25	$ 31,899,131.25
1.4	Yes	$ 32,200,000.00	$ 2,012,500.00	$1,711,631.25	$ 31,899,131.25
1.45	Yes	$ 33,350,000.00	$ 3,162,500.00	$1,711,631.25	$ 31,899,131.25
1.5	Yes	$ 34,500,000.00	$ 4,312,500.00	$1,711,631.25	$ 31,899,131.25

[1]GBPUSD currency, Yahoo Finance, https://finance.yahoo.com/quote/GBPUSD%3DX?p=GBPUSD%3DX
[2] BPVIX, Yahoo Finance, https://finance.yahoo.com/quote/%5EBPVIX?p=^BPVIX&.tsrc=fin-srch

Recommendation

      We recommend to choose the money market hedge for this foreign payment, to reduce the exchange rate exposure risk.

      After evaluating each hedging alternatives, we conclude that it works out best if we choose to hedge through the Money market. If we choose not to hedge the risk, the risk of stronger pound sterling is too big and costly. The forward contract hedge is not ideal because the forward contract exchange rate is higher than the expected exchange rate from the money market. We will pay more dollar amount if we choose the forward contract hedge rather than money market hedge. The option hedge is not worth taking because we will paying more if the pound sterling exchange rate does not exceed the strike exchange rate. Although the BNYM option is underpriced and cheap to long a call, the call premium is not an evitable cost. The option hedge works out best if the exchange rate rises far more than expected. From the money market, we can tell that the expected exchange rate is not relative high, even lower than the strike price. Therefore, if we choose to hedge through the money market, we will pay the relatively low dollar cost for the machinery.

Appendix

Appendix 1. Implied volatility of BNYM option premium

	Inputs			% of $ Amount
Spot Rate ($/£)	1.2985	Call Price =		5.67%
Strike price ($/£)	1.3125			
volatility (annualized)	11.10%	Put Price =		5.71%
US interest rate (annualized)	1.990%			
Sterling interest rate (annualized)	0.950%			
time to maturity in days (365 day year)	365			
time to maturity in years	1.00			

Appendix 2. Historical annualized volatility over past three months

Date	Close	Adj Close	Volume		interday return
3/17/2020	1.226663	1.226663	0		-0.986676
3/18/2020	1.212165	1.212165	0		-0.985502
3/19/2020	1.162534	1.162534	0		-0.950369
3/20/2020	1.149439	1.149439	0		-0.986905
3/23/2020	1.162304	1.162304	0		-1.012865
3/24/2020	1.159555	1.159555	0		-0.997251
3/25/2020	1.179204	1.179204	0		-1.019649
3/26/2020	1.185115	1.185115	0		-1.005911
3/27/2020	1.220063	1.220063	0		-1.034948
3/30/2020	1.245319	1.245319	0		-1.025256
3/31/2020	1.237164	1.237164	0		-0.991845
4/1/2020	1.239065	1.239065	0		-1.001901
				volatility	1.39%
				annulized volatility	22.06%

Appendix 3. Historical annualized volatility over past six months

Date	Close	Adj Close	Volume		interday return
3/16/2020	1.239987	1.239987	0		-1.017037
3/17/2020	1.226663	1.226663	0		-1.013324
3/18/2020	1.212165	1.212165	0		-1.014498
3/19/2020	1.162534	1.162534	0		-1.049631
3/20/2020	1.149439	1.149439	0		-1.013095
3/23/2020	1.162304	1.162304	0		-0.987135
3/24/2020	1.159555	1.159555	0		-1.002749
3/25/2020	1.179204	1.179204	0		-0.980351
3/26/2020	1.185115	1.185115	0		-0.994089
3/27/2020	1.220063	1.220063	0		-0.965052
3/30/2020	1.245319	1.245319	0		-0.974744
3/31/2020	1.237164	1.237164	0		-1.008155
4/1/2020	1.239664	1.239664	0		-0.9975
				volatility	1.01%
				annualized volatility	16.02%

Appendix 4. Historical annualized volatility over past year

Date	Close	Adj Close	Volume		interday return
3/18/2020	1.212165	1.212165	0		-1.014498
3/19/2020	1.162534	1.162534	0		-1.049631
3/20/2020	1.149439	1.149439	0		-1.013095
3/23/2020	1.162304	1.162304	0		-0.987135
3/24/2020	1.159555	1.159555	0		-1.002749
3/25/2020	1.179204	1.179204	0		-0.980351
3/26/2020	1.185115	1.185115	0		-0.994089
3/27/2020	1.220063	1.220063	0		-0.965052
3/30/2020	1.245319	1.245319	0		-0.974744
3/31/2020	1.237164	1.237164	0		-1.008155
4/1/2020	1.239096	1.239096	0		-0.998068
				volatility	0.79%
				annualized volatility	12.52%

Appendix 5. Quotation of one year $/£ implied volatility

CBOE/CME FX British Pound Volat (^BPVIX)
Chicago Options - Chicago Options Delayed Price. Currency in USD

16.27 -0.02 (-0.12%)
As of 2:35PM EDT. Market open.

Summary Chart Conversations Historical Data Options Components

Previous Close	16.29	Day's Range	15.74 - 16.70
Open	16.62	52 Week Range	15.74 - 16.70
Volume	0	Avg. Volume	N/A