Topic 5: Transaction Exposure *Solutions*

1. How would you define transaction exposure? How is it different from economic exposure?

Transaction exposure is the sensitivity of realized domestic currency values of the firm's contractual cash flows denominated in foreign currencies to unexpected changes in exchange rates. Unlike economic exposure, transaction exposure is well defined and short-term.

2. Discuss and compare hedging transaction exposure using the forward contract vs. money market instruments. When do the alternative hedging approaches produce the same result?

Hedging transaction exposure by a forward contract is achieved by selling or buying foreign currency receivables or payables forward. On the other hand, money market hedge is achieved by borrowing or lending the present value of foreign currency receivables or payables, thereby creating offsetting foreign currency positions. If the interest rate parity is holding, the two hedging methods are equivalent.

3. Suppose your company has purchased a put option on the German mark to manage exchange exposure associated with an account receivable denominated in that currency. In this case, your company can be said to have an 'insurance' policy on its receivable. Explain in what sense this is so. *

Your company in this case knows in advance that it will receive a certain minimum dollar amount no matter what might happen to the $/DM exchange rate. Furthermore, if the German mark appreciates, your company will benefit from the rising mark.

4. Should a firm hedge? Why or why not? *

In a perfect capital market, firms may not need to hedge exchange risk. But firms can add to their value by hedging if markets are imperfect. First, if management knows about the firm's exposure better than shareholders, the firm, not its shareholders, should hedge. Second, firms may be able to hedge at a lower cost. Third, if default costs are significant, corporate hedging

can be justifiable because it reduces the probability of default. Fourth, if the firm faces progressive taxes, it can reduce tax obligations by hedging which stabilizes corporate earnings.

5. Cray Research sold a super computer to the Max Planck Institute in Germany on credit and invoiced €10 million payable in six months. Currently, the six-month forward exchange rate is €1.05/$ and the foreign exchange advisor for Cray Research predicts that the spot rate is likely to be €1.10/$ in six months.

(a) What is the expected gain/loss from the forward hedging?

Expected gain/loss ($) = 10,000,000/1.05 – 10,000,000/1.10

= 9,523,809.52 – 9,090,909.09 = 432,900.43 gain

(b) If you were the financial manager of Cray Research, would you recommend hedging this € receivable? Why or why not?

There is no easy answer here. Hedging is expected to increase the dollar receipt by $*432,900*. Remember this analysis is conducted ex-post. It depends on the degree of my risk aversion.

(c) Suppose the foreign exchange advisor predicts that the future spot rate will be the same as the forward exchange rate quoted today. Would you recommend hedging in this case? Why or why not?

Since I eliminate risk without sacrificing dollar receipt, I would be more likely to hedge.

6. You plan to visit Geneva, Switzerland in three months to attend an international business conference. You expect to incur the total cost of CHF 5,000 for lodging, meals and transportation during your stay. As of today, the spot exchange rate is $0.60/CHF and the three-month forward rate is $0.63/CHF. You can buy the three-month call option on CHF with the exercise rate of $0.64/CHF for the premium of $0.05 per CHF. Assume that your expected future spot exchange rate is the same as the forward rate. The three-month interest rate is 6 percent per annum in the United States and 4 percent per annum in Switzerland.

(a) Calculate your expected dollar cost of buying CHF5,000 if you choose to hedge via call option on CHF.

Total option premium = (0.05) × (5000) = $250. In three months, $250 is worth $253.75 = $250 (1.015). At the expected future spot rate of $0.63/CHF, which is less than the exercise price, you don't expect to exercise options. Rather, you expect to buy Swiss franc at $0.63/CHF. Since you are going to buy CHF5,000, you expect to spend $3,150 (=0.63×5,000). Thus, the total expected cost of buying CHF5,000 will be the sum of $3,150 and $253.75, i.e., $3,403.75.

(b) Calculate the future dollar cost of meeting this CHF obligation if you decide to hedge using a forward contract.

$$\$3{,}150 = (0.63) \times (5{,}000).$$

(c) At what future spot exchange rate will you be indifferent between the forward and option market hedges?

$3,150 = 5,000$x$ + 253.75, where x represents the break-even future spot rate. Solving for x, we obtain x = $0.57925/CHF.

Note: At the break-even future spot rate, options will not be exercised.

(d) Illustrate the future dollar costs of meeting the CHF payable against the future spot exchange rate under both the options and forward market hedges.

If the Swiss franc appreciates beyond $0.64/CHF, which is the exercise price of call option, you will exercise the option and buy CHF5,000 for $3,200. The total cost of buying CHF5,000 will be $3,453.75 = $3,200 + $253.75.

7. Dell Computer produces its machines in Asia with components largely imported from the United States and sells its products in various Asian nations in local currencies.

(a) What is the likely impact on Dell's Asian profits of a strengthened dollar? Explain.
Dell's dollar costs largely stay fixed whereas its dollar revenues will decline. Thus, a strengthened dollar reduced Dell's dollar profits on its Asian sales.

(b) What hedging technique(s) can Dell employ to lock in a desired currency conversion rate for its Asian sales during the next year?
Dell can use forward or futures contracts to sell the local currencies forward against the dollar in an amount equal to its projected annual local currency sales. It can also buy put options on the various Asian currencies that it can exercise in the event of dollar appreciation.

(c) Suppose Dell wishes to lock in a specific conversion rate but does not want to foreclose the possibility of profiting from future currency moves. What hedging technique would be most likely to achieve this objective?
Buying put options on the local currencies would allow Dell to offset its currency losses with gains on its put options if the local currencies depreciate against the dollar. If the local currencies remain stable or strengthen, Dell would just allow the options to expire unexercised and convert its local currency revenues at the higher spot rates.

(d) What are the limits of Dell's hedging approach?

This approach will cover Dell for the first year. But if the dollar strengthens, when Dell goes to roll over its forwards or options to hedge the next year's revenues, it will pay a

price for these contracts that reflect the devalued exchange rates of the local Asian currencies.

8. In order to eliminate all risk on its exports to Japan, a company decides to hedge both its actual and anticipated sales there. What risk is the company exposing itself to? How could this risk be managed?

The company faces uncertainty as to what its future yen sales revenue will be. This uncertainty stems from quantity risk, the risk that those future sales will not materialize, and price risk, the uncertainty as to the yen prices it can expect to realize in Japan. If it uses forward contracts to hedge its uncertain future yen sales revenue, it faces the risk that it will overhedge, winding up with yen liabilities not offset by yen assets. The company can protect itself by using forward contracts to hedge the certain component of its expected future yen sales then hedging the remainder of its projected sales revenue with currency options.

9. Instead of its previous policy of always hedging its foreign currency receivables, Sun Microsystems has decided to hedge only when it believes the dollar will strengthen. Otherwise, it will go uncovered. Comment on this new policy.

Sun is engaging in selective hedging, which is really speculation. Sun faces the risk that it will be unhedged when foreign currencies weaken and be hedged when they strengthen. The purpose of hedging is to reduce risk, not to boost profits.

10. The Row owes €70 million in 30 days for a recent shipment of Spanish textiles. It faces the following interest and exchange rates:

Spot rate:	Euros 130/$
Forward rate (30 days)	Euros 131/$
30-day put option on dollars at €129/$	1% premium
30-day call option on dollars at €131/$	3% premium
U.S. dollar 30-day interest rate (annualized):	7.5%
Euro 30-day interest rate (annualized):	15%

a. What is the hedged cost of The Row's payable using a forward market hedge?

In other words, what dollar cost of the payable can The Row lock in using the forward contract? By buying Euros forward, The Row can lock in a dollar cost of $534,351 (70,000,000/131).

b. What is the hedged cost of The Row's payable using a money market hedge?

The Row can hedge its payable by borrowing the dollar equivalent of the present value of the €70 million payable, which equals €69,135,802 (70,000,000/1.0125), converting the dollars to Euros at the current spot rate, and investing the proceeds at the 1.25% monthly Euro interest rate (15%/12). The €69,135,802 amount translates into a dollar amount of $531,814 at the current spot rate of €130/$ (€69,135,802/130). This investment is financed by borrowing these dollars at the monthly rate of 0.625% (7.5%/12). At the end of 30 days, The Row will pay off this dollar loan. The cost of doing so is $535,138 ($531,814 x 1.00625). The result from this money market hedge is the equivalent of buying forward the Ptas 70 million at a forward rate of €130.81 (70,000,000/535,138). From the standpoint of the treasurer, this is a worse rate than could be realized directly in the forward market (as evidenced by the fact that the forward market hedge yields a cost that is $787 lower than the cost of the money market hedge).

c. What is the hedged cost of The Row's payable using a put option?

By buying a Euro put option, The Row can lock in a cost of $548,021 = the sum of the 1% put premium of $5,385 (0.01 x 70,000,000/130) plus the $542,636 (70,000,000/129) cost of buying Euros through the put option at a rate of €129/$. (Notice that a put option on dollars with Euro receipt is exactly the same as a call option on Euros. Hence, the

terms can be used interchangeably as long as you bear in mind which currency is being bought and which is being sold).

The PUT premium at t = T is \$5,385 * (1+0.625%) = \$5419.

Although it looks as if the put option costs \$13,704 more than the forward contract, these costs are not strictly comparable. The reason is that the put option gives The Row the option to buy Euros in the spot market in 30 days if the spot rate of the dollar at that time exceeds the exercise price of €129/\$. Hence, the \$548,055 (542,636 + 5,419) cost is the *maximum* cost of using a put option. On the other hand, with a forward contract, The Row *must* buy Euros at €131/\$ even if the spot rate at time of settlement is lower at, say, €133/\$. The value of this option accounts for the 1% premium that The Row must pay to acquire the put option.

11. In your role as an advisor to the CFO of Watermelon Technologies you have been asked to write a report on why hedging might reduce agency costs. While you have no problems convincing him that bondholders would prefer the firm hedge exchange rate risk, what arguments would you put forward to persuade him that he has a personal stake in the decision as well? 2023 exam question (*)

Hedging reduces AGENCY COSTS. Here you need to focus on the conflict of interest between shareholders and the managers of the firm. The wages and bonus plan of managers depend on the performance of the firm. If the firm does not hedge, the CFO can react in one of two ways:

(1) He is likely to insist on higher wages as a risk-premium for the extra risk that executives bears.

(2) The market determines quality of managers by their actions, and this is observed via firm's profitability and earnings numbers. If this is volatile due to the lack of hedging it is likely to impact on the manager's income stream -- hedging would reduce the variability of their income stream.

(3) Hedging can reduce the costs of financial distress thereby reduce the inability to make binding commitments to workers

12. Samuel Samosir works for Peregrine Investments in Jakarta, Indonesia. He focuses his time and attention on the U.S. dollar/Singapore dollar ($/S$) exchange rate. The current spot rate is $0.6000/S$. After considerable study, he has concluded that the Singapore dollar will appreciate versus the U.S. dollar in the coming 90 days, probably to about $0.7000/S$. He has the following options on the Singapore dollar to choose from: *

Option	*Strike Price*	*Premium*
Put on S$	*$0.6500/S$*	*$0.00003/S$*
Call on S$	*$0.6500/S$*	*$0.00046/S$*

(a) Should Samuel buy a put on Singapore dollars or a call on Singapore dollars?

Since Samuel expects the Singapore dollar to appreciate against the U.S. dollar, he should buy a call on Singapore dollars.

(b) Using your answer to (a), what is Samuel's break-even price?

Samuel's breakeven price (assuming no discount rate) is $0.65000+$0.00046 = $0.65046.

(c) Using your answer to (a), what are Samuel's gross profit and net profit (including the premium) if the spot rate at the end of the 90 days is indeed $0.7000/S$?

Samuel's gross profit, if the spot rate is $0.7000/S$, will be $0.7000–$0.6500 = $0.05000. His net profit would be $0.05000–$0.00046 = $0.04954.

13. Rio Tinto has operations in Europe. It would like to lock in the exchange rate on the €200M in operating income generated in the EU this quarter that they would like to repatriate. They are considering whether they should enter into a currency forward contract for the €200M at an exchange rate of $1.20 per Euro with a delivery date of June 30.

Rio Tinto's investment expenditures are based in Australia but are focused on product innovations for the EU market. The size of these investment expenditures is expected to increase as the European economy strengthens. If Rio plans on funding these investments using its repatriated earnings from the EU, should it hedge these earnings with the currency futures contract? Explain completely.

Another benefit from hedging is the alignment of operating cash flows with investment opportunities. Since the size of Rio Tinto's investment opportunities are positively correlated with the strength of the EU economy and the value of the Euro relative to the dollar is also tied to the strength of the EU economy, we would expect that Rio Tinto has higher investment expenditures when the Euro is more valuable and lower expenditure when the Euro is worth less.

Therefore, Rio Tinto is already naturally hedged and would <u>not</u> benefit from the forward/futures contract. By not locking in the exchange rate, the foreign income is worth more (less) in dollar terms when Rio Tinto has more (fewer) investment opportunities.

14. Coal River Industries of Cygnet, Tasmania, is completing a new assembly plant near Guatemala City. A final construction payment of Q8,400,000 is due in six months. ("GTQ" is the code for Guatemalan quetzals and its symbol is "Q".) Coal River uses 20% per annum as its weighted average cost of capital. Today's foreign exchange and interest rate quotations are: **(*)** ***Past Exam Question***

Present spot rate	*Q7.0000/$*
Six-month forward rate	*Q7.1000/$*
Guatemalan six-month interest rate	*14.00% per annum*
Australian dollar six-month interest rate	*6.00% per annum*

Coal River's treasury manager, concerned about the Guatemalan economy, wonders if Coal River should be hedging its foreign exchange risk. The manager's own forecast is as follows:

Highest expected rate: Q8.000/$, reflecting a significant devaluation
Expected rate: Q7.3000/$
Lowest expected rate: Q6.4000/$, reflecting a strengthening of the quetzal

(a) What realistic alternatives are available to *Coal River* for making payment? What are their cash flows?

Coal River's goal is to minimize the dollar payment required in the face of a possible devaluation of the Guatemalan quetzal (Q). The exposure is a debt of Q8,400,000, payable in quetzals in six months.
Coal River can (1) remain uncovered – do nothing now – and buy quetzals spot six months from now, (2) buy quetzals six-months forward, or (3) buy quetzals now and invest them in Guatemala for six months.

Remain Uncovered: If the present spot rate of Q7.000/$ does not change, the required payment in six months would be Q8,400,000/(Q7.000/$) = $1,200,000.

Using Coal River's three separate spot rate forecasts, the range of expected payments in six months is:

Highest expected cost:	Q8,400,000/(Q6.4000/$) = $1,312,500.00
Most likely cost:	Q8,400,000/(Q7.3000/$) = $1,150,684.93
Lowest expected cost:	Q8,400,000/(Q8.0000/$) = $1,050,000.00

The Guatemalan quetzal interest rate is *higher* than the AUD interest rate. If the International Fisher Effect is to be believed, the quetzal is expected to depreciate versus the AUD by an amount equal to the interest rate differential. However, the forecasts of Coal River's treasury manager differ from a simple International Fisher effect solution. One question for the manager is whether or not to rely on his or her own exchange rate forecast, accept the forward market quotation as the best indicator of the future spot rate, or assume it is not possible to forecasts future spot exchange rates.

Forward Cover: If Coal River buys Q8,400,000 forward, in six months it would pay exactly Q8,400,000/(Q7.1000/$) = $1,183,098.59

Money Market Hedge: Exchange dollars for quetzals now and invest in Guatemalan securities for the six-month period. Since Q8,400,000 is needed in six months to make the payment, we will work backwards to determine the exact number of quetzals needed today. Coal River can earn 14.00% per annum on quetzel deposits, or 7.00% for the 6-month period: Q8,400,000/1.07 = Q7,850,467.29 needed today.

That means that Q7,850,467.29 invested today in Guatemala at 14.00% per annum will grow to Q8,400,000 in six months. We can now find the dollar amount needed to acquire these quetzals in the present, using the spot rate of Q7.000/$: Q7,850,467/(Q7.000/$) = $1,121,495.33.

It would require Coal River to come up with $1,121,495.33 today to obtain the needed Guatemalen quetzals. In order compare the cost of this alternative versus the previous alternatives, this dollar cost needs to be carried forward in time six months. Coal River would carry forward all dollar amounts at its weighted average cost of capital (WACC), 20.00% per annum, or 10.00% for six months. The future value in six months of this to Coal River is: $1,121,495.33 × 1.10 = $1,233,644.86.

(Note: The comparison can be made with present values instead of future values. The necessary step is to bring all payments to the same date so we can compare them.)

(b) Which method would you select? Why?

(1) If Coal River remains uncovered, and

- If the exchange rate remains unchanged, a future payment of $1,200,000 will be required. This amount is uncertain.
- If the ending exchange rate is Q6.4000/$, a future payment of $1,312,500 will be required. This amount is uncertain.
- If the ending exchange rate is Q7.3000/$, a future payment of $1,150,685 will be required. This amount is uncertain (even though Coal River's manager thinks it's "most likely").
- If the ending exchange rate is Q8.000/$, a future payment of $1,050,000 will be required. This amount is uncertain.

(2) If Coal River uses a forward hedge, a future payment of $1,183,098.59 will be required. This amount is certain.

(3) If Coal River uses a money market hedge, a payment with a future value of $1,233,645 will be required. This amount is certain.

Of the two certain cost alternatives, the forward hedge cost of $1,183.098.59 is less than the money market hedge cost of $1,233,644.86. On a cost basis, the forward hedge is preferable.

To remain unhedged is to take a chance on a lower payment in six months (possibly as low as $1,050,000 if the quetzal drops significantly in value) against a much higher payment (possibly $1,312,500 – though the payment could be even higher as there is no real upper limit). Remaining unhedged seems very risky.

15. The following information on interest rates and exchange rates is available to all with access to any of the finance data providers:

Currency	Spot	1 Month	3 Months	6 Months	12 Months
Euro	2.0310/20	22/18	64/54	128/105	227/228
GBP*	1.4890/00	55/22	160/156	302/289	560/523
Yen	154.20/30	8/6	33/27	75/62	164/137

* The quote for the British Pound (GBP) is AUD per GBP. For the Euro and Yen it is foreign currency per AUD. For ***most*** currency pairs, a point is 1/100th of 1% (i.e., 0.0001); the Japanese Yen currency pair is the only exception to this rule. Swap points for Japanese Yen currency pairs (e.g., Yen per AUD) are quoted to two decimal places only, so one point is 1/100.

2021 exam question (*)

The table below provides bid and ask interest rates on the Australian dollar (AUD), the Euro, the British Pound (GBP) and the Japanese Yen. These rates are quoted on a per annum basis.

Currency	1 Month	3 Months	6 Months	12 Months
AUD	5.6785-5.8125	5.5000-5.6250	5.5000-5.6250	5.6250-5.7500
Euro	4.4375-4.5625	4.3125-4.4375	4.3125-4.4375	4.3125-4.4375
GBP	10.0625-10.1875	9.8750-9.9375	9.6875-9.7500	9.6250-9.7500
Yen	5.1250-5.1875	4.7500-4.8125	4.6250-4.6875	4.6250-4.6875

COMMENTARY: Note that in financial markets, dealers will provide both bid and ask quotes and this applies to interest rates as well. The rate at which the bank/dealer will borrow from you (i.e., bid) is **LESS** than the rate at which they will lend to you (i.e., ask).

[Recall Part (a) was covered in Topic 3]

(b) Now suppose this investor expects a GBP 2 million payment in a month from client based in Glasgow. While he doesn't have a strong opinion on how the exchange rate is likely to move, he is intent on eliminating the uncertainty around the value of the GBP. What options does he have and what are the costs of eliminating this risk? Which approach should he utilize? Provide your answer in dollar terms.

Spot Exchange rate: $\boldsymbol{AUD1.4890 - 1.4900/_{GBP}}$

Here is the extract from Chapter 5, Eun & Resnick (i.e., the prescribed text) that explains how to arrive at the above quotation. Also, the way spot exchange rates have been presented here is no different to Question 5 in Tutorial 1.

In conversation, interbank FX traders use a shorthand abbreviation in expressing spot currency quotations. Consider the $/£ bid-ask quotes from above, $1.4397–$1.4402. The "1.43" is known as the bid quote *big figure*, and it is assumed to be known by all traders. The second two digits to the right of the decimal place are referred to as the *small figure*. Similarly, the "1.44" is the ask *big figure*. Assuming spot bid-ask spreads for the British pound sterling are around 5 "points," it is unambiguous for a trader to respond with "97 to 02" when asked what is his quote for British pound sterling.

The establishment of the bid-ask spread will facilitate acquiring or disposing of inventory. Suppose most $/£ dealers are trading at $1.4397–$1.4402. A trader believing the pound will soon appreciate substantially against the dollar will desire to acquire a larger inventory of British pounds. A quote of "98–03" will encourage some traders to sell at the higher-than-market bid price, but also dissuade other traders from purchasing at the higher offer price. Analogously, a quote of "96–01" will allow a dealer to lower his pound inventory if he thinks the pound is ready to depreciate.

MONEY MARKET HEDGE

1. Borrow the PV of £2,000,000 so that the receivable covers interest and principal: $\frac{2{,}000{,}000}{\left(1+\left(\frac{0.101875}{12}\right)\right)} = GBP1{,}983{,}164.$
2. This amount can be invested at 5.6875% for 30 days after converting into AUD (i.e., buying AUD at 1.4890).

$$GBP1{,}983{,}164 \times 1.4890 \times \left(1 + \left(\frac{0.056785}{12}\right)\right) = \$2{,}966{,}904.71$$

3. If they are converted £2,000,000 at the current spot rate (i.e., today), they would have: $GBP2{,}000{,}000 \times 1.4890 = \$2{,}978{,}000.00$
4. The dollar cost is the difference between receiving £2,000,000 today *versus* receiving it in 30 days = ($11,095)

FORWARD HEDGE

The outright forward rate is:

BID: 1.4890 – 0.0055 = AUD 1.4835/GBP

ASK: 1.4900 – 0.0022 = AUD 1.4878/GBP

The dollar cost is: $(1.4835 - 1.4890) \times GBP2{,}000{,}000 = \$11{,}000$

If IRP holds, the costs should be the same, which it is.

16. The Swedish Steel Company has debt of 100,000 Euros, which becomes due in 12 months. The company's financial controller, Freja Doe, is having trouble sleeping at night knowing that the debt is unhedged. Sweden's currency is the Krona (Kr). The current Kr/Euro exchange rate is 20, and the per annum interest rates are 21 percent on Krona and 10 percent on the Euro. Freja is considering a forward hedge. However, a friend tells her that he recently bought a call on 100,000 Euros with strike price of 20 and is willing to sell the call option to her at the historic cost of 1 Kr per Euro or Kr 100,000 for the total contract. What should she do? Show your workings.

2023 exam question (*)

The call premium asked by her friend is very tempting.

The [fairly priced] forward rate for 12 months would be (using IRP):

$F_{t,T}$ = 20 x 1.21/1.10= Krona 22/Euro

At expiration, Freja may exercise the call option and pay 20 Kr/Euro, which is less than 22 Krona/Euro that she would pay based on the forward rate.

Comparing Options versus Forward hedging -- in present value terms, this is worth:
(22-20)/1.21 = 1.6529 Kr/Euro today > 1.0 Kr/Euro premium.

Since, unlike the forward contract, Freja does not need to exercise if the future spot exchange rate is less than 20 Kr/Euro. Thus, the option is even more valuable than 1.6529 Kr/Euro today (i.e., more flexibility)

Recommendation: Freya Doe should **buy** the Euro call option from her friend.

17. An Australian firm exports machinery to Korea at the price of 200,000 Korean won. This amount is however paid to the Australian firm only after six months. The Australian firm wishes to cover its exchange rate exposure. Using the information below, calculate its strategy of obtaining a forward contract or money market hedge will be equivalent. If not, which instrument will guarantee a higher dollar value at the end of six months. Explain how you would perform the forward contract and money market hedge.

Spot Rate: 3 won/$ Six-month forward rate: 3.5 won/$
Korean won interest rate: 41.64% *p.a.* Australian dollar interest rate: 4.04% *p.a.*

2023 exam question (*)

Forward Hedge:

Sell 200, 000 Won.
Sell Won Forward. Receive $A 57,142.86.

Money Market Hedge:

Borrow PV of 200,000 Won. Approx. Won 168,049.4 ($\frac{200000}{1.4164^{0.5}}$)

Convert at 3 Won per AUD - $56,016.48

Invest for 6 months (2.02%): $57,136.81

Forward Hedge is marginally superior