
Question: Derivative Valuation and Analysis**(24 points)**

A Japanese Company, X, makes a payment of 10 million U.S. dollars (USD) each month for imports. It expects the yen (JPY) to depreciate. To hedge against an increase in yen payments, Company X enters into the following contract with Bank Y on January 1 2020:

Payment dates: The first day of each month from July to December of the same year 2020 (total six payments).

USD received: USD10 million per payment.

Exchange rate: The contract rate for the first payment on July 1 2020 is fixed at JPY95/USD. At 10:00am on each payment date in month t , if the median spot rate, S_t , is above JPY90/USD, the contract rate for the next month, C_{t+1} , is reset to JPY95/USD. Otherwise, the next month's contract rate is given by:

$$C_{t+1} = C_t \cdot 90 / S_t,$$

with a floor at JPY90/USD and a ceiling at JPY200/USD.

When Company X signs the contract at 10:00am on January 1, the spot exchange rate is JPY100/USD. The interest rates are 1% per annum in yen and 2% per annum in dollars, both continuously compounded, for any term up to one year.

- a) Assume that the yen depreciates to JPY120/USD on July 1 as anticipated. What will be the contract rate (in yen per dollar) for each payment on July 1 and August 1 2020? (4 points)
- b) Again, assume that the JPY depreciates to JPY120/USD on July 1. Consider an alternative hedging scheme in which Company X buys USD 10 million forward on January 1, 2020 for delivery on July 1, 2020. Calculate the applicable six-month forward rate in yen per dollar, rounded to the first decimal place. What is the total yen payment on July 1? (5 points)
- c) Assume that, contrary to expectations, the yen appreciates to JPY80/USD on July 1. What will be the contract rate (in yen per dollar) for each payment on July 1 and August 1 2020? (5 points)
- d) Calculate how much more (or less) the July contract payment costs than each of the forward hedge and the unhedged spot transaction under two scenarios, (i) when the spot rate is JPY120/USD on both July 1, 2020 and August 1, 2020 and (ii) when it is JPY80/USD on those two dates. Repeat the analysis for the August payment. (10 points)