International Financial Management | FINA 4360
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First Midterm Exam

No points will be given by simply writing down formulas, and writing down definitions or irrelevant statements from the book, or saying "yes," will get you zero points. Justify all your answers. If you cannot prove something give some intuition. Good luck. Reminder: this is an open book exam, but no open notes.
Time: 1hr 50 minutes.

I. Problems (15 points each).

1. Assume a USD is worth JPY 140.1 (S_t=140.1 JPY/USD). Also, a NZD is worth USD 0.62 (S_t=0.62 USD/NZD).
i. What is the cross rate NZD/JPY?
ii. Suppose the 180-day forward rate is $F_{t,180}$ = 135 JPY/USD. Calculate the forward premium. Does the forward rate contain a premium or a discount?
iii. Suppose Kwiki Bank quotes S_t = 91 JPY/NZD. Is arbitrage possible? (Why?)
iv. If yes, describe a triangular arbitrage strategy and determine an arbitrageur's profits.

ANSWER:
i. S_t^I = 0.62 USD/NZD * 140.1 JPY/USD = 86.862 JPY/NZD => S_t^I = 0.0115 NZD/JPY

ii. p = [($F_{t,T}$ – S_t)/S_t] * (360/T) = [(135 – 140.1)/140.1] * 2 = **-0.0728** (-**7.28%**) ⇒ p<0, discount

iii. $S_t^I \neq S_t^{KB}$ = 91 JPY/NZD ⇒ Yes, arbitrage is possible.

iv. Triangular arbitrage. (Key: $S_t^{KB} > S_t^I$ ⇒ KB overvalues the NZD against the JPY.)

Triangular arbitrage strategy (simultaneously done):
1. Borrow NZD 1
2. Sell NZD/Buy JPY at S_t^{KB} = 91 JPY/NZD. ⇒ Get JPY 91
3. Sell JPY/Buy USD at S_t = 140.1 JPY/USD. ⇒ Get JPY 91 / 140 JPY/USD = USD 0.65
4. Sell USD/Buy NZD at S_t = .62 USD/NZD ⇒ Get USD 0.65 / 0.62 USD/NZD = **NZD 1.0484**
5. Return NZD 1 loan. Keep profits (π).

π = **NZD 1.0484** - NZD 1= **NZD .0484** (or **4.84%** per NZD borrowed)

2. It is June 2023. A Big Mac costs CZK 99 in the Czech Republic, while it costs USD 5.36 in the U.S. The spot rate is 22 CZK/USD (CZK= Czech Koruna).

(a) According to PPP, what should be the USD/CZK exchange rate in June 2023?

(b) Take the USD as the domestic currency. Calculate the real exchange rate, R_t. What is the over/under-valuation of the CZK relative to the USD?

(c) According to the R_t, which country is more efficient?

(d) The GDP per capita in the Czech Republic is CZK 430,000. Translate the GDP per capita in CZK to (nominal) USD and to PPP USD prices.

(e) Suppose in July 2023, the price of the Big Mac increases to CZK 110 in the Czech Republic, while it decreases to USD 5 in the U.S. According to the *linearized* version of PPP, what should the USD/CZK exchange rate be in July 2023?

(f) Assume that in July 2023 the exchange rate is .04 USD/CZK. Generate a trading signal based on PPP.

ANSWER:

(a) $\boldsymbol{S_t^{PPP}}$ = USD 5.36/CZK 99 = **0.0541 USD/CZK** (or 18.4702 CZK/USD)

(b) $\mathbf{R_t}$ = $S_t\, P_f / P_d$ = [(1/22) USD/CZK * CZK 99]/USD 5.36 = **0.8396** ⇒ CZK is undervalued by **16.04%**

(c) $\mathbf{R_t}$ < 1 ⇒ Czech Republic is more efficient.

(d) GDP per capita (in USD, nominal) = CZK 430,000 * (1/22) USD/CZK = USD 19,545.45
GDP per capita (in USD, PPP) = CZK 41,000 * **0.0627 USD/CZK** = USD 23,263

(e) I_{CZ} = (110/99 - 1) = 0.1111
I_{US} = (5/5.36 - 1) = -0.0672
$e_{f,t}^{PPP} \approx I_{US} - I_{CZ}$ = (-0.0672 - 0.1111) = -.1783
$\boldsymbol{S_{t=Jul\,23}^{PPP}}$ = $S_{Jun\,23}$ * $[1 + e_{f,t}^{PPP}]$ = (1/22) USD/CZK * [1 + (-.1783)] = **0.03735 USD/CZK**

<u>Note</u>: You could have also calculated:
$\boldsymbol{S_{t=Jul\,23}^{PPP}}$ = $\boldsymbol{S_t^{PPP}}$ * $[1 + e_{f,t}^{PPP}]$ = **0.0541 USD/CZK** * [1 + (-.1783)] = **0.0445 USD/CZK**

(f) $S_{t=July}$ = .04 USD/CZK > $\boldsymbol{S_{t=Jul\,23}^{PPP}}$ = **0.03735 USD/CZK**
According to PPP, the CZK is overvalued at S_t = .04 USD/CZK
⇒ <u>Trading signal</u>: Sell CZK/Buy USD

3. It is June 2023. Roy Gas, a U.S.-based energy company, has a AUD 200 million receivable due in December 2020. Roy Gas decides to use options to reduce FX risk. Available options with December maturity are:

X	Calls p_c	Puts p_p
0.66 USD/AUD	2.36	0.61
0.68 USD/AUD	0.89	0.96
0.72 USD/AUD	0.15	5.53,

where X represents the strike price and premiums for calls (p_c) and puts (p_p) are expressed in USD cents –i.e., 1.99 equals to USD 0.0199.

Today, the exchange rate is **0.68 USD/AUD**.

A. Calculate the premium cost and calculate the *net cash flows* (in USD) in December for Roy Gas under the following choices:

i) in-the-money option

ii) out-of-the money option

B. Suppose Roy Gas can also use a forward contract with $F_{t,Dec}$ = .69 USD/AUD. Calculate the net cash flows in December for Roy Gas under the forward contract alternative. What are the pros and cons of this forward relative to the alternatives in A?

ANSWER: FC Receivables => use put options (right to sell FC) to hedge.

A. (i) ITM put option: X_p = 0.72 USD/AUD (> **0.68 USD/AUD**) p_p = USD 0.0553/AUD

Total premium paid = AUD 200M * USD 0.0553/AUD = USD 11.06M

Net Cash flows in December

- if S_{Dec} > 0.66 USD/AUD $\Rightarrow$ AUD 200M * S_{Dec} + USD 10.66M
- if $S_{Dec} \leq$ 0.66 USD/AUD $\Rightarrow$ AUD 200M * 0.72 USD/AUD - USD 11.06M = **USD 132.94M**

(ii) OTM put option: X_p = 0.66 USD/AUD (< **0.68 USD/AUD**) p_p = USD 0.0061/AUD

Total premium paid = AUD 200M * USD 0.0061/AUD = USD 1.22 M

Net Cash flows in December

- if S_{Dec} > 0.75 USD/AUD $\Rightarrow$ AUD 200M * S_{Dec} + USD 1.22M
- if $S_{Dec} \leq$ 0.75 USD/AUD $\Rightarrow$ AUD 200M * 0.66 USD/AUD - USD 1.22M = **USD 130.78M**

B. Forward contract: $F_{t,Dec}$ = **0.69 USD/AUD**

Net Cash flows in December $\Rightarrow$ AUD 200M * **0.69 USD/AUD** = **USD 138M**

Pros: Certainty.

Cons: No upside.

4. Ms. Shiv is a European. arbitrageur. The one-year interest rate offered in Germany is 3.5%, while the one-year interest rate offered in Brazil is 10%. The spot rate is **5.20 BRL/EUR**. Beckham Bank offers Ms. Shiv a one-year forward contract at 5.30 BRL/EUR.

(1) Determine the arbitrage-free one-year forward contract exchange rate.
(2) Can Ms. Shiv make a risk-free profit? If yes, describe a covered arbitrage strategy.
(3) Determine Ms. Shiv's profits.
(4) Calculate the forward premium and compare it to the interest rate differential. Based on these numbers, what kind of capital flows will the Brazilian economy experience?

ANSWER:

(1) $F_{t,1-yr}^{IRP}$= **5.20 BRL/EUR** * (1 + .10)/(1 + .035) = **5.5266 BRL/EUR**

(2) $F_{t,1-yr}^{IRP} \neq F_{t,1-yr}^{BB}$ = **5.30 BRL/EUR** ⇒ Yes, arbitrage is possible.

Covered arbitrage strategy (Key: BB undervalues EUR forward at **5.30 BRL/EUR**).

All steps simultaneously done:
1) Borrow EUR 1 at 3.5% for 1 year. ⇒ In 1-yr, repay: **EUR 1.035**
2) Convert to BRL at S_t = **5.20 BRL/EUR** ⇒ Get BRL 5.20
3) Deposit BRL 5.20 at 10% for 1 year. ⇒ In 1-yr, get BRL 5.20 * (1.10) = **BRL 5.72**
4) Sell BRL/Buy EUR forward at $F_{t,1-yr}^{BB}$ = **5.30 BRL/EUR**
⇒ In 1-yr, **BRL 5.72**/**5.30 BRL/EUR** = **EUR 1.0792**

(3) π = **EUR 1.0792** – **EUR 1.035** = **EUR .0442**. (or **4.42%** per EUR borrowed)

(4) $p = (F_{t,T} - S_t)/S_t * (360/T)$ = (**5.30** - **5.20**)/**5.20** * 1 = 0.01923
$i_d - i_f$ = .10 - .035 = 0.065
=> $p < i_d - i_f$ ⇒ *capital inflows* to the domestic economy (Brazil)
⇒ capital outflows from Europe to Brazil.

5. Suppose you use quarterly U.S. and Japan data from 1978:Q1 to 2023:Q1 to fit the following regression:

$e_{f,t}$ (JPY/USD) = $(S_t - S_{t-1})/S_{t-1} = \alpha + \beta\,(i_{JPY} - i_{USD})_t + \varepsilon_t$.

Regression Statistics	
Multiple R	0.207778
R Square	0.043172
Adjusted R Square	0.037229
Standard Error	0.060288
Observations	163

ANOVA

	df	*SS*	*MS*	*F*
Regression	1	0.026403	0.026403	7.264289
Residual	161	0.585179	0.003635	
Total	162	0.611582		

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	-0.01414	0.006368	-2.22024	0.027799
X Variable 1	-0.58646	0.21759	-2.69523	0.007781

(i) Are the signs of the coefficients consistent with IFE?
(ii) Using individual t-tests, test IFE at the 5% level.
(iii) Suppose $S_{23:Q1}$ = 135.10 JPY/USD and $(i_{JPY} - i_{USD})_{23:Q2}$ = -.027. Using the regression model, forecast the exchange rate for the second quarter of 2023, that is, 2023:Q2 ($S_{23:Q2}$).
(iv) Suppose $S_{23:Q2}$ = 140.4 JPY/USD. Which 2023:Q2 has a smaller forecast error: the regression model or the random walk model?

ANSWER:

(i) Intercept should be 0 (no sign per se); slope should be 1 (positive). Slope is not OK with IFE.

(ii)
$t(\alpha=0)$: (-0.01414 – 0)/ 0.006368 = **-2.22024** (|-2.22| > **1.96**) ⇒ reject H_0
$t(\beta=1)$: (-0.58646 – 1)/ 0.21759 = **-7.2911** (|**-7.29** | > **1.96**) ⇒ reject H_0

(iii) $E_{18\,Q4}[e_{f,t=19\,Q1}]$ = -0.01414 + -0.58646 $(i_{JP} - i_{US})_{t=19\,Q1}$ = -0.01414 + -0.58646 * (-0.027) = **0.001694**
$E_{18\,Q4}[S_{,t=19\,Q1}]$ = 140.1 JPY/USD * (1 **+ 0.001694**) = **140.33 USD/GBP**

(iv) Forecast error Model: 140.4 – **140.33** = 0.07 <= smaller error.
Forecast error RWM: 140.4 – 135.1 = 5.3

II. CASE (25 points)

1) According to the article, the U.S. Fed is not planning to increase interest rates, but the European Central Bank (ECB) is planning to increase interest rates by 25 bps (0.25%). What is the effect of this different course of action regarding interest rates by the Fed and the ECB on the USD/EUR exchange rate? Draw a graph.

Higher $i_{EUR} \Rightarrow (i_{US} - i_{EUR}) \downarrow$ $\Rightarrow$ More US investments in EUR bonds (Demand for EUR ↑)
$\Rightarrow$ Less European investments in USD bonds (Supply of EUR ↓)
$\Rightarrow S_t$ (USD/EUR) ↑ (EUR appreciates against USD)

Check lecture notes for Graphs.

2) In the past two years, the article, the USD has appreciated against the EUR. Suppose the ECB does not want the EUR to depreciate. What can the ECB do to stop the appreciation of the USD against the EUR? Using two graphs, show the effect of ECB intervention on the FX market and the European money market. (Draw two graphs.)

ECB: FX Intervention: Sell USD. $\Rightarrow$ Effect on FX Mkt: S_t (USD/EUR) ↑
$\Rightarrow$ Effect on European Money i_{EUR}↑ (since EUR money supply ↓)

Check lecture notes for Graphs.

3) According to the article, the U.S. inflation rate is declining. What is the effect of a lower U.S. inflation rate on the USD/EUR exchange rate? Draw a graph.

Lower $I_{US} \Rightarrow (I_{US} - I_{EUR}) \downarrow$ $\Rightarrow$ Less US imports from Europe (Demand for EUR ↓)
$\Rightarrow$ More US exports to Europe (Supply of EUR ↑)
$\Rightarrow S_t$ (USD/EUR) ↓ (EUR depreciates against USD)

Check lecture notes for Graphs.

4) The article mentions that US interest rates will probably stay put at 5%. Assume that interest rates in Europe are at 3.75%. Describe, step by step, a carry trade involving the EUR and the USD. State its risks.

i) Borrow EUR (the low interest rate currency) at i_{EUR} = 3.75% for T days
ii) Convert EUR to USD (the high interest rate currency) at S_t = 1.08 USD/EUR
iii) Deposit the USD at i_{USD} = 5% for T days.
iv) Wait for T days. Then, exchange the USD for EUR at S_T.

Step (iv) is risky. Today, we do not know S_T.

5) Using linearized IFE, forecast the USD/EUR in 12 months. If the exchange rate in 12 months is exactly the rate you forecast using IFE, is the carry trade describe in question (5) profitable?

$$S^{IFE}_{t,1-yr} = 1.08 \text{ USD/EUR} * (1 + .05)/(1 + .0375) = \mathbf{1.093 \text{ AUD/USD}}$$

If $S_{T=1\text{-yr}} = S^{IFE}_{t,1-yr}$, carry trade is not profitable. That is, IFE holds.