Part I – What we trade?

In Asia NDF team, we trade "three" types of products, but essentially one of them is a mixture of the other two.

1. FX Spot

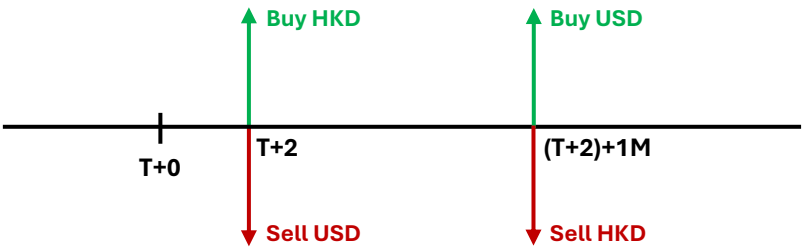
"Spot" in FX does not refer to immediate transaction. A spot trade refers to a transaction on a date known as *settlement* date. It differs for different regions.

USDHKD:	T+2
USDCNH:	T
USDTWD:	
USDSGD:	
USDINR:	
USDIDR:	
USDPHP:	
USDJPY:	T+2
USDTHB:	

For instance, if we buy USD 1mio USDHKD spot at 7.8090 at time T. It means that on T+2, we will receive 1mio USD and pay 7.8090mio HKD on T+2.

2. FX Swap

A swap is a two-leg transaction: there are two cashflow exchanges at two different timeframes. The following is the breakdown when we buy a 1M USDHKD swap at T+0:



Leg refers to the cashflow. The T+2 leg is known as near-leg, and the (T+2)+1M leg is far-leg.

On the floor, people don't say buy/sell a swap. We say "**SELL/BUY DOLLAR**" or "**BUY/SELL HKD**". When we say "BUY USDHKD", we always refer to far-leg, i.e., buying USD selling HKD at far-leg.

Here we see that **FX swap is a tool to borrow/lend money**. The swap in the figure is *borrowing HKD and lending out USD for 1 month.*

Notice that spot is T+2, so what happens for T+1? Can we do a swap before T+2? The answer is **YES**.

- Overnight swap (O/N): Near-leg is T+0, far-leg is T+1.
- Tomorrow/next swap (T/N): Near-leg is T+1, far-leg is T+2.
- Spot/next swap (S/N): Near-leg is T+2, far-leg is T+3.

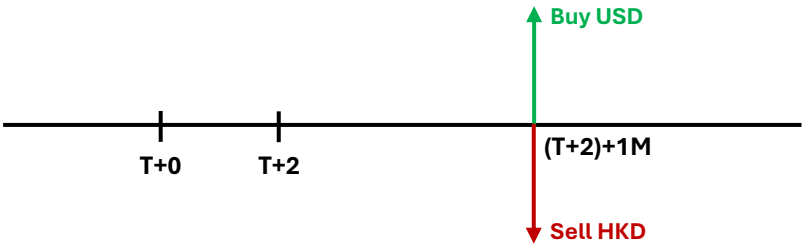
Example: We buy 1mio USDHKD T/N at 7.8095. Spot now is 7.8090.

The cashflows incurred are T+1: -1,000,000 USD and +7,809,500 HKD.
T+2: +1,000,000 USD and -7,809,000 HKD.

We lent our 1mio USD out and borrowed HKD at T/N rate on T+1.
One day later we will get back the 1mio USD using the spot rate at T+2.

3. FX Forward (FX Outright; FX O/R)

It is a single-leg transaction. If we buy USDHKD 1M outright, then we have:



Essentially it is a combination of 1M swap with spot (buy 1M USDHKD swap and buy spot).

	T+0	T+2	(T+2)+1M
Buy 1M USDHKD swap		-USD +HKD	+USD -HKD
Buy spot		+USD – HKD	
Overall (1M O/R)			+USD -HKD

Part II – Interest Rate Parity

There are two interest rate parities: *covered interest rate parity* (CIP) and *uncovered IRP* (UIP).

1. Covered Interest Rate Parity (CIP)

CIP assumes *no-arbitrage* conditions and determines the price of a forward contract. The mathematical expression of it is (assume USDHKD):

$$S \times (1 + r_{\text{HKD}} \cdot t) = F \times (1 + r_{\text{USD}} \cdot t)$$

- S: Spot exchange rate of USDHKD
- F: Forward exchange rate (agreed exchange rate)
- t: Fraction of year[1] (for denominator, HKD is 365 whereas USD uses 360).

Intuition: Assume we have 1mio USD, then the following two actions should have same payoff:

- Put the 1mio USD in treasury, and exchange it 1 year later.
- Exchange the 1mio USD into HKD first, then put the HKD into Hong Kong riskfree bonds.

The first action is L.H.S. of the equation and second action is R.H.S. of the equation.

2. Uncovered Interest Rate Parity (UIP)

UIP is based on CIP. It imposes a very strong assumption of "money markets are freely-traded and equilibrium will be attained". That is, for USDHKD,

$$\mathbb{E}[S_T] = F = S \times \frac{1 + r_{\text{HKD}} \cdot t}{1 + r_{\text{USD}} \cdot t} \ .$$

It can be interpreted as the expectation of "currency with higher yield will depreciate; vice versa". However, in real life we often see it fail, as the markets are driven by too many forces and friction.

---

[1] Depends on the rate you chose. If r_{HKD} and r_{USD} are annualized effective riskfree rates (such as US OIS rate), then the equation is correct within 1 year. For more than 1 year, exponential is needed, e.g. $S(1 + r_{\text{HKD}})^2 = F(1 + r_{\text{USD}})^2$. However, you will find deviations from the Bloomberg data. It is because Bloomberg uses something called *zero rates*, which applies 360-day-one-year rule.

Part III – Money in Pips

In FX, we express money in "pips" (percentage in point). Theoretically it refers to 0.0001 (1/100 of bps). However, some currencies have a relatively high face value which makes 0.0001 too small to talk about. For instance, USDHKD = 7.8090, so it is okay to use 0.0001 as a unit; but USDJPY = 156.98, 0.0001 is too small.

For this reason, we *usually* quote five significant figures of a currencies, and "1 pip" refers to the smallest increment for the five significant figures. That is why for JPY, 1 pip = 0.01 instead of 0.0001.

One of the most important things for FX trader is to know how much 1 pip in their currencies is. That is, we ask the question "if the spot goes up 1 pip, given USD 1mio notional, what is my PnL?".

An example is USDHKD = 7.8090. If I invest 1mio USD and spot goes to 7.8091 (+1 pip), I will earn $12.8057. We then say 1 pip = $12.8 for HKD. If we "earn 50 pips" in HKD, we earned 12.8*50 = $640 for each 1mio.

Trick: To calculate this, there are two ways I recommend. Choose the best for yourself.

Method 1 – Direct calculation (but smartly):
The change of position is $1\text{mio} \times \frac{0.0001}{7.8090} = 1{,}000{,}000 \times \frac{1}{78090} = 100 \times \frac{1}{7.8090} \approx \frac{100}{7.8} = 12.82.$
With this idea, you can apply it to any currency.
For example, USDSGD = 1.3423, 1 pip will be $\frac{100}{1.34} = 74.63.$
For instance, USDJPY = 156.88, then 1 pip will be $\frac{100}{1.56} = 64.10.$

Method 2 – Percentage
First convert everything to bps, then remember 1 bps refers to $100 for each 1mio.

For instance, if USDHKD is up 0.0008, what is the PnL if we invested 1mio? We first find the increase in % term, which is 1 bps (0.0008/7.8090 = 0.0001). Then it means we have $100 PnL.
(Verify with method 1: 12.82*8 = $102.56.)

If USDJPY is up 300 pips, what is the PnL if we invest 100mio?
3.00/156.88 is around 2%, which is 200bps = $20,000 per 1mio.
Therefore, PnL = 20,000 * 100 = $2,000,000.
(Verify with method 2: 64.10 * 300 * 100 = $1,923,000.)

Part IV – Swap Points

From Part II, we know that interest rate parity (usually referring CIP) indicates that the price of a forward

$$F = S \times \frac{1 + r_{\text{HKD}} \cdot t}{1 + r_{\text{USD}} \cdot t}.$$

For instance, if $r_{\text{USD}} = 5\%,\ r_{\text{HKD}} = 2.5\%,\ S = 7.8090$, then the 6M USDHKD forward will be priced[2] at

$$F_{6M} \approx 7.8090 \times \frac{1 + 2.5\% \times 0.5}{1 + 5\% \times 0.5} = 7.713768\,.$$

Recall that a swap can be replicated by spot and forward. Then, a 6M swap will be priced at

$$F_{6M} - S = 7.713768 - 7.8090 = -0.095232\,,$$

or -952.32 pips. We call this -952.32 pips as ***swap points***. In FX, when we talk about FX swap and forward, we usually use swap points. With this idea, we define

$$\begin{aligned}\text{Swap points} &= \text{Far Leg o/r} - \text{Near Leg o/r} \\ &= F_{\text{Near Leg}} \times \frac{(r_{\text{HKD}} - r_{\text{USD}}) \cdot t}{1 + r_{\text{USD}} \cdot t}.\end{aligned}$$

For S/N and swaps with longer tenors, spot is the near-leg. So $F = S + \text{swap points}$.
For O/N and T/N, **spot becomes the far-leg**. So $F = S - \text{swap points}$.

The series of swap points with different tenors is called ***swap curve***. In Bloomberg, we can use the [FRD] command to get the curve:

[Fig of FRD command]

[2] Note that in reality it may not be $t = 0.5$ as the actual $t =$ days to maturity / (360 or 365).
Also, the actual price is likely to deviate from the parity due to hedging activities. This will be mentioned in later parts.

Part V – Carry Trade

Carry trade assumes **no change in swap curve** (spot and forward prices all unchanged). It is an unrealistically strong assumption but it provides insights into our trade's safety of margin.

There are two types of carry: spot carry and FX swap carry.

Spot carry: Long/sell spot and roll it via T/N.

Assume we buy USD 100mio USDHKD spot at 7.8095 on July 15.

	July 15 (Today)	July 16	July 17 (Spot)
Long spot			+USD 1.000,000 -HKD 7,809,500

One day later, on July 16, the obligation becomes

	July 16 (Today)	July 17	July 18 (Spot)
Long spot (Traded rate = 7.8095)		+USD 1.000,000 -HKD 7,809,500	

However, trading desk usually does not have actual cash to settle the contract. To fulfill the obligation, we use T/N (short-term funding) to *roll* the obligation over the next day.

	July 16 (Today)	July 17	July 18 (Spot)
Long spot previously (Traded rate = 7.8095)		+USD 1,000,000 -HKD 7,809,500	
T/N swap (assume -3pips)		-USD 1,000,000 +HKD 7,809,800	+USD 1,000,000 -HKD 7,809,500
Overall		**+HKD 300**	+USD 1,000,000 -HKD 7,809,500

Notice how we have the same obligation on T+2, but with an extra HKD300 earned on July 17. Karen called it 空手套白狼 (catching wolf with empty hands). This is the *carry* we earned from the carrying USDHKD spot. The "free" carry comes from interest rate parity and the expected depreciation of USD which eventually did not happen.

We can repeat the rolling continuously until we do not want the spot position anymore. If we earn carry from the trade (e.g. long USDHKD in the example), we say it is a **+ve carry trade**. Reversely, if we short USDHKD in this example, it is a **-ve carry trade**.

If the spot or T/N points on July 16 changes, then the money will no longer be free. For instance, if the spot actually goes down to 7.8090 (USD depreciates against HKD), assume T/N unchanged[3], then

	July 16 (Today)	July 17	July 18 (Spot)
Long spot previously (Traded rate = 7.8095)		+USD 1,000,000 -HKD 7,809,500	
T/N swap (assume -3pips)		-USD 1,000,000 +HKD 7,809,300	+USD 1,000,000 -HKD 7,809,000
Overall		**-HKD 200**	+USD 1,000,000 -HKD 7,809,000

The obligation has changed and we actually lost money on July 17.

Then what is the point of carry? The answer is that it tells us how much spot can change before we lose money. If T/N is -3 pips, then spot is allowed to drop by 3 pips before we lose money. **If we think the spot will not drop by more than 3 pips, then we should enter the trade.**

FX Swap Carry: Long/sell swap and roll it using swaps.

Assume we sell USDHKD 3M swap on T+0, with spot 7.8090 and -195 swaps points.

	T+2 (Spot)	(T+2)+1M	(T+2)+2M	(T+2)+3M
Sell USDHKD 3M	+USD 1,000,000 -HKD 7,809,000			-USD 1,000,000 +HKD 7,789,500

Currently the 1M swap is at -75 points, we can immediately buy a USDHKD 1M swap:

	T+2 (Spot)	(T+2)+1M	(T+2)+2M	(T+2)+3M
Sell USDHKD 3M	+USD 1,000,000 -HKD 7,809,000			-USD 1,000,000 +HKD 7,789,500
Buy USDHKD 1M (Traded rate = 7.8090)	-USD 1,000,000 +HKD 7,809,000	+USD 1,000,000 -HKD 7,801,500		
Overall		+USD 1,000,000 -HKD 7,801,500		-USD 1,000,000 +HKD 7,789,500

Assume the swap curve does not change, we can repeat the 1M swap trade two more times.

[3] Note that T/N should change if rates are unchanged, according to interest rate parity. $\text{Swap points} = S \times \frac{\Delta r \cdot t}{1+r_{\text{USD}}}$.

1 month later, with spot unchanged at 7.8090 and 1M swap point = -75 points:

	T+2	(T+2)+1M (Spot)	(T+2)+2M	(T+2)+3M
Rollover Position		+USD 1,000,000 -HKD 7,801,500		-USD 1,000,000 +HKD 7,789,500
Buy USDHKD 1M		-USD 1,000,000 +HKD 7,809,000	+USD 1,000,000 -HKD 7,801,500	
Overall		**+HKD 7,500**	+USD 1,000,000 -HKD 7,801,500	-USD 1,000,000 +HKD 7,789,500

1 more month later, with spot unchanged at 7.8090 and 1M swap point = -75 points:

	T+2	(T+2)+1M (Spot)	(T+2)+2M	(T+2)+3M
Rollover Position		+HKD 7,500	+USD 1,000,000 -HKD 7,801,500	-USD 1,000,000 +HKD 7,789,500
Buy USDHKD 1M			-USD 1,000,000 +HKD 7,809,000	+USD 1,000,000 -HKD 7,801,500
Overall		**+HKD 7,500**	**+HKD 7,500**	**-HKD 12,000**

In total we earned HKD3,000.

To make calculation easier, we can think of *paying and receiving swap points*.

What we did:	T+0 –	Sell 3M at -195 points	(*pay* 2.10 points per day[4])
	T+0 –	Buy 1M at -75 points	(*receive* 2.42 points per day)
	T+1M –	Buy 1M at -75 points	(*receive* 2.42 points per day)
	T+2M –	Buy 1M at -75 points	(*receive* 2.42 points per day)

In total we receive -195-(-75*3) = 30 points, which corresponds to HKD3,000.

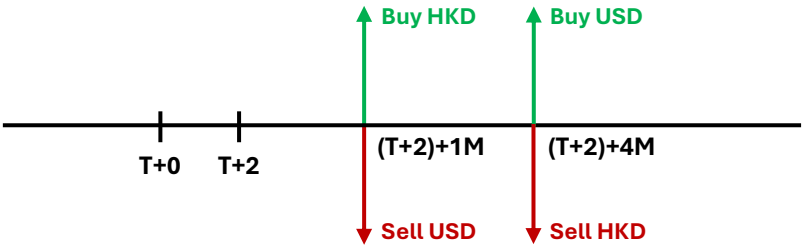
If we do this trade, we hope that the spot at T+1M and T+2M will not lower by more than 75 pips. In other words, **we have 75 pips safety of margin**.

[4] In this example, 1M has 31 days and 3M has 93 days. Then, daily point for 1M is -2.42 pips/day and for 3M is -2.10 pips/day. We want to buy low sell high, so we buy 1M and sell 3M.

Part VI – Rolldown Trade

Rolldown is essentially similar to FX swap carry trade. But this time we do not hold till maturity. We still assume the strong assumption of an unchanged swap curve.

A "1x4" (1-by-4) is a forward-forward contract. Its cashflow graph is:



It can be interpreted as

- "forward-forward": a contract that says you will enter a 3M outright 1 month later.
- "forward-swap": a swap with near-leg of 1M and far-leg of 4M.

It can be replicated by sell/buy dollar 4M and buy/sell dollar 1M.
Assume 1M swap point = -75 points, 3M swap point = -195 points and 4M swap point = -255 points

Then a 1x3 should be currently priced as $F = -255 - (-75) = -180$ points. We sell one 1x3.

One month later, it becomes a 3M outright (near-leg becomes spot, far-leg become 3M). Assuming unchanged swap curve, we can buy it at -195 points.

We sold at -180 and paid at -195; we earned -180-(-195) = 15 points.

Part VII – Implied Yields

US rates are the most traded rates in the world and hence it is extremely efficient and fair across different tenors, i.e. *smooth* (no bumps in the rate curves). For comparison, we may only have 1 trade per month for an illiquid tenor in some rate markets (such as Korea).

For this reason, often we do not know the actual rate to put in the interest rate parity. Using the last traded rate does not reflect the true rates. Since FX is more liquid than rates, we may use the FX forward price to back out the implied rate of the market.

For instance, given the following data

- USDCNH Spot = 7.2714,
- USDCNH 1M swap point = -150 pips,
- USD 1M SOFR OIS rate = 5.33%[5],

the implied yield (rate) for CNH is (assume 30 days to maturity)

$$\text{Swap points} = S \cdot \frac{(r_{\text{HKD}} - r_{\text{USD}}) \cdot t}{1 + r_{\text{USD}} \cdot t}$$

$$-0.0150 = 7.2714 \cdot \frac{(r_{\text{CNH}} - 5.33\%) \cdot \frac{30}{360}}{1 + 5.33\% \cdot \frac{30}{360}}$$

$$r_{\text{CNH}} = 2.8436\% .$$

It means that if we **buy** 1M USDCNH swap, we are

- Borrowing CNH at 2.8436% annualized rate for one month,
- Lending USD at 5.33% annualized rate for one month.

If T/N swap has an implied yield of 4.0921%, then we can **sell** T/N to

- Lending CNH at 4.0921% annualized rate for one month,
- Borrowing USD at 5.33% annualized rate for one month.

The USD part will cancel out each other, and we will be able to borrow CNH at 2.8436% and lend at 4.0921%. This will mean a 4.0921%-2.8436% = 1.2485% annualized profit for the trade, assuming an unchanged curve.

[5] Overnight indexed swap (OIS) is an IRS between some floating rate (here SOFR rate) and fixed rate. It essentially says: what is the fixed rate you are willing to receive every day so that you will pay SOFR rate to your counterparty every day throughout the contract period. It is generally perceived as the risk-free rates for USD.

Note: Be aware that implied yield depends a lot on the USD rate. If the USD rate changes, it may not be a good idea to use implied yield to think of trades. It is because **interest rate differential** is the core behind swap carry, but not **implied yield.**

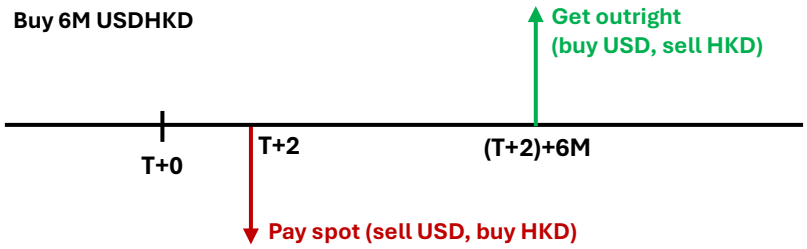
Use the above example, the T/N implied yield was 4.0921%, corresponding to a swap point of -2.5 pips. It is a good carry trade because we bought at -150 pips but sold at -2.5*30 = -75 pips, earning 75 pips.

But what if the USD SOFR rate is actually 5.75% for T/N? The T/N swap point is actually $7.2714 \times \frac{(4.0921\%-5.75\%)\div 360}{1+5.75\%\div 360} = -3.35$ pips. The trade will only earn -3.35*30-(-150) = 50 pips now, which is 33% worse (you lost 33% safety of margin!).

Same implied yield, but the ignorance on SOFR change exposed you to much higher risk!

Besides, if the USD rate is going to change, it means that there will be a FOMC meeting. If the final rate decision is different from the market expectation, the spot is going to change a lot! And this will definitely bring risks to our carry trade, which assumes no change in swap curve.

If we *buy* 6M USDHKD outright, the cashflow is the same as buying swap selling spot:



which i, and so we **pay** $\$(S - 952.32 \text{ pips})$.

On Bloomberg (FRD command), you will see something like this: