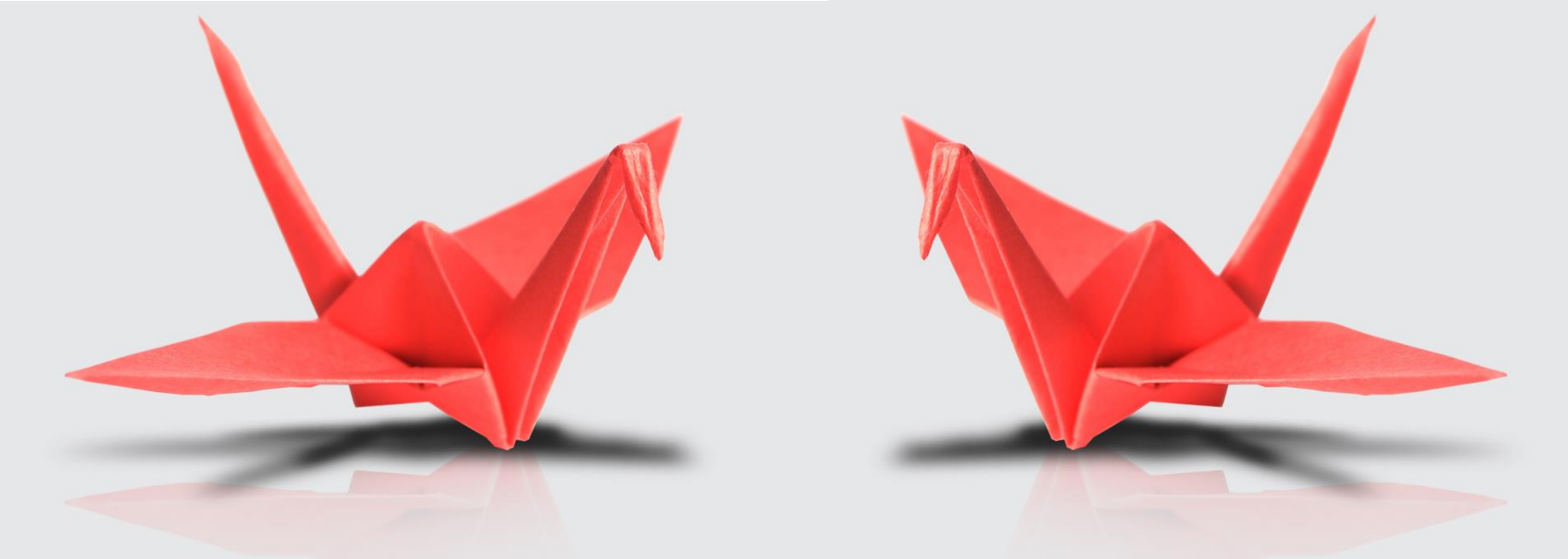


Cross-currency basis – what drives it?

Prof Jessica James, Commerzbank

Introduction

There's 'interest' in xccy basis swaps

- Negative rates in Europe and rising rates in the US makes it imperative for many global investors to look abroad, and hedging the FX risk attendant upon foreign assets becomes critical.
- The story of xccy basis swaps originates with the start of the floating currency market regime in the late 1970's / early 1980's, as corporations and investors with global exposure sought methods for hedging FX
- Forward FX rate contracts are popular hedges. The forward rate calculation is trivial, and any deviation in the market from the calculated rate gives traders a chance to do arbitrage trades, which makes such deviations unlikely.
- And yet, since 2008, such deviations have persistently emerged. They are expressed in the market as the 'cross currency basis', which is a spread to one of the Libor interest rates used to calculate the forward FX rate

- We sketch the theory and technical aspects underlying the fx basis, explain why a persistent non-zero basis has emerged since 2008, and illustrate how investors and issuers can take advantage of this market distortion

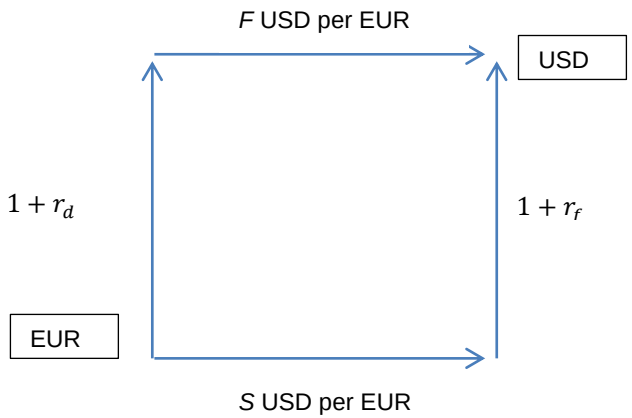
The FX forward rate

Perhaps the simplest formula in financial mathematics

- There are two ways of getting from holding the domestic currency now, to holding the foreign currency in the future
- Method 1. Invest now for the period in question, at the domestic interest rate, then exchange at the end of the period
- Method 2. Exchange now so that you hold the foreign currency, and invest at the foreign currency rate for the period
- Arbitrage pricing would tell us that Method 1 and Method 2 must be the same, or there will be a chance to 'round trip' the system and make some risk free money (arbitrage).
- Conventionally, and in the pre-crisis world, this will only occur in a small and transient manner, as sharp eyed traders look out for the chance and thus keep pressure on the forward rate to comply with the equation on the right

FX forward calculation

$$\frac{F}{S} = \frac{1 + r_f}{1 + r_d}$$



F = forward FX rate
S i= spot (current) FX rate
r_f = foreign interest rate
r_d = domestic interest rate
The FX rate is quoted as units of foreign currency per domestic currency, for example, 1.1 USD (US Dollar) per EUR (Euro).

Source: Bloomberg, Commerzbank

The inefficient market

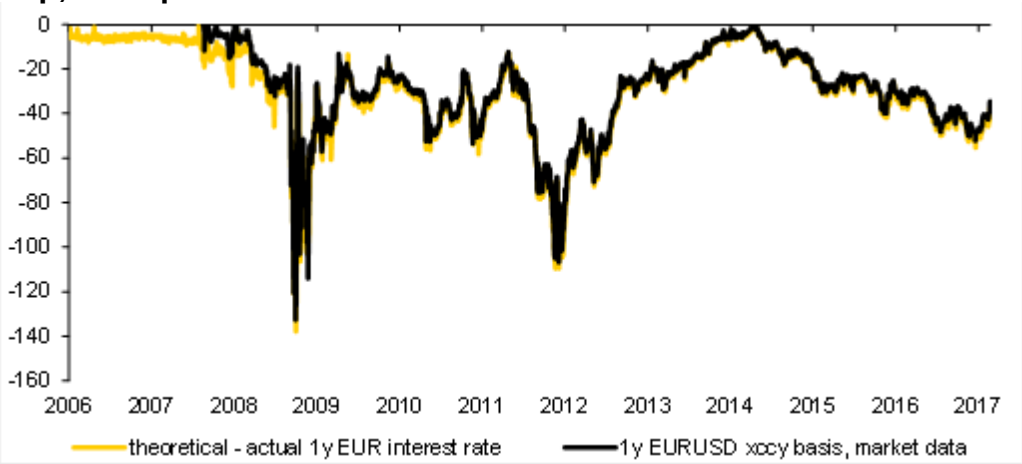
No-arbitrage pricing does not hold post-crisis

- Market size and liquidity do not however protect the FX forward calculation in the post-crisis world!
- If EUR is the domestic currency, and USD the foreign, then a quick re-arrangement gives us the equation on the right.
- We calculated r_d using this equation, and compared it to the market rate since 2000. Before 2008, the calculated value of r_d matches the EUR 1y swap rate. But after that date, they vary considerably
- We plot the difference, calculated using r_d (theory) - r_d (market), as the yellow line. We add the quoted xccy (shorthand for cross-currency) EURUSD 1y basis swap (black line)
- The degree to which the arbitrage pricing is violated is almost exactly equal to the market quantity known as the cross currency basis swap.

Interest rate difference and xccy basis

$$r_d = \frac{S}{F} \times (1 + r_f) - 1$$

'Theoretical' 1y EUR interest rate – actual 1y interest rate, in bp, with quoted basis



Source: Bloomberg, Commerzbank

Sample calculation

The forward rate calculation has not held since 2008

- What is going on? The calculation is not holding, even between the EUR and the USD, the two largest currencies
- This degree of violation is called the 'basis' or 'basis swap'
- It is expressed as the difference between the non-USD interest rate (in this case the 1 year EUR swap rate) implied by the FX forward, and the actual market value of this rate.
- One may exactly repeat this analysis for tenors from 3M to 30Y, and the same relationships will hold.
- The cross-currency basis seems to have moved in and is here to stay

On 29th December 2011

EUR-USD xccy basis	= 101.9bp (EUBS1 Curncy)
EURUSD spot FX rate	= 1.296 (EURUSD Curncy)
EUR 1Y swap rate	= 1.094% (EUSW1V3 Curncy)
USD 1Y swap rate	= 0.691% (USSA1 Curncy)
EURUSD 1Y FX forward	= 1.304 (EUR12M Index)

EUR 1Y swap rate (theoretical) = $\boldsymbol{r_d = \frac{S}{F} \times (1 + r_f) - 1}$

= 1.296/1.304 x (1+0.691%) -1

= 0.073%

But the actual swap rate is not 0.0733%, it is 1.094%.
The difference is
0.073% - 1.094% = -1.021% = -102.1bp

And this is almost exactly equal to the quoted basis in the market, -1.019%.

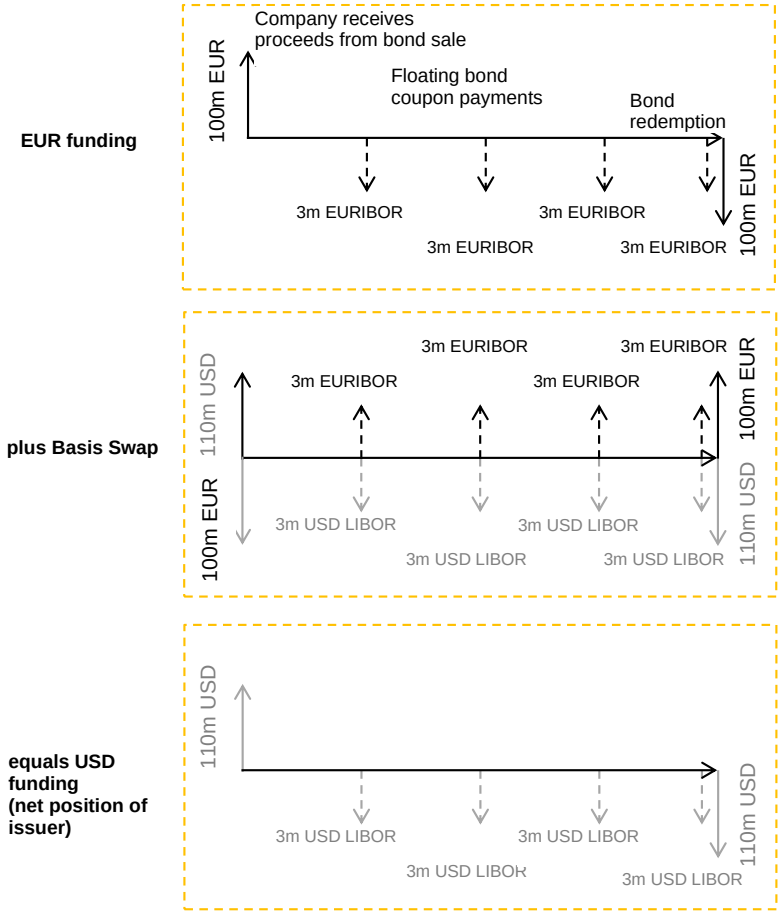
Note that market convention usually has the basis in bp though interest rates would more normally be in %

Source: Bloomberg, Commerzbank

What exactly is a cross currency basis swap?

The central figure is the cross currency basis swap

- Assume an institution starts off with EUR funding, which it converts with a basis swap to USD funding. This could be a EUR based issuer.
- The basis swap includes initial and final exchanges of capital (both at the spot exchange rate at the start of the deal) and interim floating rate interest rate exchanges
- The basis is expressed as the difference between the non-USD interest rate (in this case the 1 year EUR swap rate) implied by the FX forward, and the actual market value of this rate.
- At the start of the deal both currency legs will have the same value, but as FX rates vary then the value of the deal can change.
- Demand for USD cashflows means that the EURIBOR interest rate available for the deal is not the one which makes the PV of the EUR and the USD legs equal; it is a little less, and **this difference is the basis**



Source: Bloomberg, Commerzbank

Conversion Factor

An often neglected factor

- The conversion factor is the number of basis points per annum in one currency that equates to 1 basis point (bp) per annum in another currency
- It varies with the structure of the two interest rate curves. It does not depend upon the FX rate, where1 bp in one currency is always 1 bp in the other
- Where interest rate differentials are large the difference may be quite significant
- The conversion factor of a particular tenor is given by ratio of the sum of the discount factors up to that point of the different currencies – so for the 10 year point, it is the sum of all the EUR discount factors, divided by the sum of all the USD discount factors
- The example shows that the conversion factor element in cross-currency swaps made around 48% (or 36bp) of the overall swap costs of 76.0bp if the credit spread of the instrument is 400bp in February 2017.

To convert from basis points in a non-EUR currency into basis points in EUR:

If the non-EUR rates < EUR rates, then EUR conversion factor > 1
If the non- EUR rates > EUR rates, then EUR conversion factor < 1

Or vs the USD,

If the non-USD rates < USD rates, then USD conversion factor > 1
If the non-USD rates > USD rates, then USD conversion factor < 1

Example for conversion factor calculation as of 20 Feb 2017

Interest Rates (as of 20 Feb 2017)										
Tenor	1y	2y	3y	4y	5y	6y	7y	8y	9y	10y
USD	1.30%	1.56%	1.75%	1.90%	2.01%	2.09%	2.16%	2.26%	2.32%	2.38%
EUR	-0.21%	-0.15%	-0.07%	0.02%	0.13%	0.26%	0.38%	0.51%	0.64%	0.75%
Discount Factors										
USD	0.991	0.976	0.959	0.940	0.920	0.900	0.879	0.859	0.838	0.818
EUR	1.004	1.007	1.008	1.008	1.005	0.999	0.990	0.978	0.964	0.948
Conversion Factors										
	1.013	1.022	1.032	1.042	1.051	1.061	1.069	1.077	1.085	1.091

Source: Commerzbank Research

Source: Bloomberg, Commerzbank

Cross currency basis origins

Where does it come from?

- The basis arises because issuers prefer to match the currency mix they have on the asset side with the currency mix on the liability side while investors prefer to hedge their FX risk. for certain currencies, often the USD
- If an issuer cannot obtain sufficient foreign currency funding (as happened during the 2008 financial crisis), they can create synthetic foreign funding via domestic funding in combination with FX forwards (in the FX market) or basis swaps (the rates market).
- This can create a mismatch in the supply/demand for foreign funding and the hedging instruments.
- As long as the access to foreign funding remains distorted between domestic and foreign issuers and market participants lack balance sheet or credit lines to arbitrage away the distortion, there will be pressure for the basis to exist

- Increased sensitivity to credit risk has driven swap and deposit curves apart since the crisis, with markets putting a different price on the risk of a loan (with its large cashflow at maturity) to the risk of a swap (where cashflows are based on rate differentials). This ‘curve multiplication’ drives and sustains the xccy basis.

Drivers of the basis

It centres on issuance of debt in different countries and currencies

Note that the top boxes and the bottom boxes 'balance' each other – if the top boxes dominate, the basis becomes more negative; if the bottom box effects grow, the basis becomes less negative.

USD (EUR) payer swap: owner of a cross-currency basis swap which changes their net position from paying USD (EUR) floating rates to paying EUR (USD) floating rates.

Negative Basis: the difference between the actual interest rate for a currency and the theoretical interest rate. When the actual rate is less than the theoretical rate, the basis is negative.

Issuers and the xccy basis

Situations in which issuers would be USD payers

USD Payer swap : USD funded, wish to raise EUR

Why? Tight EUR credit spreads relative to USD

Result: **More negative basis**

Current situation: Balanced effect. Given the US credit spread tightening after the Trump election relative to €, the € funding advantage for US issuers has become less compelling and so-called reverse yankee issuance has subsided (for most of last year, the effect was large)

Source: Commerzbank

Investors and the xccy basis

Situations in which investors would be USD payers

USD Payer swap : EUR based, EUR synthetic investment

Why? Asset diversification, capture higher yields abroad

Result: More negative basis

Current situation: Modest effect. While there is significant asset scarcity due to ECB purchases, the credit spread pick-up in the US has become less compelling. Foreign dollar portfolios with rolling fx hedges at the front end also appear less attractive at the moment given prevailing fears of faster Fed hikes.

Source: Commerzbank

Issuers and the xccy basis

Situations in which issuers would be EUR payers

EUR Payer swap: EUR funded, wish to raise USD

Why? For some products and tenors, it is cheaper to issue in USD

Result: Less negative basis

Current situation: Moderate effect, most significant in longer tenor instruments where the conversion factor is large and ECB purchases less relevant, or in short tenors for highly rated entities like KFW where the EUR credit curve is very flat.

Source: Commerzbank

Investors and the xccy basis

Situations in which investors would be EUR payers

EUR Payer swap: USD funded, but EUR investment

Why? Asset diversification

Result: Less negative basis

Current situation: Small effect, tight spreads and elevated political risks in euro area make assets less attractive for foreign investors

Source: Commerzbank

Issuer Decision Process

More complex than it used to be

- A company will want to issue debt in the most economical way. Credit spread due to their own issuer quality in their own country needs to be compared with that in others
- The base level of interest rates in different countries is important. Cross currency basis and cost of FX hedging must be included. The conversion factor matters as well.
- A combination of these effects means that many moderate credit quality companies in the US choose to issue debt in EUR
- Euro area supras and agencies are the prominent counter example, as they actively cover their EUR funding needs in the USD market and hence take advantage of the basis.

- Another significant basis driver is currency mismatches on the balance sheets of large financial institutions.

Why does it persist?

What keeps the basis swap from being arbitraged away?

- We can see why there might be one-way pressure on the forward rate/Libor rates, but traditionally, an equal and opposite pressure would be provided by arbitrage activity which would bring rates back in line. Why does this not happen?

- **Capital cost of FX derivatives**: derivatives like cross currency swaps which are used to arbitrage the basis all require large amounts of risk capital to be held against them. Arbitraging will thus entail a cost and have a limited extent

- **Counterparty risk and credit limits:** credit quality of the counterparties limits the exposure that one institution can have to others. This limits the extent to which leveraged investors can arbitrage the basis away.

- **Clearing:** Cross currency swaps are not eligible for clearing with many of the world's larger exchanges. Non-cleared derivatives tend to attract a higher cost of funding.

- For a highly rated cash rich organisation, which could issue bonds in USD and take advantage of the basis to do a swap to the end date to deliver value in a different currency, then the cost of placing bonds is important. For a large hedge fund, price and availability of funding to provide the large arbitrage cash flows will be paramount.

XVA

Where does it come from?

- Credit-derived costs of doing deals. The first popular one was CVA (credit valuation adjustment) then DVA (debit value adjustment) and then many more until XVA became a shortcut.
- Derive from old-style management of loan portfolios
- There are many complexities involved in taking the concept from a simple loan to a derivatives portfolio!
- These include multiple transactions and how they might offset each other, positive and negative deal values, exposure probabilities and profile, etc
- To reduce exposure, many counterparties began to take mitigation measures like netting agreements or posting collateral

If all you have is a loan…

Expected Loss =
(exposure at default) x (probability of default) x (loss given default)

- Can create an exposure 'profile' through time which is dependent on deal type
- Strongly credit dependent
- Often dependent on legal/country specific factors

Source: Bloomberg, Commerzbank

Why XVA?

Risk vs cost

- Originally, exposure management was designed to reduce risk
- But it is complex. Imagine a risky, but profitable deal. Perhaps the client does other business with the Bank as well. Perhaps the deal adds ccy risk.
- This decision would take time, and involve multiple people. If it could be reduced to a cost decision, it would be simpler.
- If risk becomes cost, then no need to worry about exposure, netting, correlation, collateral, etc
- The growing complexity of managing the risk of a portfolio of deals paved the way for the introduction of CVA

When risk becomes cost

If

Profit of deal > cost of deal

Then

Do the deal!

Market calculation

Including all risk factors

Source: Bloomberg, Commerzbank

CVA

Many different ways of calculating this

- Full calculation as given opposite
- Calculate by cost of hedging using CDS or proxy
- This gives risk to internal 'CVA desks' whose job it is to take on the credit risk of deals in the book
- Discounted cashflows – CVA is assumed to be the difference between the future cashflows discounted by the risk free rate and by the credit adjusted rate
- Duration approach – quick and dirty but well correlated to other approaches

Calculations

$$CVA = (1-\delta)\sum_{j=1}^{m} DF(t_j)\, EE(t_j)\, q(t_{j-1}, t_j)$$

Recovery fraction

Discount factor

Expected exposure at time t

Default probability from time t_j to t_{j-1}

$$CVA = \sum_{t=1}^{T} PV_{cashflow}(CDS_t)$$

$$CVA = FV_{risk\ free} - FV_{credit\ adjusted}$$

$$CVA = MTM \times Credit\ Spread \times Duration$$

Source: Bloomberg, Commerzbank

DVA

Controversial when first introduced

- CVA is not the whole story
- For every transaction, each counterparty will calculate CVA with respect to the other(s).
- DVA (debit value adjustment) is the CVA from the perspective of a company's counterparty looking back at the company
- Why should a company include its own credit risk in a calculation?
- And when the credit quality of a company goes down, its DVA goes up, thus meaning deals may be 'cheaper' to do.

Why use DVA

› DVA is needed to arrive at a mid-market value of the deal from both counterparties' point of view (although this must be tempered by the realisation that the DVA one counterparty calculates is probably not exactly the same as the CVA calculated by the other).

› In one way, DVA has always been included when valuing transactions like bonds – lower credit issuers have to pay a higher credit spread when selling bonds (ie make them more valuable).

› Finally, in case of a default, a lower credit counterparty would repay only the recovery amount, which is lower for lower credits, thus can be viewed as a benefit to the issuer.

› Bilateral valuation adjustment (BVA) is sometimes used to refer to CVA+DVA.

› There are other XVAs – FVA (funding value adjustment) COLVA (including collateral) and others.

Source: Bloomberg, Commerzbank

How XVA can drive the basis

'Costs' of some deals are higher than they used to be

- Cross currency swaps have heavy XVA and capital costs, due to the large notional exchange at expiry
- But, xccy swaps are the very tools one would use to arbitrage the basis. Thus XVA could place limits on the basis arbitrage
- There have frequently been 30-50 bp of value in the basis, so there must be a substantial barrier to doing the trade
- In pre-crisis times, the basis would have been close to zero, as can be seen on the graphs
- Perhaps we can estimate the limits which XVA and capital costs place on the basis

10y EURUSD xccy basis

10y USDJPY xccy basis

Source: Bloomberg, Commerzbank

Estimate of XVA costs

Very little information out there!

We use a sample of Commerzbank data from Feb 2017, for a set of hypothetical counterparties, with no particular degree of offset to the rest of the trading book. We can see that CVA and FVA are higher for longer term deals and lower credit counterparties, that hedge costs behave similarly to CVA and FVA, and that DVA is lower (more negative) for lower credit counterparties and longer term deals. Hedge costs are associated with the hedges which the trading desk uses to reduce trading book volatility.

For the 10y case, we see that the XVA cost of doing this deal with a AA, BBB or BB- counterparty would be 2, 8 or 12 bp. But in February 2017 the EURUSD 10y basis swap traded at -40 bp. Thus even most conservatively, there would have been about 30 bp of profit to be made.

Hypothetical XVA charges (costs are annualised, in bp)

EURUSD xccy XVA charges	AA 2y	AA 5y	AA 10y	BBB 2y	BBB 5y	BBB 10y	BB- 2y	BB- 5y	BB- 10y
CVA	0.4	0.6	0.8	2.6	6.4	8.1	5.1	9.9	11.3
DVA	-0.6	-0.8	-0.9	-3.4	-10.1	-18.4	-3.4	-10.1	-18.4
FVA	-0.0	-0.0	-0.0	-0.7	-1.4	-2.6	-0.6	-1.4	-2.4
Hedge cost	0.0	0.0	0.0	0.2	0.5	0.7	0.3	0.6	0.8
Cost of Capital	0.9	1.0	1.2	0.9	1.0	1.2	0.9	1.0	1.2
EU Bank Levy	0.0	0.0	0.0	0.3	0.4	0.7	0.3	0.4	0.7
Total Deal Cost (CVA, bp)	1	2	2	3	7	8	6	11	12
Total Deal Cost (-DVA, bp)	1	2	2	4	11	18	4	11	19

Source: Bloomberg, Commerzbank

XVA costs through history

‘Costs’ of some deals are higher than they used to be

- Is February 2017 an outlier? To try and see, we we ‘scale’ the CVA part of the trade costs, assuming that the other costs stay approximately constant.
- We use the Markit ITraxx Europe Senior Financial Index* which comprises 30 CDS spreads on investment grade European financial entities.
- If we look back at all the equations for the CVA calculations, it’s clear that it should roughly scale with CDS spreads in all cases.
- Prior to 2014, we could indeed have made a case that XVA charges and the xccy basis were strongly related, and that the basis was to some extent limited by the charges. But since then this relationship has broken down.
- In Jan 2015 the ECB expanded its QE program. This has kept EUR rates at record lows while US rates are rising. This puts some widening pressure on the basis
- However, it is still not clear why the basis is not arbitraged away.

XVA and capital charges vs xccy basis swap

Source: Bloomberg, Commerzbank

* SNRFIN 5Y on Bloomberg

‘I want to trade the basis’

Why doesn’t it work?

- ‘The difference between the interest rate derived FX forward and the actual traded forward is 33 forward pips, or -28 basis points. So, I will do the two interest rate contracts, and the actual traded forward, to lock in the basis.’ – trader thinks
- But those interest rates above are NOT depo rates. They are 1y swap rates. The USD depo rate is, about 28 basis points higher, at 1.77%. This is one way of appreciating that the basis is due to credit.
- Our hopeful trader cannot borrow and lend at these rates. This is part of the ‘multiplication of curves’ – the yield curve for swaps (less credit risk) and for deposits (more credit risk) differ, whereas before the crisis they were almost the same
- Ok, says the still-hopeful trader. Let’s do the two interest rate components of this set of deals with two fixed-floating IRS. Fine, we can now access the above interest rates.
- But, because the trader is not now doing the deposit contracts, he or she will have to fund the future exchange cashflow, so will need to hold the principal amount on the books until the deal expiry. This needs to be funded… from the deposit market!

The following data is taken from trading screens on 6th July 2017, for deals with start date 10th July 2017, end date 10th July 2018.

EUR interest rate	-0.30%
USD interest rate	1.48%
Spot FX rate	1.1423
Market Forward Rate	1.1660 (forward points are 237)
Implied Forward	1.1626 (implied from interest rates)

The implied forward is calculated using the expression

$$\frac{FX2}{FX1} = \frac{1 + r_2}{1 + r_1}$$

where

FX1= Spot FX rate
FX2 = 1y implied forward FX rate
r_2 = USD 1y interest rate
r_1 = EUR 1y interest rate

The xccy basis here is often quoted as a spread to the implied forward, so in this case it would be 34 ‘forward pips’. This translates back to an interest rate spread of -28 basis points – so one could also imply a USD 1y interest rate of 1.48%+.28% = 1.76%. Thus if one applied the ‘correction’ to the EUR interest rate it would come out as -0.58%.

Source: Bloomberg, Commerzbank

Yield pickup calculation

Basis-derived opportunities – can we make some money?

- We calculate a ‘yield pickup’ for 1Y government bonds. We assume that the investor is based in Germany, and can hold or short via repo bonds in Germany, the USA, Japan, the UK and Australia, with similar rating or perceived credit risk
- The yield pickup is the bond interest rate differential hedged for the 1Y period via the cross-currency swap market. It is given by $\Delta_{bond} - \Delta_{swap} + basis$, where Δ_{bond} and Δ_{swap} are the 1Y yield differentials for the relevant instruments in each currency.
- If the spread of bond yield to swap was the same in both currencies, the first two terms would cancel out
- If then the basis were zero there would be no pickup at all.

- So it is due to differential market views on credit and to the basis.

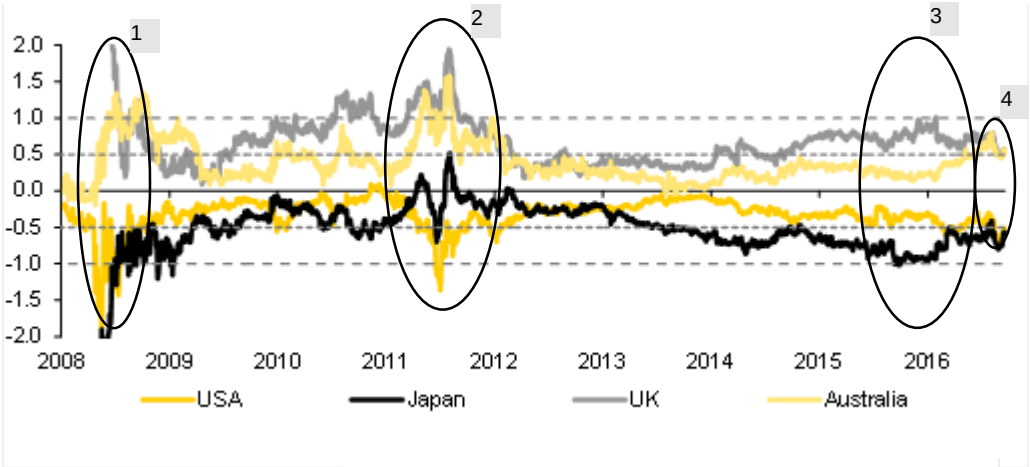
Yield pickup history

Opportunities in the basis world

- To the right is the time series of this yield pickup since the end of 2008 for the different currencies. The second graph focuses on the EURUSD case, showing Δ_{bond} and Δ_{swap} and the basis separately
- (1) sees both JPY and USD with a negative basis from the EUR investor's point of view; in 2008, clearly both were seen as safe havens from the crisis storm.
- In (2) in 2011 however, the JPY correlates more strongly with AUD than USD, and only the USD is seen as the true safe haven in the first of the Greek debt crises.
- More recently in (3), both USD and JPY maintain a negative basis but short range movement of the JPY basis can correlate with more risky currencies.
- Finally, we see in (4) that all four currency bases are going lower vs the EUR, quite possibly indicating a general nervousness about the euro area in a time of multiple elections, where political surprises and reversals are becoming the norm.

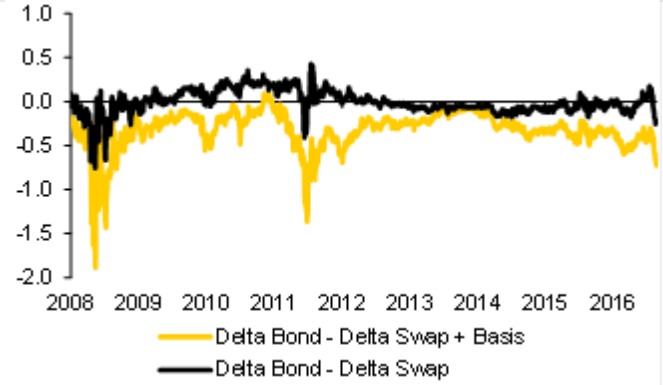
Yield pickup, with potential arbitrage opportunity levels

Pickup for a EUR based investor, using 1Y foreign govt bonds, in %



EURUSD yield pickup components (%)

The addition of the basis makes a significant difference



Source: Bloomberg, Commerzbank

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I) Recommendations versus benchmarks:

Overweight (OW)	We expect outperformance versus the benchmark in spread and/or total return terms
Marketweight (MW)	We expect performance in line with the benchmark in spread and/or total return terms
Underweight (UW)	We expect underperformance versus the benchmark in spread and/or total return terms
Benchmark:	Unless stated otherwise, the benchmark is the iBoxx € Corporate for IG-rated names/instruments, and the iBoxx € High Yield core cum crossover LC for HY-rated names/instruments

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Distribution of Commerzbank AG credit research recommendations as of 31 March 2017

	All covered instruments	The proportion of issuers in each of these categories for which Commerzbank provides investment banking services
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Marketweight	26%	42%
Underweight	38%	21%

Source: Commerzbank Research

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