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Research Report

Role of cross currency swap markets in funding and investment decisions

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Occasional Paper Series

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Role of cross currency swap markets in funding and investment decisions

No 228 / August 2019

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Abstract

A US dollar funding premium in the EUR/USD cross currency swap market has been in existence since 2008. Whilst there are many reasons behind this dislocation, since 2014 the divergence in monetary policy between the euro area and the United States has played a growing role. This paper aims at exploring and gaining more insight into the role the Eurosystem's Expanded Asset purchase Programme (APP) has had in guiding investment and funding decisions and its influence on the cross currency basis. The downward pressure on yields, exerted by the APP, has made euro assets less attractive and has led investors to search for yield abroad. At the same time, the decline in yields and tighter credit spreads have attracted US corporate issuers to the euro market in search of cheaper funding costs. These cross-border flows from issuers and investors have played a strong role in driving the US dollar funding premium. The purpose of this study is to gauge whether these changing trends in cross-border flows have implications for the implementation of the Eurosystem's APP. Beyond the structural increase in the US dollar funding premium described above, a cyclical component has led to an amplification of the premium over balance sheet reporting dates, due to new bank regulations. This paper also analyses the behaviour of euro area banks in cross currency swap markets over balance sheet reporting dates, using the money market statistical reporting (MMSR) dataset in order to discern whether the increase in the US dollar funding premium at these specific points in time has an adverse impact on the transmission of monetary policy.

Keywords: cross currency basis swap, US dollar funding premium, monetary policy divergence, cross-border investment and funding flows, balance sheet reporting dates, balance sheet constraints

JEL codes: D53, E52, G11, G15, G18

Executive summary

A cross currency swap occurs when two parties simultaneously lend and borrow an equivalent amount of money in two different currencies for a specified period of time. A US dollar funding premium in the EUR/USD cross currency swap market has been in existence since 2008. This means that the rate at which the US dollar is sourced in the cross currency swap market is more expensive than is warranted by the Covered Interest Rate Parity (CIP) condition. CIP implies that the interest rates priced in cash/bond markets should correspond to the interest rates implicit in cross currency swap markets. The deviation from CIP in the swap market is known as the cross currency basis. Whilst there are many reasons behind this dislocation, since 2014 the divergence in monetary policy between the euro area and the United States has played a growing role. Monetary policy divergence alters the price of money in relative terms, thereby influencing the relative demand for and supply of currencies. Furthermore, central bank non-standard measures (e.g. purchase programmes) impact supply by creating readily available liquidity in the respective currencies. On balance there has been a large demand for US dollars in the cross currency swap market to hedge FX risk and fund US dollar assets. New regulatory requirements put in place since the financial crisis, which have increased the cost of engaging in transactions that can be used to take advantage of discrepancies in the basis, have impeded possibilities for arbitraging away the US dollar funding premium (euro discount).

The divergence in monetary policy has affected investment and funding decisions. The Eurosystem's Expanded Asset Purchase Programme (APP) intervenes directly in the supply and demand of securities by extracting duration from the market and exercising downward pressure on yields. This downward pressure on yields has led investors to search for yield outside the euro area. At the same time, the decline in yields and tighter credit spreads have attracted US corporate issuers to the euro market (so-called reverse yankees) in search of lower funding costs.

Cross-border investments and cross-border issuance are exposed to interest rate risk and FX risk. To hedge the FX risk, bond issuers and investors enter into cross currency swaps. These flows from issuers and investors have played a strong role in driving the US dollar funding premium. The widening of the basis (i.e. larger US dollar premium) has worked to the advantage of some highly rated euro area supranational, sub-sovereign and agency (SSA) issuers active in the US dollar market. This has allowed them to obtain cheaper funding by converting proceeds from US dollar funding into euro. The widening of the basis has also worked to the advantage of US dollar-rich market participants. Overall, however, the demand for dollars has outweighed the supply in the cross currency swap market, leading to an adjustment in prices i.e. a euro discount compared to the CIP condition. As there is evidence that the size of the basis impacts the behaviour of issuers, the basis thereby also impacts the eligible universe available, in particular for CSPP and supranational purchases under the PSPP.

Beyond the structural increase in the US dollar funding premium described above, a cyclical component has led to an amplification of the premium over balance sheet reporting dates. This suggests a causal relationship between bank regulation and asset prices. Analysis conducted for this study, using the recently launched MMSR data collection system, analyses the behaviour of the cross currency basis and confirms the role played by balance sheet constraints at these specific points in time. In themselves, these frictions do not warrant policy action as they are not symptomatic of a malfunctioning market, nor do they raise financial stability concerns. Nevertheless, this study delivers insightful evidence of the relationship between bank regulation and asset prices. These findings in themselves merit further study, in particular regarding the extent to which bank regulation may interact with monetary policy implementation.

1 Overview of cross currency swaps

The following chapter provides an overview of cross currency bases as embedded in cross currency swaps. This includes: a brief introduction to what a cross currency basis is; what factors contribute to the pricing of the basis; why the EUR/USD basis has not been arbitraged away; and, finally, an update on recent developments in EUR/USD basis pricing.

1.1 Introduction to cross country swaps

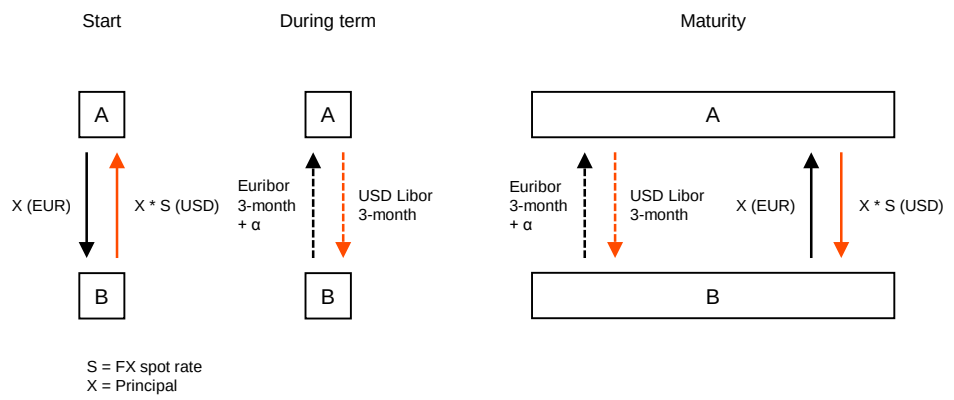
Cross currency swaps are used by market participants as a means of hedging currency exposure or speculating on currency direction over a given period of time. A cross currency swap occurs when two parties simultaneously lend and borrow an equivalent amount of money in two different currencies for a specified period of time. It entails an exchange of interest payments in one currency for interest payments in another. The interest rates can both be fixed, both be floating, or one of each. As well as the exchange of interest payments, there is also an exchange of principals (in the two different currencies) at the beginning of the contract and at the end, at the spot rate prevailing when the swap is initiated.

As suggested by the BIS (2016), covered interest parity (CIP) is “the closest thing to a physical law in international finance”. CIP stipulates that the interest rate differential between two currencies should equal the differential between the forward and spot exchange rate. Therefore it implies that the interest rates priced in cash/bond markets should correspond to the interest rates implicit in cross currency swap markets for the respective currencies. In the event that these rates do not correspond to the FX forward rate, an opportunity would exist that would allow a party to generate a riskless profit. Under efficient markets, such an opportunity should be arbitraged away immediately by market participants. However, for a number of reasons outlined in Section 1.2.2 below, since 2008 in particular, CIP does not hold in FX markets, resulting in a persistent cross currency basis across many currency pairs, including EUR/USD.

A cross currency *basis* swap is a floating-for-floating exchange of interest rate payments and notional amounts in two different currencies. The cross currency basis is indicative of supply and demand for one currency versus another. It is the additional cost, or gain, of transacting between one currency and another, not explained through the published reference interest rate differential. Chart 1 below provides an overview of the transactions conducted within a cross currency basis swap, where α identifies the basis.

Chart 1

Overview of cross country basis swaps



Source: ECB.

EUR/USD cross currency swaps are priced assuming the US dollar LIBOR leg of the transaction is exchanged as is and any premium/discount for the other currency is the quoted parameter (the basis α in the above chart). In a EUR/USD cross currency swap, the basis α is the negative spread added to the non-USD leg of the interest payments. For example, in a 3-month EUR/USD cross currency swap, a negative quotation of -25 basis points (bps) means that the counterparty borrowing USD in a cross currency swap pays the 3-month US dollar Libor, while the counterparty borrowing the euro in the same transaction pays the 3-month Euribor minus 25 bps. In the case of EUR/USD, where the euro has been consistently at a discount compared to the US dollar, an increase in the discount is referred to as a widening of the basis, while a reduction in the discount is referred to as a tightening of the basis.

1.2 Demand/supply drivers of the EUR/USD basis

The pricing of a cross currency basis is mostly determined by currency supply/demand dynamics and the availability and cost of instruments that can be used to benefit from the basis and thereby “arbitrage” it away. The following section considers the demand/supply drivers behind the EUR/USD basis pricing, both from a structural perspective and considering developments in this market post-financial crisis.

1.2.1 Structural drives of the EUR/USD basis

There are a number of structural drivers behind the movement of the EUR/USD basis, on both the demand side and the supply side for the two currencies. Those market participants that demand (or borrow) US dollars will receive the basis, in other words, make the US dollar premium larger, eventually causing the basis to become negative, as has been the case since 2008 due to an increased demand for US dollars. Those that supply US dollars will pay the basis. For a given demand, the higher US dollar supply yields a less negative basis.

On the demand side for US dollars:

1. The euro area banking sector, in particular, affects the basis, given that these institutions tend to hold dollar-denominated assets without having a natural dollar-denominated deposit base. These banks need to fund their US dollar assets and can so do in a number of ways, for instance by issuing commercial paper (CP) or certificates of deposit (CDs) or via repurchase agreements (repo) etc. in US dollars. Alternatively they can fund in euro and convert euro to US dollars using cross currency swaps.

2. Euro area investors looking for higher returns in the United States (this will be dealt with in Chapter 2): The FX risk associated with the purchase of US dollar assets can be hedged with a cross currency swap.

3. US issuers of euro-denominated debt (this will be dealt with in detail in Chapter 3) can resort to a cross currency swap if they want to swap their euro liabilities back to US dollars.

On the supply side of US dollars:

4. Euro area issuers of US dollar-denominated debt (this will be dealt with in Chapter 3): To the extent that these euro area issuers want to swap their US dollar liabilities back into euro, they can use a cross currency swap to do so.

5. US investors investing in euro assets (this is touched upon in Chapter 2): Even though, as is the case now, yields are lower in the euro area than in the United States, during certain periods US investors may be able to realise a yield pick-up by swapping US dollars to euro and investing the proceeds in euro bonds if a sufficiently large widening in the basis has occurred. They can do so using a cross currency swap.

The balance of all these players will impact the price of the basis. Furthermore, the relative amount of excess liquidity in euro and US dollars as a result of central bank actions contributes to the relative supply/demand of/for the currencies.

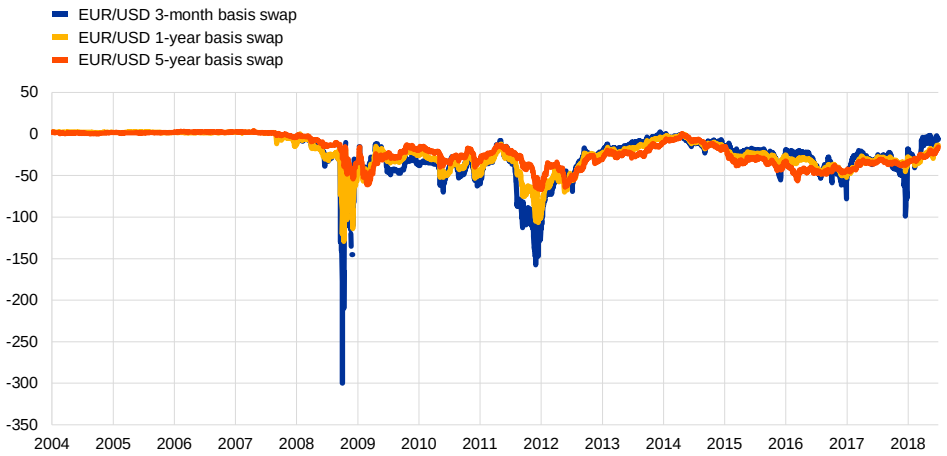
1.2.2 Post-crisis developments in the EUR/USD basis

Prior to the financial crisis, market pricing adhered to CIP, with the EUR/USD basis generally priced at, or close to, zero, with investors tending to arbitrage away any potential risk-free income, as detailed above. However, since 2008, deviations from zero have persistently emerged; evident from Chart 2 below, there has been a sometimes significant negative basis (euro discount) on EUR/USD transactions at all maturities (with the negative figure indicating that a party seeking to switch from euro to US dollar holdings is required to pay a premium for borrowing US dollars in the cross currency swap market).

Chart 2

EUR/USD basis (3-month, 1-year & 5-year)

(bps; basis swap spreads)



Source: Bloomberg.

Firstly, immediately in the wake of the 2008-2009 financial crisis, amid heightened global risk aversion emanating from the financial system, market participants reduced their direct cash lending due to counterparty credit concerns. This resulted in a sizeable US dollar shortage in global money markets, leading market participants to satisfy their US dollar needs through the swap market, particularly due to the secured nature of this transaction, resulting in a widening in the basis for most major currencies against the US dollar.

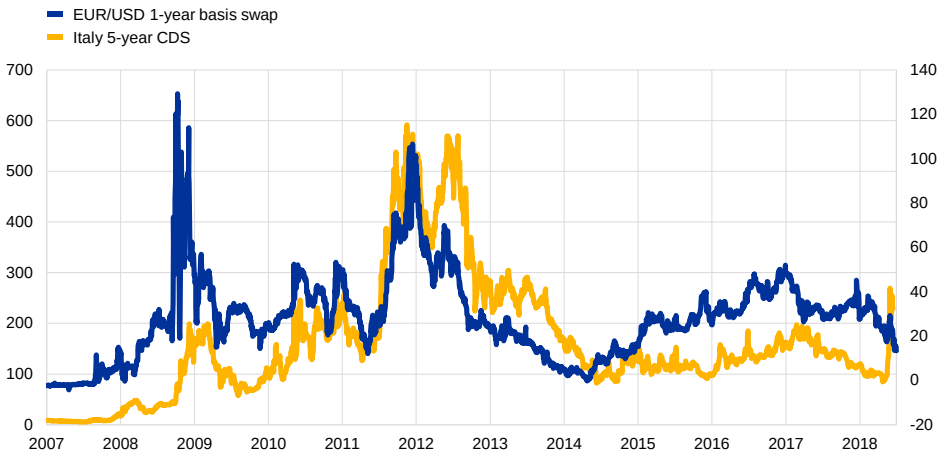
Later, amid the 2011-2012 euro area sovereign debt crisis, heightened credit risk fears gave rise to another widening in the EUR/USD basis, in line with a significant increase in the CDS levels on several European sovereigns and banks (Chart 3).[1] During this period, when US dollar funding became less available to euro area banks, these institutions were required to depend on cross currency swaps to manage their FX exposure and liquidity. Furthermore, at this time US firms sought to retrench US dollar funding from the euro area back to the United States, also contributing to a widening in the basis.

[1] This heightened risk aversion also spilled over into credit markets, with a similar upward move in the interbank lending rates charged in the euro area, with US banks seeing increased credit risk within the European banking sector.

Chart 3

EUR/USD 1-year basis (inverted) & Italian 5Y CDS

(left-hand scale: credit default swap, percentage; right-hand scale: inverted basis swap spread, bps)



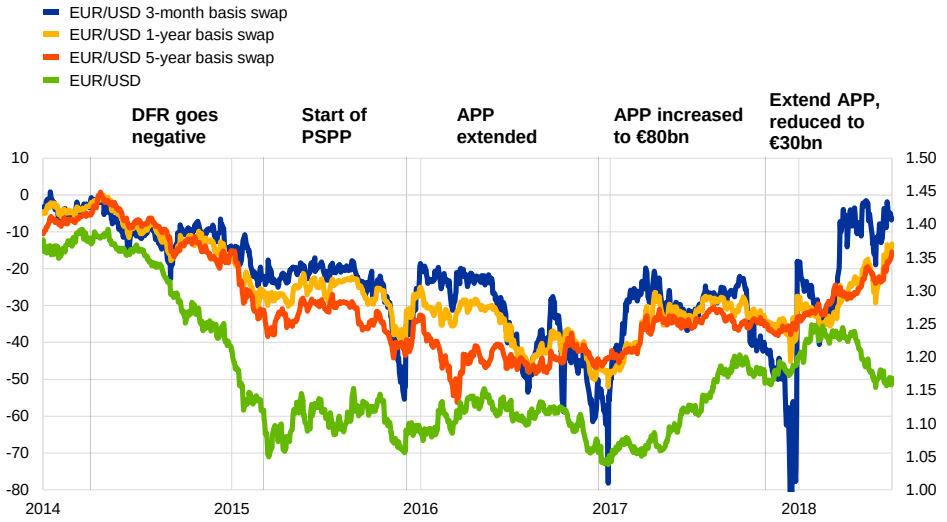
Source: Bloomberg.

Throughout 2014-2017, there was a persistent EUR/USD negative basis (euro discount) priced into markets, despite the significantly reduced credit risk premia and more benign market conditions. The primary contributor to this seems to be the divergence in monetary policy between the euro area and the United States. Throughout this period, the Eurosystem maintained a negative rate policy, with the rate on the Deposit Facility reaching -0.40% in March 2016, and continued net asset purchases through the APP. Conversely, over the period the Federal Reserve began its rate-hiking cycle, in December 2015, and also began the process of balance sheet normalisation. This policy divergence between the euro area and the United States, and certain policy announcements in particular, have coincided with relatively higher demand for US dollars via the cross currency swap market and a widening in the EUR/USD basis (Chart 4).

Chart 4

EUR/USD, Cross currency basis (3-month, 1-year and 5-year) and main ECB announcements

(bps; left-hand scale: basis swap spreads; right-hand scale: EUR/USD)



Source: Bloomberg.

Throughout the first half of 2018, there was a significant easing (tightening) in the basis swap, reducing the cost of switching between euro and US dollars. In part, this reduction was driven by shifts in investment flows, with euro area investors having reduced the pace of purchases of US Treasury debt over this period. In addition, some commentators have noted that an adjustment in US tax law (the Base Erosion and Anti-Abuse Tax or BEAT) that aims to reduce the ability of multinationals to minimise US tax liabilities also contributed to this easing, as US branches of foreign corporations are now more incentivised to raise US dollars locally than receive an intercompany loan from headquarters (which would have been raised locally, i.e. in euro and swapped to US dollars via a cross currency swap). Besides BEAT, the Tax Cuts and Jobs Act of 2017 has encouraged US multinational firms to repatriate earnings back to the United States. This, it is believed, is behind the reduced issuance needs of US firms, including reverse yankee issuance.

1.3 Impediments to arbitraging away the EUR/USD basis

While Section 1.2.2 considered the drivers of the EUR/USD basis, the key remaining question is why a theoretical “arbitrage” opportunity has existed in one of the most highly traded, liquid financial markets over the past decade. The following subsection outlines a number of reasons why market participants have been deterred from taking advantage of the pricing of the basis.

This paper argues that the primary impediment to arbitraging away the EUR/USD basis is the increased balance sheet cost for banks since the financial crisis of conducting money market transactions that could be used to take advantage of any

mispricing in the basis. This has arisen due to newly introduced regulations, including the:

Liquidity Coverage Ratio (LCR): requires banks to hold highly liquid assets in order to meet net liquidity outflows over a 30-calendar-day stress period. As a result of banks being required to hold a certain level of highly liquid assets against short-term outflows, they are more constrained in terms of money market activity, which reduces the amount of US dollar funding available to euro area banks.

Leverage ratio: requires all US banks to maintain a ratio of Tier 1 capital to balance sheet assets at a minimum level of 4 percent. In order to be considered "well-capitalised", banks must then achieve a 5 percent minimum leverage ratio. Since the financial crisis, the introduction of the Enhanced Supplementary Leverage Ratio, which requires the holding of further capital if deemed necessary, has led to an increased cost of conducting transactions that has the effect of inflating the size of banks' balance sheets, thereby requiring higher capital levels. While the leverage ratio is not yet a binding requirement in the EU, market pressure encourages banks to manage their leverage.

Volcker rule: is a US Federal regulation that prohibits banks from conducting certain investment activities with their own accounts, and limits their ownership of and relationship with hedge funds and private equity funds. This again increases demand for short-dated US government issuance, reducing US dollar funding available to euro area banks.

Net Stable Funding Ratio: has been proposed under Basel III with the intention of encouraging banks to fund their operations via stable funding sources. The ratio calculates the proportion of available stable funding (including customer deposits, long-term wholesale funding and equity) over required stable funding. While not yet implemented within the EU, this ratio may impact basis pricing, given the requirement to hold stable funding against potential shorter-term operations.

US money market fund (MMF) reform: has encouraged US money market funds to invest in government funds and move away from other private investments, such as commercial paper, which would have once been used by euro area banks. Government MMFs have become large providers of US dollars to European banks via repurchase agreement operations that are backed by US Treasuries. However, this activity has not fully replaced the funds formerly provided by prime MMFs.

In essence, conducting transactions that would take advantage of discrepancies in the basis requires institutions to conduct large capital flows, potentially reducing regulatory liquidity metrics, with regulatory capital also required to be held against the net institutional exposure of this transaction. Since the financial crisis, there are increased requirements for banks to hold more regulatory capital against such transactions, thereby increasing the cost of conducting this business. Evidently, a number of the aforementioned regulations are implemented strictly within the United States, including the Volcker rule and the US MMF, while the others have been implemented in a broadly similar manner across the EU, which again may lead to different dynamics within FX swaps markets.

In the event that the cost of conducting such transactions exceeds the income generated from arbitraging away this basis, financial institutions will not conduct these transactions. As such, these regulatory changes will only affect pricing to the extent that they affect the manner in which banks manage their balance sheet, or the cost thereof, with any improvement in such ratios by banks reducing such an impact.

2 What role has the APP had in guiding investment decisions and what is its influence on the cross currency basis?

As outlined in Chapter 1, of late monetary policy (including the Expanded Asset Purchase Programme of the Eurosystem, APP) has been a significant driver of pricing in the EUR/USD basis. Four transmission channels of the APP have been identified: (i) the effect on excess liquidity, (ii) the reduction in the availability of securities in the secondary market, (iii) the portfolio rebalancing effects and iv) the signalling effect of forward guidance.

2.1 Strong FX market impact due to excess liquidity volumes has impacted investment and hedging strategies

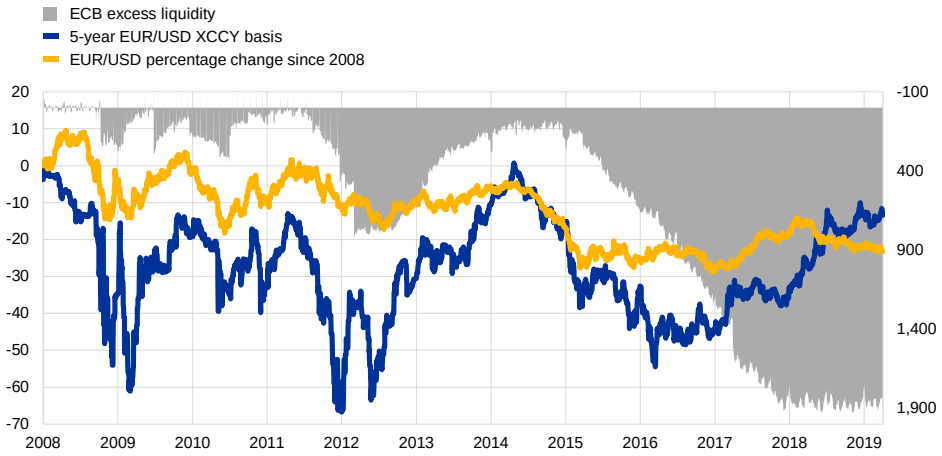
The APP has increased euro liquidity gradually over time, while in the United States the Fed's excess reserves started decrease as of 2014. Therefore, the relative supply of US dollars and euro has been diverging since then. The relatively higher demand for US dollars from investors in contrast to a relatively more abundant supply of euro has implied a new positioning on the cross currency swap market.

Until the end of 2016, this was associated with a clear correlation between euro excess liquidity and the EUR/USD basis, as depicted in Charts 5 and 6 (with a lag from the excess liquidity, however, as announcements of unconventional measures may have had an impact on the EUR/USD basis even before the effect on excess liquidity occurred).

Chart 5

ECB excess liquidity, EUR/USD 5-year basis and EUR/USD spot exchange rate since 2008

(left-hand scale: basis points; right-hand scale: inverted EUR billions)

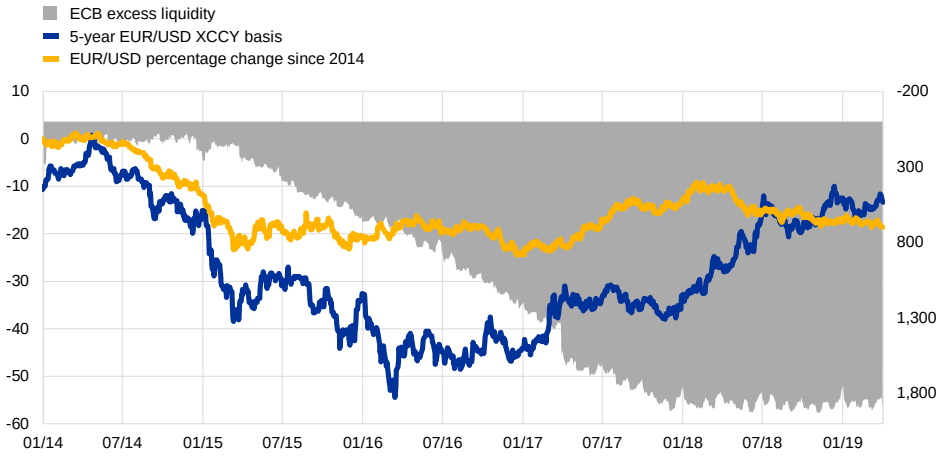


Source: Bloomberg.

Chart 6

ECB excess liquidity, EUR/USD 5-year basis and EUR/USD spot exchange rate since 2014

(left-hand scale: basis points; right-hand scale: inverted EUR billions)



Source: Bloomberg.

However, the divergence since the end of 2016 between the ECB excess liquidity and the EUR/USD basis might be attributable to several interconnected factors:

Firstly, even as ECB excess liquidity was still growing in 2017, investors were anticipating a medium-term normalisation of the ECB's monetary policy.

Secondly, the end or decline of a potential risk premium towards the euro area (Euroscepticism, political risk, etc.) after the French elections in April and May 2017. This could have rekindled risk-averse investors' interest in euro area assets, tightening the basis.

2.2 The reduced availability of euro-denominated securities in the secondary market and consequent lower yields as a driver of asset reallocation towards US dollar-denominated assets

The APP intervenes directly in the medium- and long-term securities balance of supply and demand by extracting interest rate risk (duration) and credit risk from the market and exercising downward pressure on medium- to long-term yields.

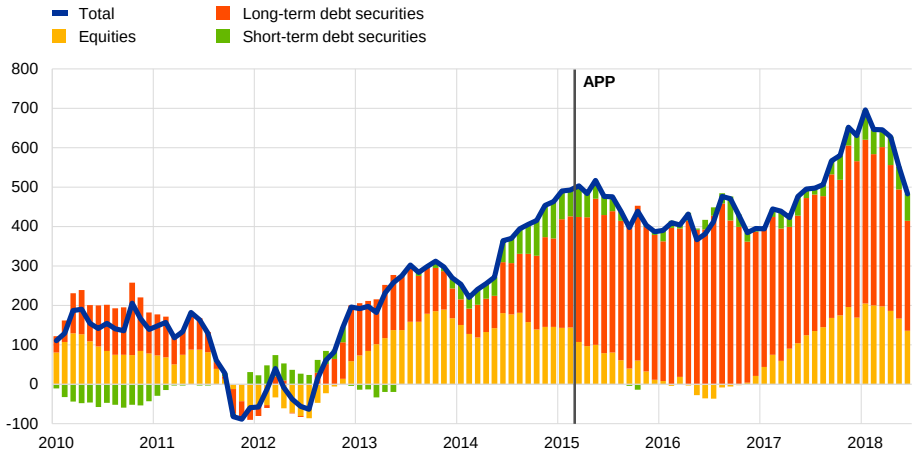
Euro area bond prices have rallied and yields have significantly decreased, especially at the long end of the curve, for the different fixed income asset classes targeted by the APP (euro area government bonds, covered bonds, ABS and corporate bonds).

This downward pressure on yields has made euro assets less attractive and has led investors to search for yield abroad. Net outflows of euro-denominated assets can stem from two mechanisms: either euro area investors divert their funds abroad, or foreign currency investors sell their euro area bonds. Charts 7 and 8 show that while portfolio debt securities recorded a net liability position of 15% of GDP in the first quarter of 2015, this changed to a net asset position of 2% by the end of 2017. This shift resulted from a decrease in non-euro area residents' holdings of euro area debt (from 55% of GDP to 42%), and an increase in euro area holdings of non-euro area debt securities (from 40% to 44%).

Chart 7

Euro area portfolio investment abroad

(EUR billions, twelve-month moving sums)

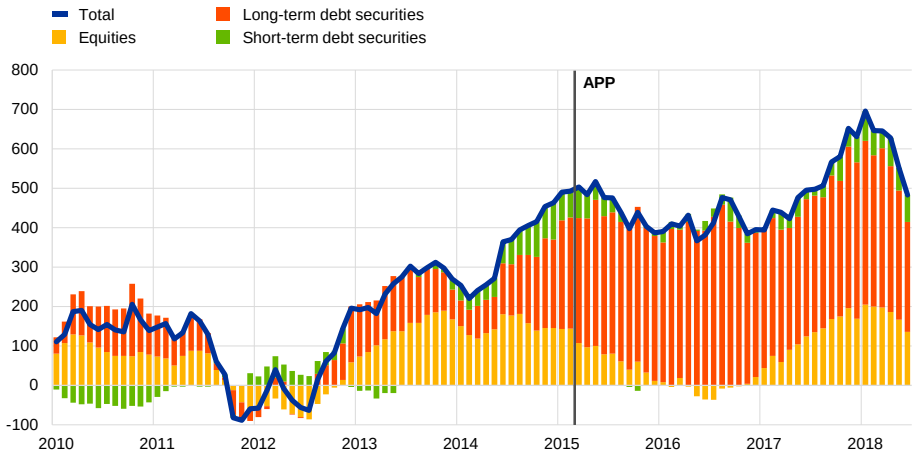


Source: ECB.
Notes: A positive (negative) number indicates net purchases (sales) of non-euro area securities by euro area investors. Equity includes investment fund shares. APP stands for Asset Purchase Programme. The latest observation is for June 2018.

Chart 8

Foreign portfolio investment in the euro area

(EUR billions, twelve-month moving sums)



Source: ECB.
Notes: A positive (negative) number indicates net purchases (sales) of euro area securities by non-euro area investors. Equity includes investment fund shares. APP stands for Asset Purchase Programme. The latest observation is for June 2018.

An important theme in 2018 has been the tightening trend of the EUR/USD cross currency basis. Shifts in investment flows have played a role. As can be seen in Chart 7, euro-area residents have reduced the pace of foreign security purchases: net acquisitions of foreign debt securities by euro area residents decreased to €116 billion in 2018, from €463 billion in 2017. At the same time as can be seen in Chart 8, non-residents slightly reduced their net sales of euro area debt securities, from €133 billion in 2017 to €100 billion in 2018. This has aided the tightening of the basis inasmuch as FX hedging needs are reduced.

For market participants to invest in foreign currencies, it requires, firstly, buying these currencies in the cash market or borrowing them, for instance, through the cross currency swap market. Buying currencies on the cash market implies that exposures are not FX-hedged whilst borrowing them through cross currency swaps ensures a hedge against currency movements. Short-term hedges will be usually put in place through FX swaps[2], while longer-term hedges (usually over one year) will take place via cross currency swaps.

If we take the case of euro area investors increasingly seeking investment opportunities outside the euro area by purchasing higher yielding US dollar fixed-income instruments, this activity increases the demand for borrowing US dollars through FX swaps or cross currency swaps, putting pressure on the EUR/USD basis to widen. As a result, deviation from CIP reflects the swap market positioning. The interest rate advantage is still positive until a break-even level is reached for the basis, and investors (especially institutional ones) may be insensitive to the basis up to a certain threshold.

[2] An FX swap is the combination of a simultaneous spot and an opposite forward transaction at maturity. There are no interest rate payments and the interest rate differential between the two currencies exchanged is reflected in the pricing of the forward transaction (forward points).

As would be expected, the widening of the basis can also lead some investors to adjust their asset management strategies by arbitraging the basis, thus contributing to its tightening. This is particularly the case for conservative institutional investors like central banks, who own traditional reserve currencies. By swapping, for instance, their US dollars into euro or into Japanese yen, they benefit from the US dollar premium and make a profit even though they invest this cash in low yielding assets (such as short-term EGBs or JGBs, as the portfolio duration of central banks – especially liquidity buffers – is usually short)[3].

By acquiring government bills with decent yields (for instance short-term paper from lower rated countries), investors can take advantage of the basis and generate revenues on this activity. If we take the case of the 12-month Spanish Government bill index, since the beginning of unconventional ECB measures, we have seen a parallel evolution in the yield and in the EUR/USD basis (Chart 9). This suggests that non-euro area investors are willing to benefit from a wide basis by swapping their US dollars to invest even in relatively low-yield euro area securities. On the contrary, when yields go higher, investors can afford to receive a smaller basis to keep their pick-up stable.

Chart 9

EUR/USD 5-year cross currency basis and yield on 12-month Spanish treasury bills

(left hand scale: yield in percentage terms; right-hand scale: in basis points)

Source: Bloomberg.

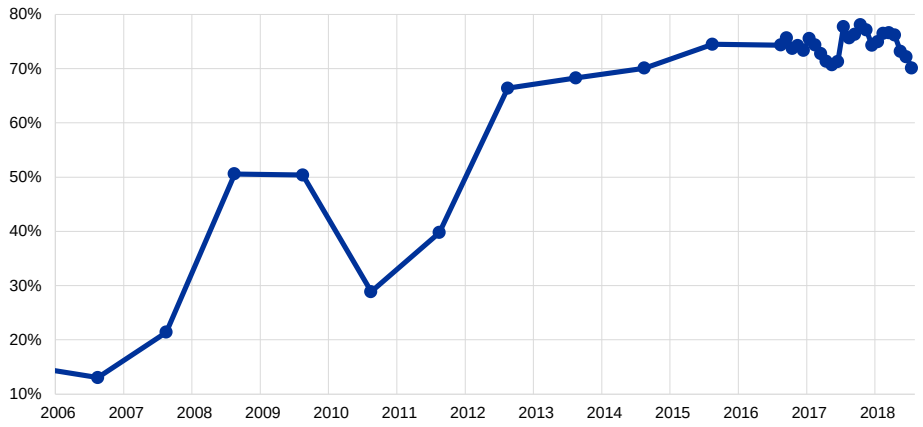
This finding also coincides with the increasing trend in non-resident holdings of Spanish bills, especially since 2013, as seen in Chart 10 below, based on data from the Spanish Treasury: investors outside the euro area may have a growing interest in swapping to euro to buy these lower-rated securities.

[3] This cash management strategy has been developed notably by the Reserve Bank of Australia (RBA), as disclosed in a speech by Deputy Governor Guy Debelle on 22 May 2017. In this case, the RBA uses its currency reserves and even its natural funding currency – the Australian dollar – (which experiences a positive basis (premium), even against the US dollar) and swaps them into Japanese yen, where the basis is the widest.

Chart 10

Share of Spanish Treasury bills held by non-residents

(percentage of Spanish treasury bills held by non-residents)



Source: Tesoro Público.
Note: Includes term investment holdings of securities.

2.3 Portfolio rebalancing impacts the shape of the basis curve (reallocation towards longer maturity US dollar-denominated assets)

The spillover effects of the ECB's unconventional measures on non-euro area assets' yields is well documented[4]. Investors tend to divert their investments to higher yielding securities, within or outside the euro area, implying a rally of these non-euro securities. One consequence of this mechanism is that – all else being equal – investors have had to increase the duration of their non-euro portfolios to sustain their yield levels[5].

To the extent that euro area investors are investing in higher yielding US dollar-denominated assets and have recourse to the cross currency swap market, unconventional monetary policy is likely to have impacted the relative demand of EUR/USD cross currency swaps with different maturities. Looking at the yield curve below (Chart 11), we can see that since the beginning of the APP, the slope of the curve has reversed as demand for long-term hedging instruments has increased.

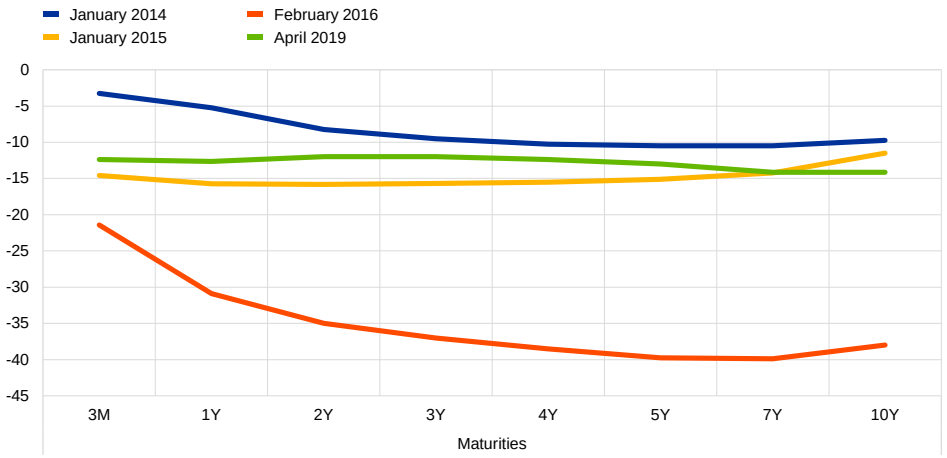
4 See Fratzscher M., Lo Duca M., Straub R. (2013).

5 See Domanski D., Shin H-S, Sushko V. (2015).

Chart 11

EUR/USD basis swap curve

(y-axis: basis points; EUR/USD cross currency basis curve at different points in time)



Source: Bloomberg.
Note: Before the introduction of negative rates, before the start of the APP, during the APP, and at present.

It is also worth noticing that between January 2014 and January 2015, when the negative deposit facility rate was introduced, the shift in the swap curve occurred mostly at the front end; the 3-month EUR/USD basis widened significantly, while the 10-year EUR/USD basis kept almost stable, implying that investors increased their demand for US dollars via short-term FX swaps mainly in reaction to negative short-term yields in euro.

3 What role has the APP had in guiding funding decisions and what is its influence on the cross currency basis?

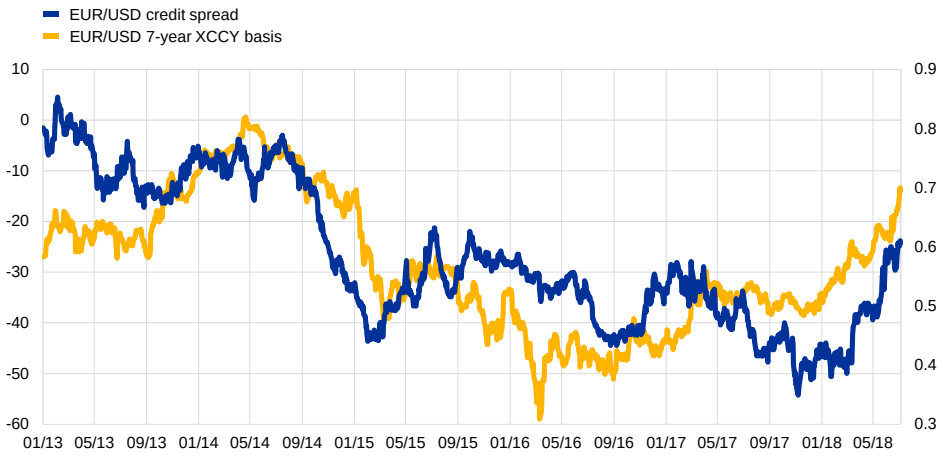
This chapter looks at how the EUR/USD basis drives issuance patterns of corporates and Supranational, Sub-Sovereign and Agency (SSA) issuers. It also covers the interaction between the APP and the cross currency basis.

One of the traditional drivers of the basis has been cross-border issuance. The Eurosystem's APP has been an important player behind the movements in cross-border issuance. Record low yields and tight credit spreads in euro saw high amounts of foreign bond issuance come to the euro market to take advantage of the attractive funding levels. As can be seen below in Chart 12, between 2014 and 2017 the increase in spread divergence (as euro credit spreads fell further relative to their US counterparts on the back of the APP and excess liquidity) led to a widening of the EUR/USD basis. Since the start of 2018, euro credit has underperformed US dollar credit. This spread convergence has led to a tightening of the EUR/USD basis.

Chart 12

EUR/USD basis swap curve

(left-hand scale: xccy basis in basis points; right-hand scale: ratio of EUR to USD credit spreads)



Sources: Bloomberg, ICE BofA ML, BdE.
Note: Corporate indices include only investment grade corporate debt and credit spreads are asset swap spreads.

A US issuer's decision to issue in euro or US dollars depends ultimately on cost. It can issue in US dollars, in which case it would determine at what spread it could fund itself using the local (US dollar) asset swap spread as a benchmark. The spread reflects the difference between the yield it pays on its bond and the yield on the benchmark yield curve[6] at the same maturity. The spread will depend on the credit rating or quality of the issuer. The US issuer could also issue in euro. Similarly to issuing in US dollars,

[6] The benchmark curve being the interest rate swap curve.

when a US entity issues in euro it has to take into account the extra yield it has to pay in euro over and above the euro asset swap curve, i.e. determine what its euro credit spread is. But when a US issuer issues in euro it incurs the extra cost of hedging the FX risk of the issue. This extra cost has to be added to the credit spread to calculate the overall cost of issuing in euro. The cost of hedging the FX risk is the cross currency basis. Taken all this account, then, a US issuer should issue in euro from a purely financial perspective if:

- euro credit spread < US dollar credit spread + cross currency basis[7],[8].

Due to the APP and low ECB interest rates, which have led to a large decline in euro yields and compression in euro credit spreads, the cost of funding in euro has come down. This has led to an increase in euro issuance on behalf of US entities. The increase in euro issuance, however, has also led to higher demand for FX hedges, which, in the case of a US issuer in euro, creates a need to borrow US dollars. This increased demand for US dollars leads to an increase in the rate at which it borrows US dollars, which in turn is reflected in the basis. The more negative the basis, the more expensive it becomes to borrow US dollars. It can get to the point where the cost of hedging the FX risk (embodied by the basis) will cancel out the extra benefit obtained by the lower EUR credit spread.

A euro area issuer will have the same points to consider when deciding whether to issue in the euro market or the US dollar market. From the point of view of a euro area issuer, issuing in US dollars instead of euro will be more advantageous, if:

- euro credit spread > US dollar credit spread + cross currency basis.

A euro area entity issuing in US dollars, however, will have the opposite effect on the basis. It will hedge its US dollar exposure by entering a cross currency swap where in effect it will lend out US dollars and borrow euro. This will reduce the cost of borrowing US dollars (assuming a premium for US dollars) and increase the cost of borrowing euro, making the basis less negative.

Data on issuance show that euro issuance by US corporates, i.e. reverse yankees in market parlance, has grown strongly. While yankee issuance (US dollar issuance by euro area corporates) has also risen, from 2012 onwards it has done so at a slower pace (Chart 13), curbing the amount of net supply (i.e. US dollar issuance by euro area companies – euro issuance by US companies)[9]. This imbalance in cross-border issuance has eventually weighed on the EUR/USD cross currency basis, helping to widen it, i.e. make it more negative.

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7 The cross-currency basis is not the only adjustment that should be made when comparing spreads across different currencies. The spread conversion process should include: (i) the cross currency basis (ii) quoting conventions: quarterly vs. semi-annual swap frequencies and (iii) the spread conversion factor.

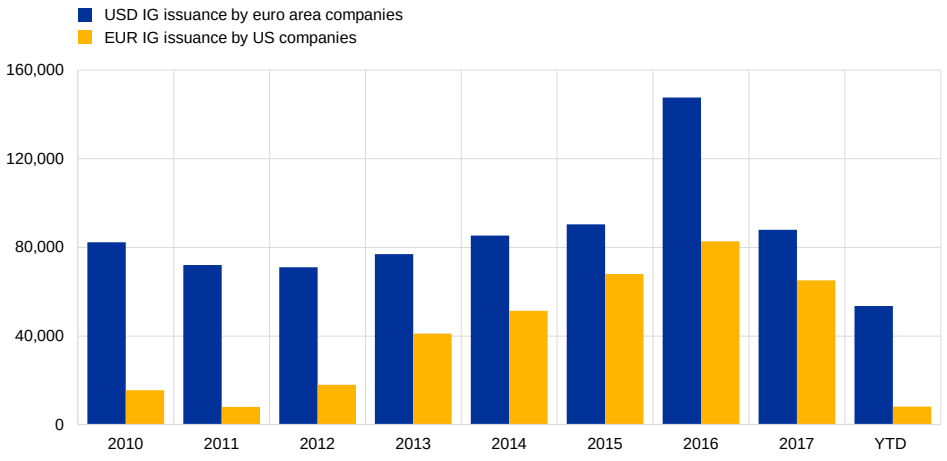
8 For the purpose of this study, we are ignoring a set of other costs that will determine what the real break-even rate is between issuing in the euro or US dollar markets. These include liquidity costs and capital costs, amongst others. Aside from purely financial aspects, other factors e.g. company structure and taxation issues, can also play a role.

9 The jump in yankee issuance in 2016 was mainly due to one issuer, Anheuser-Busch Inbev, which raised $46bn to purchase SABMiller, one of the largest offerings in history in the investment grade space.

Chart 13

US dollar and euro issuance by US companies

(left-hand scale: EUR million; right-hand scale: USD million)



Sources: Dealogic, BofA ML, BdE.
Notes: YTD: January to May 2018. US dollar issuance by euro area firms is also known as yankee issuance. Issuance in euro by US companies is also known as reverse yankee issuance.

Thus, the APP has encouraged the inflow of US issuers to the euro market looking for cheaper sources of funding due to the relatively faster decline in euro credit spreads than US credit spreads, as shown in Chart 12. This in turn has provoked a widening of the EUR/USD basis.

As will be shown in a later section, the widening of the basis (increasing cost of hedging euro exposure) has worked to the advantage of some highly rated euro area issuers active in the US dollar market, which is the case for some SSA issuers, notably KFW and EIB, who are able to price their debt off the US dollar swap curve at relatively tight spreads. This has allowed them to obtain cheaper funding in US dollars, despite the wider credit spreads in that market thanks to the cross currency basis. Movements in relative credit spreads in both markets and the cross currency basis will determine to what extent it will be more beneficial to issue in one market or another.

During 2018, euro issuance by US firms (i.e. reverse yankee issuance) dropped considerably, while US dollar issuance by euro area firms (i.e. yankee issuance) remained pretty stable. This contributed to the tightening of the cross currency basis this year, especially in the middle and at the long end of the curve.

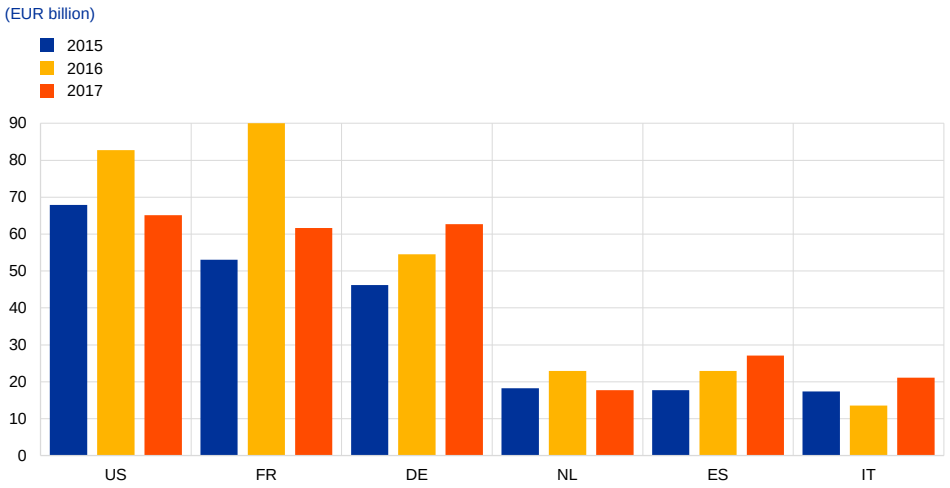
Not all US firms that issue in euro hedge their FX risk. The majority do not. Most issuance comes from US companies with sales in the euro area, so they have a natural currency hedge. Those that do not have this natural currency hedge are therefore exposed to both credit risk and FX risk. However there is evidence that a growing proportion of US issuers coming to the euro market of late have little or no euro operations. These companies, in theory, would want to hedge their FX risk using a cross currency swap.

3.1 Corporate bonds

The role of US corporates in the euro market has been growing in importance since 2012. Reverse yankees were the main source of supply in the euro investment-grade (IG) credit market in 2017, issuing €65 bn worth of bonds: 18% of total market issuance, ahead of Germany and France with a market share of 17.5% and 17.2% respectively (see Chart 14 and Table 1). Although US issuers are not eligible for the CSPP, they have benefited indirectly as investor demand has moved towards them, since the CSPP crowds out investors from the CSPP-eligible universe.

Chart 14

Gross supply investment grade credit



Sources: Dealogic, BofA ML.
Notes: Investment grade issuance by country in EUR market. US issuance known as reverse yankee issuance.

Table 1

IG issuance in euro by euro area and US corporates

	Euro area companies		% of total market issuance	US companies		% of total market issuance
	mn €	% change		mn €	% change	
2009	321,581		72%	18,750		4%
2010	182,374	-43%	68%	15,548	-17%	6%
2011	160,177	-12%	76%	7,981	-49%	4%
2012	232,841	45%	70%	17,915	124%	5%
2013	184,690	-21%	62%	41,150	130%	14%
2014	180,016	-3%	54%	51,390	25%	15%
2015	168,094	-7%	50%	67,900	32%	20%
2016	229,246	36%	55%	82,714	22%	20%
2017	204,955	-11%	57%	65,112	-21%	18%
YTD*	95,315	-11%	64%	8,100	-79%	5%

Sources: Dealogic, BofA ML, BdE.
Notes: YTD (Jan-May 2018). Percentage change represents change with respect to same period year before.

During 2018, euro issuance globally declined, but reverse yankee issuance declined by a larger degree, collapsing by 79% with respect to the same period the year before

(see Table 1). Euro investment grade issuance by euro area firms also fell, but to a lesser degree, meaning their share of the market actually grew. The sharp drop in reverse yankee issuance means less demand for US dollar funding via the cross currency basis, leading to a tightening of the EUR/USD basis. Wider euro credit spreads versus US dollar credit spreads, all else being equal (see Chart 12), means it is financially less appealing to issue in euro.

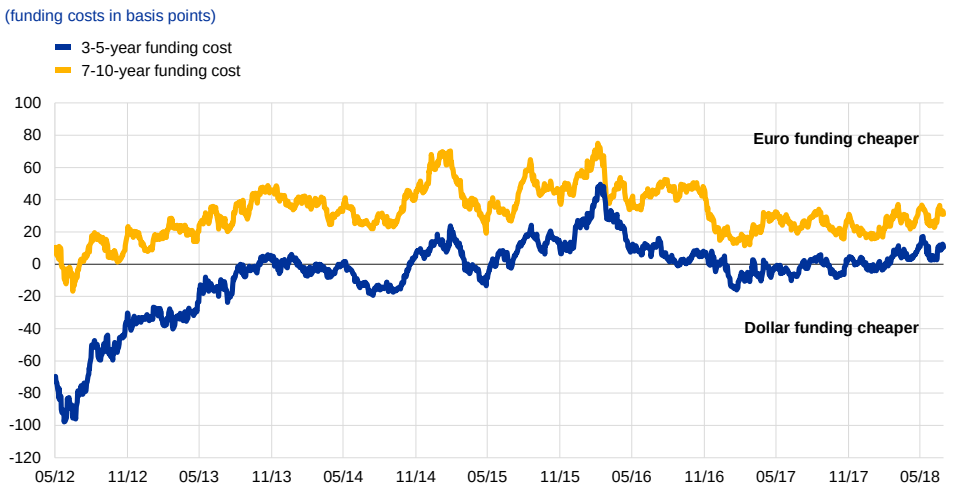
One notable trend in issuance in 2019 is the return of reverse yankee supply. As highlighted before, 2018 saw a big drop in reverse yankee supply, so the sharp increase in supply so far in 2019 reflects, to a certain degree, pent-up demand by US issuers for establishing a presence in the euro market.

Chart 15 reflects the difference in relative funding costs, taking into account the quoted US dollar and euro bond spreads and the cross currency basis of the respective maturity[10]. As can be seen, a US issuer issuing in euro would lock in slightly better funding costs on the 3- to 5-year part of the curve than it would if issuing directly in its domestic US dollars. At the longer end of the curve (7 to 10 years), the advantage of issuing in euro is greater. Even so, issuing longer maturity reverse yankees is not as cheap as it was in 2016.

While the cross currency basis tightened considerably in 2018, which would, all else being equal, help to cheapen the overall cost of issuing in euro, from a US issuer's perspective, EUR credit spreads widened more than US dollar credit spreads, worsening the EUR/USD credit spread differential, meaning the overall cost of funding in euro ended up cheapening only slightly from the levels reached in 2017. The majority of reverse yankee issuance has been in longer maturities where funding levels are still more attractive after accounting for the basis.

Chart 15

Funding costs (inclusive of basis swap)



Sources: Bloomberg, ICE BofA ML, BdE.
Note: Funding costs represent the EUR/USD asset swap spread differential plus the EUR/USD XCCY basis.

[10] It does not take into account, however, different quoting conventions that exist in each market. The fact that euro spreads are quoted to the 6-month Libor while US dollar spreads are quoted to the 3-month Libor. Refer to footnote 7 for more information.

Although not eligible, foreign issuers, especially reverse yankees, have come to the euro market to exploit the cheaper funding costs brought about by the APP, exerting downward pressure on the EUR/USD basis. EUR-based corporate issuers react to movements of the cross currency basis by shifting issuance patterns. The widening of the basis could make funding in US dollars more attractive, reducing the amount of primary supply on the euro market, which would have implications for the eligible universe available for the CSPP. Growing euro investor appetite for reverse yankees is also worth monitoring, since it could produce a crowding out effect, influencing the supply of euro eligible credit.

3.2 Supranational, Sub-Sovereign and Agency (SSAs) issuers

Big international SSAs regularly fund themselves in different currencies to fund regional and development programmes. Their bonds are usually considered of high credit quality, and thus considered an alternative to sovereign debt. This also holds true for big European names in the US market. They usually trade at lower yields than other spread products but offer some yield pick-up to US Treasuries. Their US dollar asset swap spreads may not be as tight as in their domestic (euro) market, but are sufficiently tight at times to allow them to borrow more cheaply in the US dollar market when the cross currency basis widens sufficiently to compensate for the slightly wider credit spreads in the US dollar market.

US investor interest is concentrated in the 3 to 5 year sector. The longer part of the curve is issued in euro where there is more demand for duration. The curve is quite flat due to the APP so euro area investors looking for yield have increased the maturity of their investments. Because there is currently high demand in the 3 to 5 year space in the US market, Euro area SSAs have been able to fund themselves competitively at relatively tight spreads. The widening of the EUR/USD cross currency basis during these last few years has allowed them to achieve “all in” cheaper funding costs in US dollars than in euro.

As an example, consider a 5-year issue of KFW, a German guaranteed agency. It will issue in US dollars if

5Y euro credit spread > 5Y US dollar credit spread + 5Y EUR/USD cross currency basis – 5Y 3s6s basis[11]

On 3/8/2017 this was the case, as

-31.07 > 0.22 -31.25 -10.435[12] or

-31.07 > -38.29

[11] US dollar credit spreads are quoted vs. the quarterly Libor, while euro credit spreads are quoted vs. the semi-annual Libor. Since the 3-month Libor rates are below the 6-month Libor rates, the different conventions result in spreads quoted wider in US dollars vs. euro. Therefore, to make spreads equivalent, from a euro area investor’s perspective, the 3-month vs. 6-month swap has to be subtracted from the US dollar spread.

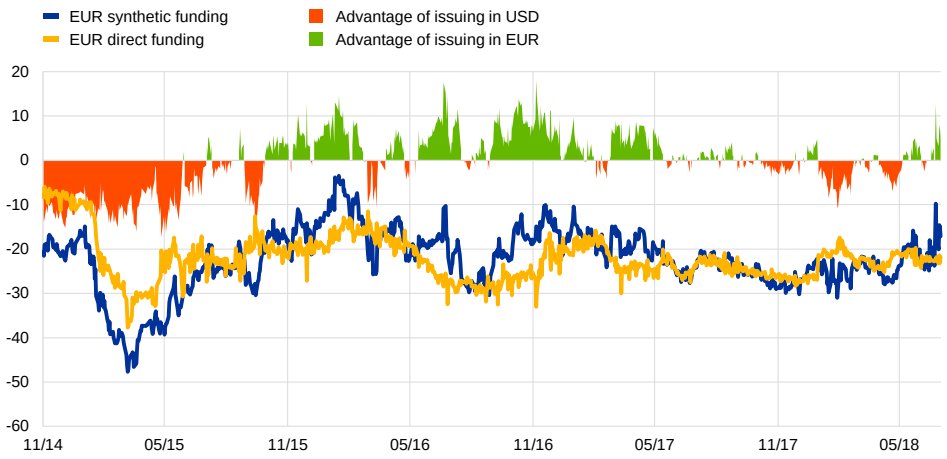
[12] For calculations and charts, Bloomberg’s BFV curves and par rates were used.

Chart 16 illustrates the relative advantage of issuing a 5-year bond either in US dollars or euro for KFW. Issuing in US dollars and swapping the proceeds to euro has tended to be cheaper than directly issuing in euro. This advantage increased significantly with the onset of the Eurosystem's different asset purchase programmes starting in 2014 (green shaded area).

Chart 16

Implied funding levels for 5-year KFW: outright in euro, US dollar-swapped, and the difference between the two

(KFW's funding costs in basis points)



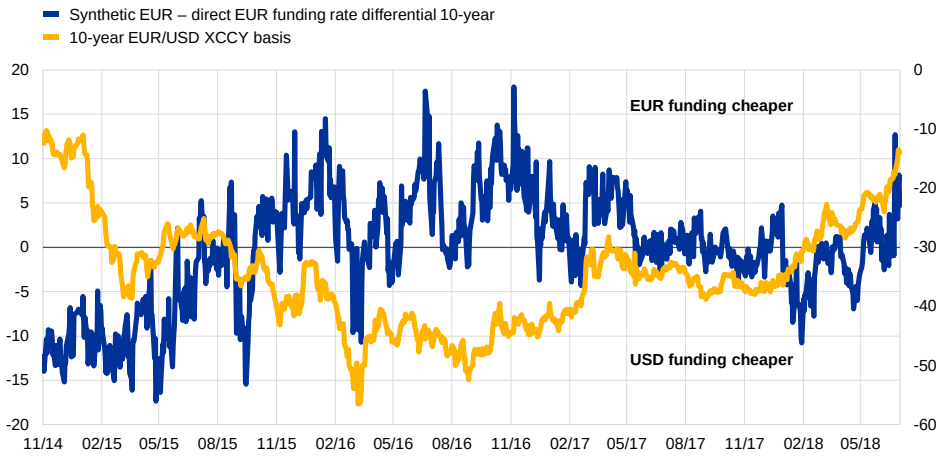
Source: Bloomberg.
Notes: Euro direct funding cost represents the spread between the yield on a 5-year par rate KFW bond issued in euro and the 5-year euro swap rate. Euro synthetic funding represents the spread on a 5-year par rate KFW bond issued in US dollars and the 5-year US dollar swap rate converted to euro by adding the 5-year EUR/USD XCCY basis and subtracting the 5-year 3s6s basis swap.

As has been explained, there exists a close correlation between movements in the cross currency basis and relative funding cost (see Chart 17). The widening of the euro cross currency basis during 2014 and early 2015 made US dollar funding cheaper from KWF's perspective. The extreme tightening in the EUR/USD cross currency basis since the start of 2018 has made US dollar funding unattractive. The tightening of the basis has made it considerably more advantageous for KFW to bring 5-year paper in euro to the market than fund in US dollars and swap the proceeds back to euro. This has started to have an impact on issuance patterns.

Chart 17

KFW's relative funding costs along with the EUR/USD cross currency basis

(left-hand scale: KFW's relative 5y funding costs in basis points; right-hand scale: EUR/USD 5y XCCY basis in basis points)



Source: Bloomberg.
Note: Relative funding costs represents the difference between euro synthetic funding and euro direct funding.

The role of euro area SSAs in the US market has been growing strongly since 2012, to the detriment of the domestic market (Table 2). Euro area SSA issuance reached a peak in 2015 and 2016 with an overall share of the US dollar market of 37%. The opposite is true of their home market, where the role played by euro area SSAs has been declining at a steady pace, from 65% to a low of 49% in 2015. Although a number of factors have played a role in this shift in funding behaviour, a large part can be attributed to the Eurosystem's bond buying programmes and its impact on the basis. On the one hand, and more directly, the Eurosystem's purchases have lowered the yields of euro-denominated SSA paper, resulting in lower home market investor demand; on the other hand, a widening of the basis, induced indirectly again by the Eurosystem's APP, has lowered the cost of funding in US dollars relative to euro for euro area SSAs. In 2017 euro area SSA issuance in US dollars dropped off considerably, its share declining to 31% of the overall market, while picking up to 58% in the euro market. This trend continued in 2018, as the tightening of the EUR/USD cross currency basis helped erase the funding advantage for EUR-based borrowers. Second quarter data shows a reduced reliance on US dollar issuance by European SSAs. This shift back towards domestic issuance has taken the euro share to 67%, well above the 57% five-year average. As discussed earlier, the tightening of the EUR/USD cross currency basis has made US dollar funding for euro-based issuers less attractive. From a euro-based issuer's perspective, the trade-off between euro and US dollar funding costs has three basic components: euro spreads, US dollar spreads and the EUR/USD cross currency basis. Although the widening of euro SSA spreads and the tightening of US dollar SSA spreads were beneficial for US dollar issuance, the tightening of the EUR/USD cross currency basis more than offset this and tilted the balance, even if just slightly, in favour of euro issuance. To this one must add the reopening, at least at one point, of the front end of the euro curve for issuance. As euro rates increased at the end of 2017, 5-year German yields were back in positive territory in the first quarter of 2018 for the first time since 2015, making valuations more attractive from an investor's point of view. Moreover, recent data show

that traditional US dollar-funded international institutions are turning to the euro market, as it is now cheaper to issue in euro and swap back the proceeds to US dollars.

Table 2

Issuance in euro and US dollars by euro area SSAs

	EUR denominated		% of total € market issuance	USD denominated		% of total market issuance
	mn €	% change		mn $	% change	
2001	13,545		55%	1,496		7%
2002	17,899	32%	55%	4,805	221%	16%
2003	24,610	37%	50%	13,378	178%	24%
2004	28,200	15%	48%	21,536	61%	29%
2005	64,034	127%	54%	33,505	56%	23%
2006	54,825	-14%	43%	50,854	52%	32%
2007	64,680	18%	40%	61,492	21%	28%
2008	96,928	50%	42%	128,707	109%	38%
2009	178,554	84%	53%	140,727	9%	31%
2010	116,275	-35%	44%	123,109	-13%	35%
2011	231,355	99%	62%	125,777	2%	24%
2012	257,016	11%	65%	111,637	-11%	22%
2013	201,034	-22%	61%	122,013	9%	28%
2014	167,120	-17%	56%	121,470	0%	30%
2015	142,554	-15%	49%	118,653	-2%	37%
2016	165,971	16%	51%	135,208	14%	37%
2017	199,503	20%	58%	117,627	-13%	31%

Sources: Dealogic, BofA ML.

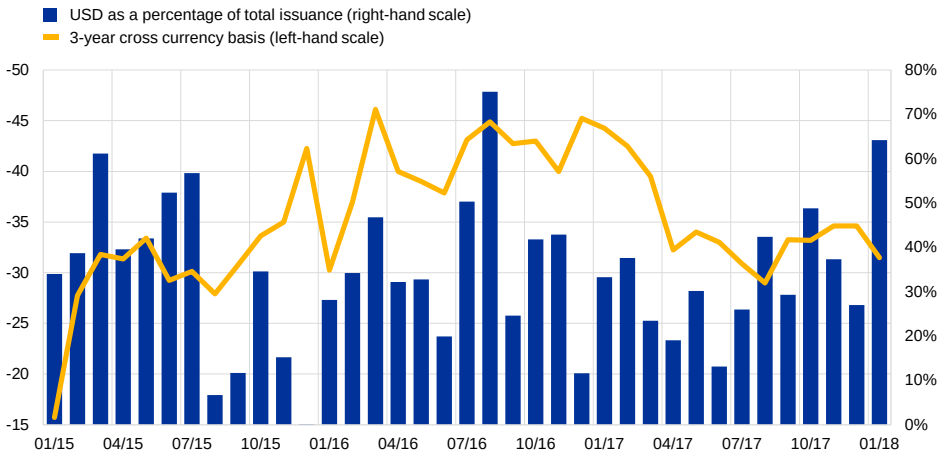
The growing reliance on US dollar funding by euro area SSAs affects the universe of eligible bonds available for implementation of the PSPP. As outlined above, 2017 saw a shift back to euro funding; nevertheless, changing trends in cross-border issuance do have implications for the implementation of the Eurosystem's APP. Reliance in some jurisdictions on supranational bonds to comply with their PSPP targets may have to increase as the APP amount increases. This makes the movements in cross-border issuance on behalf of euro area SSAs worth monitoring.

Euro area SSA issuance in US dollars and the EUR/USD basis follow a close pattern (note: sign of basis has been reversed for Chart 18). When the basis widens, euro area SSAs take advantage and issue more in US dollars. The heavy reverse yankee issuance recorded between March and May of 2015 contributed to the widening of the EUR/USD basis, allowing euro area SSAs to lock in better funding levels in US dollars. This led to a surge in the share of US dollar issuance on behalf of euro area SSAs. SSA issuance in US dollars picked up again in 2016, thanks to a great degree to the new CSPP, which was announced in March 2016 and implemented from June onwards. This again provoked a widening in the EUR/USD basis, encouraging euro area SSA issuance in the US dollar market.

Chart 18

Share of US dollar-denominated gross issuance by euro area SSAs

(left-hand scale: inverted bp; right-hand scale: percentage)



Sources: BofA ML, Bloomberg.

The drop in issuance in the second half of 2015 was partly due to the German Bund sell off, although this had a much larger impact on euro supply. Euro-denominated supply by euro area SSAs ended up falling by 15% in 2015 compared to the previous year, while US dollar issuance fell by only 2%. In fact the share of US dollar issuance by euro area SSAs rose to 37% from 30% the previous year (Table 2).

4 Should the Eurosystem be concerned about the sharp increase in the funding premium for US dollars over balance sheet reporting dates?

4.1 The phenomenon: costlier US dollar funding on reporting dates[13]

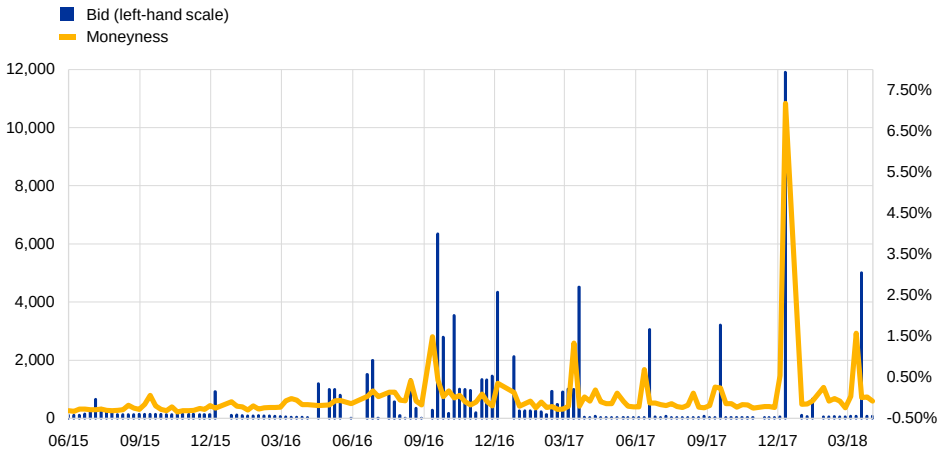
Recurrent increases in the US dollar funding premium over balance sheet reporting dates point to a causal relationship between bank regulation and asset prices. For instance, it has been found (Alexander Tepper, Verdelhan, & Du, 2017) that 1-week and 1-month US dollar implied rates tend to increase for contracts that cross quarter-end reporting dates. Furthermore, they highlight that the magnitude of the effect has increased since January 2015, with the beginning of the public disclosure of the leverage ratio for European banks.

This cyclical premium component overlays the existing structural increase in the premium that was described in the introductory section of the paper. As a result, there is a noticeable premium amplification every quarter-end, when US dollar funding in the FX swap market becomes considerably more expensive. The implied US dollar borrowing yield typically rises above the cost of funding US dollars at the one-week ECB operation, making the operation economically appealing (see Chart 19).

Chart 19

Participation in the US dollar operation and economic benefit

(EUR millions, ECB one-week operation in blue)



Sources: ECB, ECB calculations and Bloomberg.
Notes: moneyness refers to the difference between the cost of funding in the FX swap market and the cost of borrowing with the Eurosystem. Bidding at the operation increases at quarter-ends when the moneyness, economic benefit, increases sharply.

[13] This section looks at FX-swaps as reported in the MMSR.

The cost of transacting related to regulatory requirements has been estimated to represent around two-thirds of the funding premium and is mainly related to the leverage ratio. The new regulations are deemed to have increased the cost of balance sheet usage, as well as costs associated with market-making activities. The main costs affecting the cross currency swap markets are the following:

1. Charges related to the leverage ratio: The leverage ratio requires banks to hold a minimum amount of capital against all on- and off-balance sheet exposure, regardless of their degree of risk. Cross currency swap trades involve borrowing and lending in the cash market and thus have a lengthening impact on the balance sheet, which results in a proportional increase in the charge;

2. Margin requirements for over-the-counter (OTC) derivatives: The reform of OTC derivatives markets sets higher capital and minimum margin requirements for cross currency swaps, effectively increasing the capital cost of transacting in this market; and

3. Risk-weighted capital requirements: This cost primarily affects cross currency swaps in longer maturities, given that the risk weight of a short-dated cross currency swap is minimal.

Overall, balance sheet costs are proxied to make up for more than half of the discrepancy between the cost of borrowing US dollars in the domestic cash market vis-à-vis sourcing them in the cross currency swap market (Du, Tepper & Verdelhan, 2018).

The scarce resource of US dollar funding on reporting dates due to balance sheet constraints ultimately shapes bank behaviour, with important implications for asset prices. Indeed, qualitative feedback from counterparties confirms that balance sheet space is offered to clients in a more “stringent” manner over reporting dates. Larger amounts of cash that leave the banking system amid higher “parking” charges over reporting dates seek less punitive alternatives. Alternatives include the following:

1. The Eurosystem for counterparties who have access to it: This is evidenced in the evolution of non-monetary policy accounts in the Eurosystem. These accounts exhibit significant growth in foreign central banks’ deposits over quarter-ends as the opportunity cost of euro deposits in the banking system exceeds the cost of depositing cash at the negative deposit facility rate;

2. Secured money markets where cash can be lent against collateral: Indeed, the pronounced decline in euro repo rates at reporting dates has been partially attributed to the excessive amount of cash that bids for collateral. In addition, counterparties have highlighted that communication between cross currency swap desks and repo desks has increased substantially, since both markets are perceived to be affected by the same driving factor; and

3. Purchases of short-dated sovereign bonds (T-bills).

Despite the higher cost of US dollar funding at reporting dates, euro area banks are reportedly able to secure US dollar funds. This is in contrast to the global financial

crisis and the euro area sovereign debt crisis, when the higher cost of US dollar funding reflected more limited access to it for some institutions.

4.2 MMSR evidence: balance sheet constraints determine bank behaviour

With the help of a novel data set, the MMSR[14], this section focuses on observed bank behaviour in FX swap markets over balance sheet reporting dates. Importantly, since the MMSR covers only euro-related money market transactions in the interbank market, other sources of short-term US dollar funding like repo collateralised with US treasuries and CP/CD issuance in US dollars are outside the scope of the analysis. Moreover, the analysis below is based on forward-dated transactions that have as a common feature the fact that the spot leg of the cross currency swap settles in the last week of the quarter, while the forward leg settles in the first week of the new quarter. In other words, the analysis is based on a subset of transactions that are incurred exclusively for the purpose of covering the quarter-end. The benefit of narrowing down the analysis to this subset is to achieve comparability between the ECB US dollar operation and the reported FX swap transactions through almost equivalent maturities. The analysis is based on FX swap market transactions that cover Q3 2016, Q4 2016, Q1 2017 and Q2 2017.

1. Quarter-ends have a (short) “memory”: a relatively expensive quarter-end tends to be followed by a more benign quarter-end and a well-prepared quarter-end tends to be followed by a laxer quarter-end. For instance, over Q2 2017 the volume of US dollars borrowed declined from €144 bn to €132 bn compared to Q1 2017, which may be partially the consequence of an increase in term borrowing activity. In addition, the share of US dollars pre-funded – that means traded ahead of the last week in the quarter – declined from 18% to 13%, suggesting that more funds were borrowed “last-minute”. Finally, the spread between the cost of pre-funding vis-à-vis “last-minute” funding declined from 2.1 forward points to 1.7 from Q1 to Q2. In other words, a well-prepared quarter-end may result in a higher share of term funding covering later quarter-ends and eventually a higher share of “last-minute” trades that are, however, less penalised, as the cost spread relative to pre-funding is lower. Therefore, a well-prepared quarter-end reduces the incentive to pre-fund, all else being equal. This observation confirms anecdotal feedback according to which an “expensive” quarter-end leads to more pre-funding activity;

2. The bulk of quarter-end related funding is traded in the week prior to quarter-end: most transactions and volume are exchanged immediately ahead of quarter-end. Overall, more than 80% of forward-dated FX swap transactions that aim at covering the quarter-end occur in the last week prior to quarter-end;

[14] The MMSR dataset is based on transaction-by-transaction data from the largest euro area banks covering the secured, unsecured, foreign exchange swap and euro overnight swap money market segments. The regular data collection started on 1 July 2016 (see also Euro money market). The number of MMSR reporting agents was 52 at the time of writing.

3. Balance sheet constraints seem to be more binding over year-end: there is an exponential increase in the cost of US dollar borrowing towards the year-end. This is substantially different from other quarter-ends, where the cost of US dollar borrowing eventually subsides ahead of ultimo. This relationship suggests that year-ends are different. In addition, substantially higher implied borrowing rates over year-end relative to quarter-end suggest that the balance sheet cost of transacting over year-end is substantially higher than over a regular quarter-end. Some regulatory costs are computed based on the balance sheet upon year-end. This holds true, for example, for euro area banks' contribution to the Single Resolution Fund (SRF) (Group, 2017). At the same time, exchanged volumes over year-end 2016 were, with €107 bn, considerably lower than the average volume of €134 bn observed for all other quarter-ends ex year-end in the observation sample;

4. Year-end is prepared well in advance in comparison to a regular quarter-end: the data reveal a higher proportion of pre-funding for year-end. Whereas the average share of US dollar borrowing activity transacted in the last week of the quarter for a quarter-end which is a not a year-end within observation period is 84%, this share reduces to 70% for the 2016 year-end, which suggests that a year-end is prepared further in advance compared to a regular quarter-end;

5. The economic benefit of pre-funding is substantially higher for year-ends: for the 2016 year-end, the volume-weighted average forward points at which US dollars were pre-funded was 7.8, compared to 15.3 for the "last-minute" trades conducted in the last week of the quarter. This results in a spread of 7.5 forward points compared to an average spread of 1.5 forward points across all other quarter-ends. This large difference is partially explained by the exponential shape of the forward points curve as a function of the trade date for the year-end;

6. MMSR banks are important intermediators in offshore US dollar markets, as reflected in particularly balanced activity between lending and borrowing: this holds true across all quarters observed. The relationship is particularly balanced, in terms of both observed transactions and transacted volumes;

7. MMSR banks were net US dollar borrowers over the observed quarter-ends[15]: in spite of the aforementioned balanced relationship between borrowing and lending US dollars, MMSR banks are on aggregate net US dollar borrowers by a small average margin of 5% relative to the overall transacted volume across all quarter-ends observed; and

8. Net US dollar borrowing is stable across quarter-ends: MMSR banks' net borrowing activity represents on average 5% of the overall transacted volume in the cross currency swap market over quarter-ends. The share ranges between 5.1% and 5.8% and is stable across all quarter-ends observed.

These findings point to the conclusion that the FX swap market is a smoothly functioning, highly liquid market that shows no signs of either impairment or distress.

[15] This does not hold true for later quarter-ends. MMSR banks became eventually net US dollar lenders since H2 2017.

MMSR data suggest that the cross currency swap market is an efficient market with two-way flows where euro area banks play an important role as intermediators. This conjecture backed up by regular activity in terms of both transactions and volumes, even at times when the cost of US dollar borrowing spikes ahead of a quarter's ultimo[16]. Anecdotal counterparty feedback confirms this observation. According to dealer desks, the cross currency swap market remained functional even during the peak of the crisis when EUR/USD cross currency basis reached historical lows.

Banks appear to be in a transition period in terms of implementing the new regulations and gaining efficiency in managing resources. Anecdotal counterparty feedback suggests that bank treasuries and collateral desks are investing in technology and human capital in order to allow for efficient resource consumption. This holds particularly true for scarce resources such as collateral, balance sheet or US dollars. Thus, it can be expected that as the banking system innovates and adjusts to the new regulatory environment, some of the costs induced by regulations should stabilise at lower levels.

Participation in the Eurosystem's one-week US dollar operation has remained limited. Participation in the operation has increased markedly at quarter-ends in proportion to the increase in the funding premium for US dollars in the cross currency swap market. However, the increase in participation is by no means comparable to the levels seen during the euro area sovereign debt crisis. The increase in premium over quarter-end is at least partially predictable to the extent that the date is known and banks seem to behave in response to the previous quarter-end (see "Quarter-ends have a (short) 'memory'" in Section 2). This is different from an unexpected supply shock as it occurred during the crisis. It is true that the US dollar operation may not be accessed, even in situations where it is economically beneficial, due to penalisation by bank stakeholders such as rating agencies, investors or supervisors. Nevertheless, it can be assumed that there is a threshold beyond which such considerations would become secondary to the economic argument.

However, euro area banks are net US dollar borrowers by a small margin. MMSR data show that euro area banks have been net US dollar borrowers over all quarters observed. The margin by which US dollar borrowing activity exceeds lending activity can be considered to be small. However, other data sources suggest that European banks experience a substantial decline in short-term US dollar funding from US money market funds over quarter-end. Therefore, to the extent that unexpected US dollar funding shortages arise that cannot be satisfied via market-based funding, the Eurosystem should be attentive, particularly if a surge in the US dollar funding premium is indicative of a supply-demand imbalance, which may result in a financial stability issue. However, quarter-end related increases in the US dollar premium do not qualify as market distress or malfunctioning, nor do they seem to warrant central bank action on the grounds of systemic risk concerns.

[16] The US Treasury's Office for Financial Research (OFR) documents that US money market funds' (MMFs) largest assets under management outside the United States are held in European banks. US MMFs invest primarily in repo against US Treasuries and to a lesser extent in European banks' commercial paper and certificates of deposit (see Treasury, 2017).

Conclusions

A US dollar funding premium in the EUR/USD cross currency swap market has been in existence since 2008. This means that the rate at which US dollars are sourced in the cross currency swap market is more expensive than is warranted by the Covered Interest Rate Parity (CIP) condition. This is reflected in a persistently negative cross currency basis.

Whilst there are many reasons behind this dislocation, since 2014 the divergence in monetary policy between the euro area and the United States has played a big role. Monetary policy divergence alters the price of money in relative terms, thereby influencing cross-border capital flows. On balance these flows have led to considerable demand for US dollars in the cross currency swap market to hedge FX risk and fund US dollar positions.

New regulatory requirements put in place since the financial crisis, which have increased the cost of engaging in transactions that can be used to take advantage of discrepancies in the basis, have impeded steps to arbitrage away the negative basis (euro discount).

The divergence in monetary policy has affected investment and funding decisions. On the investment side it has encouraged euro area investors to search for higher yielding assets in the United States. Many euro area investors will hedge this currency exposure by engaging in cross currency swaps, which has the effect of widening the basis. This limits the amount of yield pick-up, given the negative values of the basis. Spillover effects of the APP may have also contributed to changing the shape of the cross currency swap curve, as euro area investors have had to increase the duration of their non-euro portfolios to sustain their yields levels (implying increasing demand for long-term hedging instruments).

On the funding side it has attracted US corporate issuers to the euro market (reverse yankees) in search of cheaper funding costs due to the decline in yields and tighter credit spreads. The growth in the share of US issuers in the overall euro investment grade market is testament to this. The hedging of currency risk by US firms issuing in euro via cross currency basis swaps has helped widen the basis. The widening of the basis (increasing cost of hedging euro exposure) has worked to the advantage of some highly rated euro area SSA issuers active in the US dollar market. This has allowed them to obtain cheaper funding in US dollars. The funding decisions of corporates and euro area SSAs can have an impact on the eligible universe available for the CSPP and the PSPP in particular.

The funding premium in the EUR/USD cross currency market since 2008 has been increasing cyclically over balance sheet reporting dates. Analysis conducted for this study using the MMSR, a novel data set, confirms the role played by balance sheet constraints at these specific points in time. The existence of a violation of covered interest rate parity (CIP) in itself drives a wedge between interest rates in the cash market and those in the cross currency swap market. This wedge may have an

adverse impact on the transmission of monetary policy and merits continuous monitoring. However, the data analysed for the purpose of the present study confirm research findings indicating that the aforementioned discrepancy is rooted in transaction frictions mainly resulting from increased balance sheet costs. In themselves these frictions do not warrant policy action, as they are not symptomatic of a malfunctioning market, nor do they raise financial stability concerns. As banks are in a transition period in terms of implementing the new regulations, it can be expected that, as they adjust to this new regulatory environment, some of the costs induced by regulations should stabilise at lower levels. Nevertheless, this study delivers insightful evidence of the relationship between bank regulation and asset prices. These findings in themselves merit further study, particularly of the extent to which bank regulation may interfere with monetary policy implementation.

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