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Foreign exchange derivatives and currency mismatch in Irish investment funds[1]

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[1] This paper and presentation were prepared for the meeting. The views expressed are those of the authors and do not necessarily reflect the views of the BIS, IFC, BoP, ECB or the central banks and other institutions represented at the meeting.

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Benedetta Bianchi & Giovanna Bua[1]

Abstract

This paper has two goals. First, we study the currency composition of assets and liabilities in Irish-domiciled investment funds. Second, we analyse valuation gains and losses in the foreign exchange derivatives position, and the relation with gains and losses from currency mismatch in the balance sheet. A positive relation indicates amplifying the currency position on balance sheet, while a negative relation indicates hedging. Focusing on two periods of currency turbulence, we find that the proportion of hedging funds and the proportion of amplifying funds are stable. However, those funds amplifying tend to do so relatively more in the first quarter of turbulence, while the hedging rates of hedgers increase in the subsequent quarters. The main novelty of our study is to build a financially-weighted exchange rate index at micro-level and to develop a framework to analyse currency risk strategies of investment funds, taking into account the use of derivatives.

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[1] The views expressed are those of the authors and not necessarily those of the Central Bank of Ireland or the European Central Bank. Any errors remain the responsibility of the authors.

1. Introduction

This paper has two goals. First, we study the currency composition of assets and liabilities in Irish-domiciled investment funds. Second, we analyse valuation gains and losses in the foreign exchange derivatives position, and the relation to gains and losses from the currency mismatch on balance sheet. Our contribution is twofold. First, we illustrate the potential use of the financially-weighted exchange rate index developed in the macro literature on currency exposure (Lane and Shambaugh, 2010) to analyse entity-level micro data. Second, we extend the framework commonly used to study currency exposures in international balance sheets, by introducing the financial derivatives dimension.

By providing detail on the balance sheet of a globally active sector, we contribute to the literature on the size of international balance sheets. The seminal papers by Lane and Milesi-Ferretti (1999, 2007) have pioneered the analysis of international assets and liabilities. The authors propose a measure of international financial integration based on the sum of external assets and liabilities. In more recent work, Lane and Milesi-Ferretti (2018) document the growing importance of financial centres in global external assets and liabilities, highlighting the need to separate pure international financial *intermediation* from financial market *integration*. In a similar spirit, Galstyan (2019) delved into the complexity of the Irish international investment position to strip out the intermediation component that arises from the activities of investment funds and other entities with little domestic activity.

At the same time, analysing the currency risk profile of international balance sheets is important. Currency mismatches can have a significant impact on the dynamics of external balance sheets (Gourinchas and Rey, 2014; Forbes et al., 2017). For example, Tille (2003) showed that the strong dollar has a sizable role in the acceleration of the net indebtedness of the Unites States toward the end of the Century. Stoffels and Tille (2018) have constructed data on the Swiss external investment position and have showed that Switzerland has faced sizable losses from the strength of the franc. Using a larger sample of countries, Benetrix et al. (2015) and Lane and Shambaugh (2010) have studied the sensitivity of the net IIP to exchange rates movements.

In translating our analysis of Irish investment funds to the IIP context, it is important to keep in mind that, due to the balance sheet structure of investment funds, any valuation impact of the currency mismatch translates in a change in price of the fund's shares. Since the bulk of Irish investment funds assets and liabilities are international, valuation effects impact the *size* of the Irish external balance sheet, but have no direct impact on the *net* IIP. Nevertheless, our analysis improves our understanding of the balance sheet of an internationally-active financial centre, as well as the role of derivatives.

In the absence of granular data, researchers have estimated the currency shares of international assets and liabilities to infer the impact of exchange changes. Compiling a new dataset on the currency composition of the IIP, recent research has shed light on the cross-country distribution of foreign currency exposures (Benetrix et al., 2015; Benetrix et al., 2020). Using the methodology developed in Lane and Shambaugh (2010), the authors construct estimates on international currency over 1990-2017 by drawing on a range of datasets and inferential techniques. They also trace out the scale of valuation changes due to exchange changes. As discussed in their paper, the dataset suffers some limitations: it provides a breakdown only for portfolio debt; it tracks currency exposure based on geographical exposure; and it does not consider the use of derivatives and hedging behaviour. As the authors suggest, better availability of actual data is key for further improving the accuracy of the dataset.

While the impact of currency-driven valuation changes on external imbalances has been documented, the overall picture including the role of financial derivatives is missing due to lack of data. In order to include the impact of financial derivatives, an internationally agreed set of rules and methodologies to record and analyse these complex instruments in the context of international capital flows is missing.

To contribute to this debate, we employ quarterly investment funds balance sheet information collected by the Central Bank of Ireland to study the currency profile of the balance sheet and the use of foreign exchange derivatives in relation to it. Specifically, we first estimate the valuation effect due to currency mismatch on balance sheet based on the currency shares at the beginning of each quarter, following the methodology in Lane and Shambaugh (2010). Secondly, we calculate the assets appreciation rate, or the percentage change in the value of assets given by the change in the relevant exchange rates. We then use this metric to explain the currency composition of investment funds, and to look at their behaviour around two episodes of currency turbulence in our sample: the announcement of the Asset Purchase Programme (APP) and the Brexit referendum.

Our study relates to the micro literature that examines a firm's decision to hedge foreign currency exposure. Most of these studies estimate the total impact of exchange movements on firms' returns looking at the impact on share prices. Results are not conclusive and suggest a limited relationship between the two variables. Despite some authors argue that these results may reflect hedging behaviour, only few studies explicitly incorporate derivatives in their analysis, often using binary variables or notional value as a proxy for the use of derivatives (Becker et al., 2006; Geczy et al, 1997; Allayannis et al, 2001; Cowan et al. 2005; Adkins et al., 2007, Bartram, 2019). Using this indirect method, the findings in Nguyen and Faff (2010) and Allayannis et al. (2001) suggest that the use of foreign derivatives is used predominantly for hedging purposes, rather than for speculation motives. Only one recent study by the Nederlandsche Bank looks at the revaluation of assets due to exchange rate changes including the change in value of derivatives directly (Hillebrand, 2016).

Comparing valuation effects on balance sheets with valuation effects on the derivatives position, our findings indicate a significant amount of hedging, but also instances where the currency mismatch is increased via the derivatives book – a speculative behaviour. We differentiate between normal times and special events, such as the Asset Purchase Programme of the ECB, which was accompanied by a depreciation of the euro, and the Brexit referendum, which was accompanied by a depreciation of the sterling. The proportion of hedging funds and the proportion of speculating funds are stable in the periods of currency turbulence compared to normal periods. However, those funds speculating tend to do so relatively more in the first quarter of turbulence, while the hedging rates of hedgers increase in the subsequent quarters.

2. Empirical framework

The balance sheet of investment funds is such that funds are not themselves exposed to currency risk, like they are not exposed to their invested assets, because they pass all gains and losses onto unit holders. However, to maximise the value of units, investment funds should minimise the negative impact of currency movements on the value of the balance sheet. One way funds can decrease the impact of currency movements is by matching the currency composition of assets and liabilities. This can be done by issuing units in the same currencies as the denomination of invested assets, or by investing in assets in the same currency of the units, whichever decision is taken first. Similarly, when funds use leverage, debt can be raised in a currency which the fund is long to reduce the mismatch. We call this behaviour matching.

Furthermore, funds can use foreign exchange derivatives to hedge the currency mismatch. We measure hedging through derivatives as follows. When the change in the replacement value of foreign exchange derivatives runs in the opposite direction to the valuation effect due to currency mismatch on balance sheet, we say that derivatives are used for hedging. Conversely, when the change in replacement value of currency derivatives runs in the same direction as the valuation effect due to currency mismatch, then we say that the derivatives are amplifying currency risk.

We estimate the valuation effect due to currency mismatch based on the currency shares at the beginning of each quarter, following the methodology in Lane and Shambaugh (2010). Specifically, we follow four steps. Firstly, we calculate the currency shares in total assets and the currency shares in total liabilities. We exclude assets and liabilities deriving from foreign exchange derivatives, therefore total assets may not equal total liabilities. We calculate the shares in the following currencies: EUR, USD, GBP, JPY, and group the remaining ones in the category "Others". The difference between the share of assets and the share of liabilities, the net share, indicates whether the fund is long or short in a given currency.

Secondly, we calculate the assets appreciation rate, measuring the percentage change in the value of assets given by the change in the relevant exchange rates. Similarly, we calculate the liabilities appreciation rate, based on the currency shares in the liabilities. Given that the concept of domestic currency is not relevant in our setting, we adapt the methodology in Lane and Shambaugh (2010) as follows. We assign an arbitrary currency to each fund, amongst the currencies in which the fund is active. We then multiply the percentage exchange rate change of each non-base currency vis-à vis the base currency by the share of the respective currency. The sum across all non-base currencies gives the appreciation rate. The formulas are given below.

$$AsApprR_{it} = \sum_{x} (Share\ of\ Assets\ in\ currency\ x_{it} * \%\Delta E_{xt})$$

Similarly,

$$LiApprR_{it} = \sum_{x} (Share\ of\ Liabilities\ in\ currency\ x_{it} * \%\Delta E_{xt})$$

where $\%\Delta E_{xt}$ is the percentage change in the end-of-period nominal exchange rate between currency x and the base currency. By construction, the choice of the base currency does not affect the appreciation rates. An appreciation of the assets implies that the value of assets increases due to exchange changes; an appreciation of the liabilities implies that the value of liabilities increases.

Thirdly, we calculate the net asset appreciation index, given by the following formula.

$$NApprI_{it} = AsApprR_{it} * \frac{A}{A + L_{it}} - LiAppr\ R_{it} * \frac{L}{A + L_{it}}$$

where A and L are total assets and total liabilities, excluding foreign exchange derivatives. This is a financially-weighted exchange rate change index, corresponding to the percentage change in the net financial index of Lane and Shambaugh (2010).

Finally, we calculate the currency-driven valuation effect on balance sheet as the net asset appreciation index multiplied by the sum of assets and liabilities.

$$Balance\ sheet\ Val\ eff_{it} = NApprI_{it} * (A + L)$$

To include derivatives in our analysis, we compute the change in replacement value (sometimes called market value) of foreign exchange derivatives. This is given by the difference between closing and opening positions, plus net transactions. We include net transactions to account for changes in the replacement value which have been settled via variation margin payments, for example in a clearing

house.[2] We refer to the change in value of foreign exchange derivatives as the derivatives valuation effect, or the valuation effect off-balance sheet.

$$Derivatives\ Val\ eff_{it} = \sum_{d} (Closing - Opening + Net\ transactions)_{d_{it}}$$

where d represents each foreign exchange derivatives contract.

Finally, the total valuation effect is equal to the sum of the valuation effects on and off balance sheet:

$$Total\ Val\ eff_{it} = Balance\ sheet\ Val\ eff_{it} + Derivatives\ Val\ eff_{\mathrm{it}}$$

Comparing the sign of valuation effects on and off balance sheet allows us to identify whether a fund is hedging or speculating on exchange changes. Figure 1 illustrates the intuition. The horizontal axis measures the derivatives valuation effect; the vertical axis measures the balance sheet valuation effect. When a fund sits in the top-left or bottom-right quadrants, derivatives are compensating for valuation changes on balance sheet. We thus consider this fund as hedging the currency mismatch. Conversely, a fund in the top-right or the bottom-left quadrants has valuation changes on balance sheet and in derivatives going in the same direction. We call this latter behaviour speculating, or amplifying the currency mismatch, because the fund is increasing balance sheet currency exposure via derivatives.

The 45 degree line indicates full hedging. Points above this line in the top-left quadrant indicate that derivatives compensate partially for balance-sheet valuation gains, while points below it in the same quadrant indicate over-compensation. Conversely, points above the 45 degree line in the lower-right quadrant indicate over-compensation, whereas points below the line indicate partial hedging.

The optimal hedging strategy depends on the correlation between currency effects and other price effects: when the correlation is negative, it is optimal to partially hedge; when correlation is positive, it is optimal to over-compensate. We do not attempt to define the optimal strategy here, rather we simply show hedging rates, defined as the ratio between valuation effect on balance sheet and valuation effect off balance sheet.

3. Data analysis

3.1 Overview of the data

We start with an overview of the investment fund sector in Ireland. We then show aggregated currency shares and currency-driven valuation effects, to illustrate how macro-level statistics can be enriched by granular micro data. We differentiate between sub-sectors, and between funds using or not using foreign exchange derivatives. Finally, we then turn to cross-fund distributions to analyse differences in currency risk management across funds.

The total asset value of Irish non-MMF investment funds is EUR 2,588 billion at Q1 2019 (Figure 2).[3] Our sample contains investment funds with total asset value of EUR 2,211 billion at Q1 2019,

[2] Variation margin proxies for the change in replacement value, although it sometimes includes other factors, for example volatility adjustments. Net transactions in this dataset also include options premium payments. The structure of the underlying dataset does not allow to strip out premium payments; however, the distortion caused is likely small since options represent a small share of foreign exchange derivatives.

[3] https://www.centralbank.ie/statistics/data-and-analysis/other-financial-sector-statistics/investment-funds

representing 85% of the total in that quarter. Coverage ranges between 85% and 100% depending on the quarter.[4] Figure 2 shows that the largest sub-sectors in terms of total assets are bond funds and equity funds. The size of the hedge fund sector may be underestimated due to their often large use of off-balance sheet instruments, including derivatives. The investment fund sector has doubled over the period between Q2 2014 and Q1 2019, with largest growth rates in real estate funds (314%), other funds (280%), and mixed funds (114%). The slowest-growing bond fund sub-sector grew by 50% over the period. For a more detailed overview of market-based finance in Ireland, see Cima et al. (2019).

The investment fund sector domiciled in Ireland has an international nature (see also Lane and Moloney, 2018). Approximately 93% of the liabilities are held by foreign residents, while 90% of the assets are invested abroad (approximately EUR 2,300 billion and EUR 2,400, respectively). The industry accounts for approximately half of the Irish international balance sheet. As such, the data collected by the Central Bank of Ireland on investment funds assets and liabilities are an important source of detailed information on the Irish International Investment position. One important application of these data, which we pursue in this study, is uncovering the currency composition of the financial intermediation industry based in Ireland.

Recent research has made important advances in the mapping of international currency exposures (Benetrix et al., 2015; Benetrix et al., 2020). However, data gaps remain, and the assumptions made to fill the gaps may not always be appropriate, especially for financial centres. For example, in the dataset compiled by Benetrix et al. (2020), USD-denominated liabilities of Irish resident are approximately EUR 524 billion in 2017. In our data, USD foreign liabilities of non-MMF investment funds alone are approximately EUR 720 billion. The discrepancy is likely due to the assumption made in Benetrix et al. (2020), whereby when macro data is missing, portfolio equity liabilities are assumed to be in the domestic currency. This illustrates the potential for Irish funds data to be incorporated in external statistics on the currency composition of the IIP.

Figure 3 shows the time series of currency shares in Irish investment funds assets and liabilities. The shares are remarkably stable during the sample period.[5] The dollar is the most common currency in both assets and liabilities, accounting for a share of approximately 40% respectively, followed by the sterling. The yen represents a small share of the assets, and an even smaller share of liabilities. Other currencies account for 10% of assets and a negligible share of liabilities. Overall, Irish investment funds have a short position in EUR, GBP and JPY, and a long position in USD.

Figure 4 provides a breakdown of currency shares by type of fund. Real Estate funds and Other funds have a relatively balanced currency position. The other types of funds replicate the overall exposures, except for equity funds, which are short USD. Equity funds tend to raise funds in the international currencies and invest globally: the "Other" currency assets and JPY assets are relatively large in equity funds.

Figure 5 compares funds using foreign exchange derivatives with funds not using these derivatives. Total assets of derivatives users are larger, except for real estate funds and other funds. Foreign exchange derivatives users tend to have more pronounced currency mismatch than non-users, except equity funds. However, to the extent that equity funds invest in assets denominated in currencies pegged to an international currency, the chart may overestimate the currency mismatch in this type of fund.

The lower degree of currency mismatch in funds not using currency derivatives is also evident in Figure 6. The figure depicts the time series of balance-sheet valuation effects in funds not using currency

[4] We exclude funds which do not have assets or liabilities in any one of the five currencies analysed in this study. We also drop observations with data quality issues in at least one of the variables used in this study. This reduces the amount of observations compared to public statistics, which rely on a smaller number of variables.

[5] Cross-fund distributions, not shown here, as also stable over time.

derivatives on the left panel, and in funds using currency derivatives on the right panel. On the right panel, the derivatives valuation effect is also depicted, along with the total valuation effect. At an aggregate level, users of foreign exchange derivatives have wider valuation effects than non-users, although users tend to reduce on-balance sheet currency exposure via derivatives.

In Figure 7, we focus only on derivative users. A split of valuation effects by fund type shows heterogeneity. Three observations emerge. First, in bond funds, mixed funds, hedge funds and other funds, aggregate valuation effects on balance sheet tend to be reduced by derivatives positions. Conversely, equity funds and real estate funds often amplify aggregate balance sheet exposures via derivatives. Second, the impact of derivatives is relatively small in real estate funds, while in hedge funds derivatives play an important role, often compensating balance sheet valuation effects. Third, there are differences in specific periods. During the euro depreciation in Q1 2015, bond funds amplified gains on balance sheet with the derivatives position, whereas equity funds had losses on both fronts. Conversely, during the quarter of the Brexit referendum (Q2 2016), all fund types hedged currency risk at least to some extent.

We now turn to cross-fund distributions. In Figure 8, we look at matching. Blue boxes represent the distribution of the asset shares (excluding funds with no assets denominated in the currency); the orange boxes represent the distribution of the net asset shares (asset share minus liability share). The top right panel shows that the median share of euro-denominated assets is 17%. In contrast, the median net euro share is zero. This indicates that the median balance sheet mismatch in euro is null. The interquartile range also shrinks, with 50% of funds invested in euro having a net share between -19% and 6%. A similar picture for the dollar: the median asset share is 50%, but the median mismatch is zero. From Figure 8 it is also evident that there are relatively more funds with dollar mismatch than funds with mismatch in euro or sterling.

Going from distributions to tracking individual funds, Table 1 adds information on the frequency of funds matching the currencies shares in their assets and liabilities. The first column contains the percentage of funds where the net share is lower than the asset share, but still positive, indicating partial matching. The second column is the percentage of funds with a positive asset share completely matched by liabilities; the third column is the share of funds with zero liabilities share in the currency (but positive asset share). The fourth column reports the percentage of funds "over-matching", that is, where the liability share is larger than the asset share, so the net asset share is negative.

Summing the first two cells in the euro row suggests that 29% of the funds reduce their euro exposure by issuing liabilities in euro. Of this, 6% completely match their euro asset exposure with euro liabilities. In the second row, 37% of funds match some of their dollar exposure, but only 3% with a complete offset. Matching is less frequent in sterling and yen, though 5% of funds have both assets and liabilities completely denominated in sterling. The last column shows that it is not uncommon for funds to turn their long positions into short positions, that is, to issue more liabilities in a currency than the invested assets in that currency.

Next, we show the cross-fund distributions of the net asset appreciation index, for funds not using foreign exchange derivatives (left panel of Figure 9), compared to derivatives users (right panel). The net asset appreciation index measures the change in the value of net assets given by the exchange rate change occurred in the period, taking into account the effects of matching and diversification, but not derivatives. The interquartile range of the net appreciation index is between -2% and 2%, with the exception of q1 2015, in both distributions, with a small difference between derivative users and non-users. There are some differences in the tails, but the distributions are quite similar except for the year 2016. The same distribution weighted by total assets in Figure 10 suggests that funds not using derivatives are smaller, since similar net asset appreciation indices lead to much smaller valuation effects.

Figure 11 focuses on funds using derivatives. It shows the distribution of the balance sheet valuation effect in the left panel, and the distribution of the total valuation effect (including derivatives) in the left

panel. The use of derivatives shrinks the distribution of valuation effects between 10th and 90th percentile. However, the tails become longer; gains of funds above the 90th percentile tend to be larger, and losses of funds below the 10th percentile tend to be larger. Fund-level analysis – not shown here – confirms that funds in the centre of the distribution of the total appreciation index tend to use derivatives to hedge, whereas funds in the tails tend to increase their exposure via derivatives.

Figure 11 suggests that the aggregated valuation effects shown in Figure 6 mask some heterogeneity. The finding in Figure 6 that aggregate valuation effects are reduced by the use of derivatives is the reflection of two effects. On the one hand, a large mass of funds hedge currency exposure. On the other hand, the funds in the tails of the distribution amplify currency exposure, but those with valuation gains largely compensate those with valuation losses. In the next section, we study the behaviour of hedging funds and amplifying funds more closely, focusing on two events associated with large currency movements.

3.2 Event study

In this section, we focus on funds using foreign exchange derivatives. We analyse hedging and amplifying behaviour during two episodes of currency turbulence in our sample: the announcement of the Asset Purchase Programme (APP) and the Brexit referendum. We consider the quarters of the announcements (Q1 2015 for the APP and Q1 2016 for the Brexit), the quarter when the Brexit referendum actually took place (Q2 2016), and the following quarters (Q2 2015 and Q3 2016), where we observe further exchange rate adjustment. Table 2 recaps currency movements during those periods. EUR depreciates vis-à-vis GBP in APP quarters (Q1 and Q2 2015), but overshoots vis-à-vis USD. GBP depreciates every quarter during Brexit quarters (Q1, Q2 and Q3 2016), except a small recovery vis-à-vis the dollar in Q2 2016.

As described in section 2 and illustrated in Figure 1, we define hedging funds as those with the valuation effects off balance sheet of opposite sign to the valuation effects on balance sheet. We define amplifying funds, or speculating funds, as those where the sign of the valuation effects is the same. For hedgers, we calculate aggregate hedging rates as the ratio between the two types of valuation effects – the slope of Figure 1.

Table 1 shows the percentage of funds hedging and the percentage of funds amplifying currency mismatch with derivatives. On average in normal times (outside our shock periods), 53% of the funds reduce currency exposure via derivatives, whereas 37% amplify it. The proportion is similar when weighing by assets. This is stable during the shock periods, except for the quarter when the Brexit referendum took place (Q2 2016), when relatively more funds hedged at least some of their currency mismatch. More specifically, in Q2 2016 hedgers account for 60% of total assets, amplifiers 33%. Table 4 shows that also hedging rates were higher in that quarter.

In Table 4, we differentiate between funds gaining from the balance sheet mismatch and funds losing from the mismatch. The table shows hedging rates and total valuation effects (on and off balance sheet) of hedging funds. In the quarters outside the shock periods, hedging rate is approximately 60% for both funds whose currency mismatch led to a valuation gain, and those with valuation losses. There are lower hedging rates in the quarter of the news shock (Q1 2015q1 and Q1 2016); higher hedging rates in the quarter following the news shock (Q2 2015 and Q2 2016). In the quarter following the Brexit referendum (Q3 2016), there is significantly larger hedging in those funds which were losing from the sterling depreciation, and lower hedging of funds which were gaining from the depreciation. This is consistent with some degree of confidence in expecting a further sterling depreciation.

Table 5 shows valuation effects on and off balance sheet of those funds amplifying on-balance sheet currency exposure via derivatives. Not surprisingly, valuation gains and losses on balance sheet are large when there are large currency movements. However, valuation losses are also large in Q2 2015, when

exchange rates movements are not sharp, though the euro depreciated against the sterling while appreciating against the dollar. The detrimental effect of this combination is also visible in Table 4, where the valuation losses in this quarter are relatively large notwithstanding 77% hedging rate.

Turning to the use of derivatives, from Table 5 it appears that speculating tends to be more intense in the quarters of the event announcement. In Q1 2015, funds which successfully amplified their currency exposure increased the valuation gain by 35% through derivatives, gaining close to EUR 11 billion overall. Conversely, funds which were losing on balance sheet mismatch only increased exposure via derivatives by 13%, for a total loss of close to EUR 4 billiion. This suggests that there was some degree of confidence in the expectation of a depreciating euro. Conversely, in the quarter of announcement of the Brexit referendum (Q1 2016), speculating in both directions was relatively intense.

In summary, Irish investment funds decreased hedging rates and increased speculation in the quarter when the APP was announced, and so they did in the quarter when the Brexit referendum was announced. This suggests that these news were somewhat expected, although expectations on the direction of the exchange rate impact were mixed. After the announcements, the hedging rates increase. The increase in hedging rates seems to be particularly evident after shocks where the direction of the impact was less predictable (Brexit).

4. Conclusion

Given the growing importance of financial centres in global external assets and liabilities, it is important to understand the behaviour of financial intermediaries. To the extent that currency mismatches can have an impact on the dynamics of external balance sheets, analysing the currency risk profile of financial institutions is fundamental. Interesting and important questions are whether investment funds shareholders are exposed to foreign currency shocks and whether investment funds reduce such risks through the use of derivatives or other strategies (such as matching).

Our contributions are manifold. First, we give an improved picture of the currency composition of the investment-fund component of the Irish IIP, adding to the recent work of Benetrix et al. (2020). Second, we describe the currency risk strategies of investment funds, by combining in an innovative way the financially-weighted exchange rate index developed by Lane and Shambaugh (2010) with the replacement value of foreign exchange derivatives. Finally, we provide insights to regulators and policy makers about the behaviour of investment funds around policy decision events.

Our analysis suggests that foreign exchange derivatives users tend to have more pronounced currency mismatch than non-users. At an aggregate level, users of foreign exchange derivatives have wider valuation effects than non-users, even if the former tend to reduce on-balance sheet currency exposure via derivatives. Interestingly, our data also highlight differences amongst type of funds. Bond funds, mixed funds, hedge funds and other funds tend to reduce aggregate valuation effects by using derivatives. Conversely, equity funds and real estate funds tend to amplify aggregate balance sheet exposures via derivatives.

Finally, our analysis of specific events suggests that funds are not idle when policies are likely to affect the exchange rate. In the quarter of announcement of the APP and the quarter of announcement of the Brexit referendum, there is more speculation and less hedging. In the subsequent quarters, speculation decreases and hedging increases.

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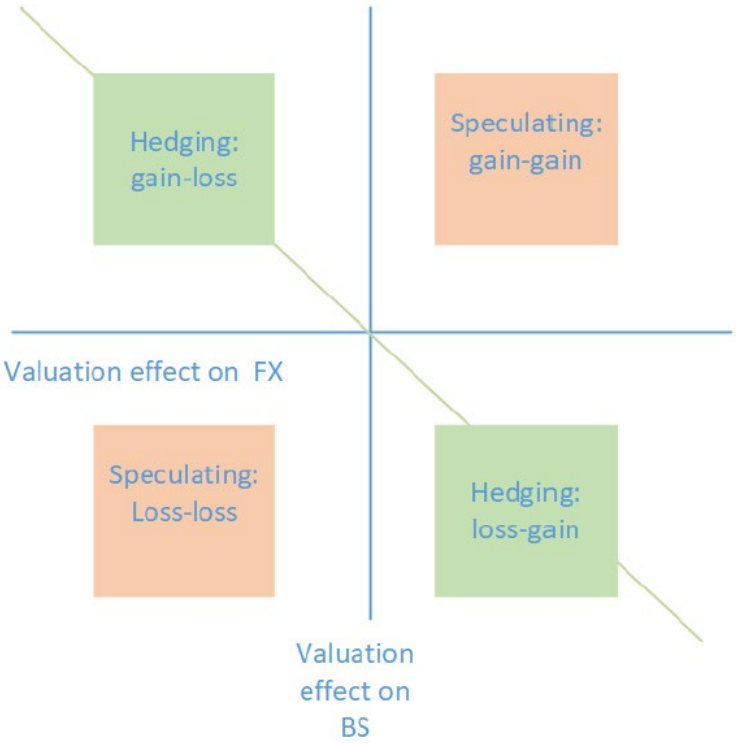
Tables and figures

Figure 1 Illustration of hedging and speculating via derivatives



Notes: The horizontal axis measures the change in replacement value of foreign exchange derivatives. The vertical axis measures valuation effects on balance sheet.

Figure 2 Total assets by investment fund type, 2014q2 to 2019q1

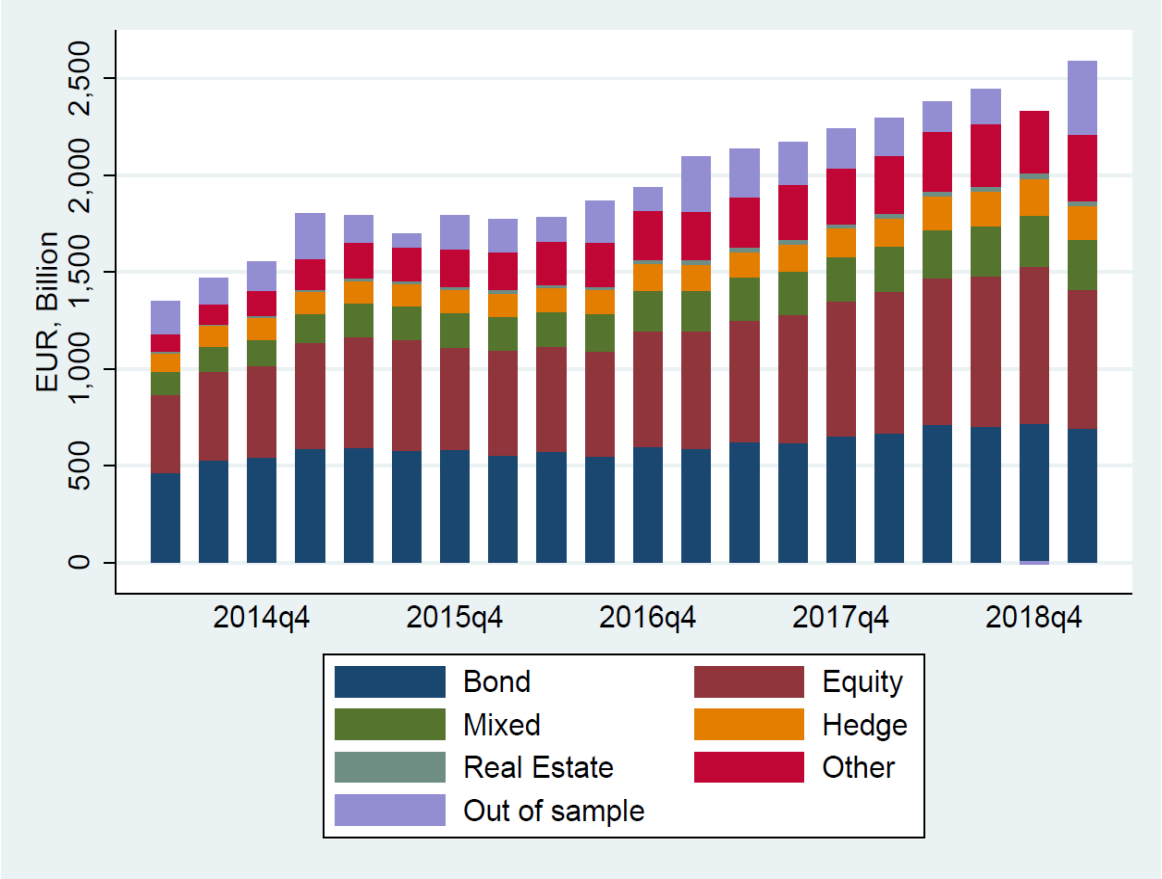


Figure 3 Currency shares of assets and liabilities of Irish investment funds, 2014q1 to 2019q1

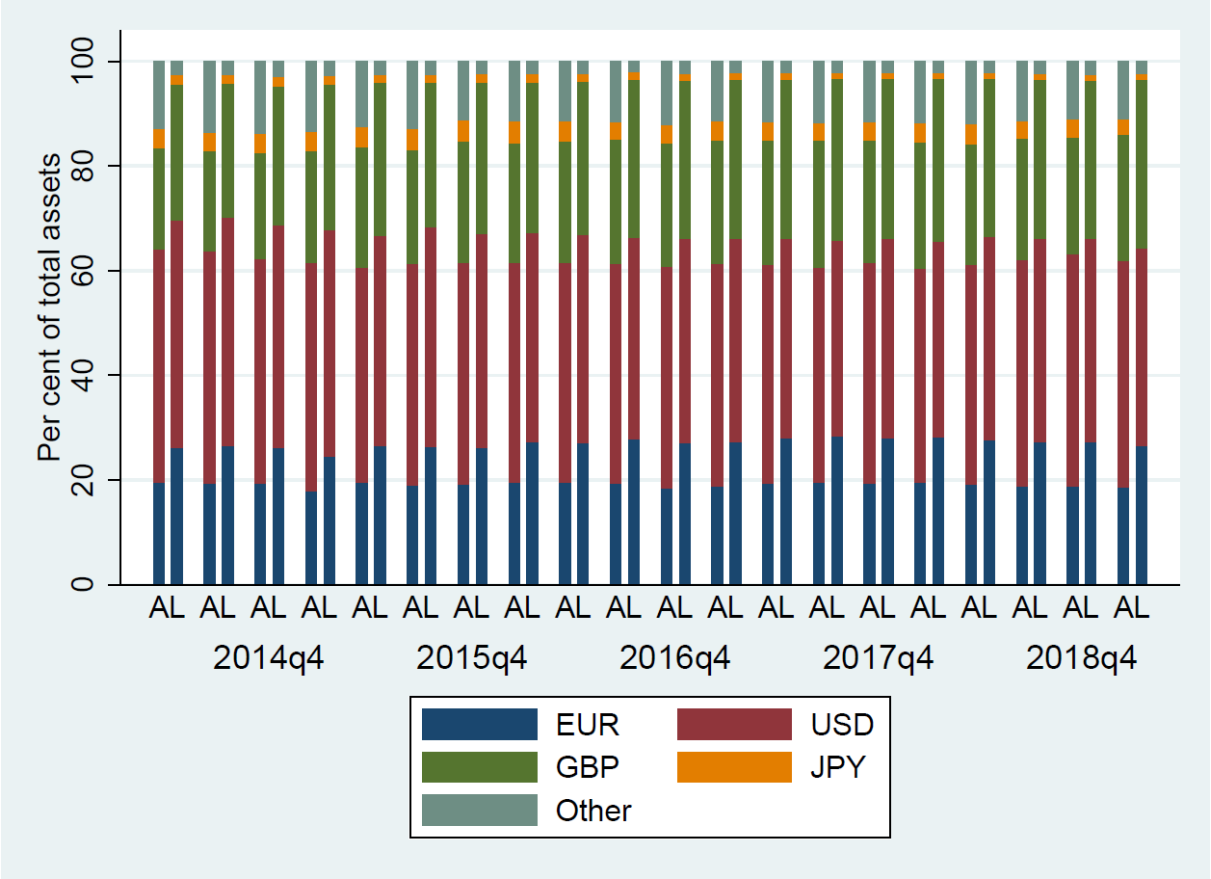


Figure 4 Currency shares by type of fund, 2019q1

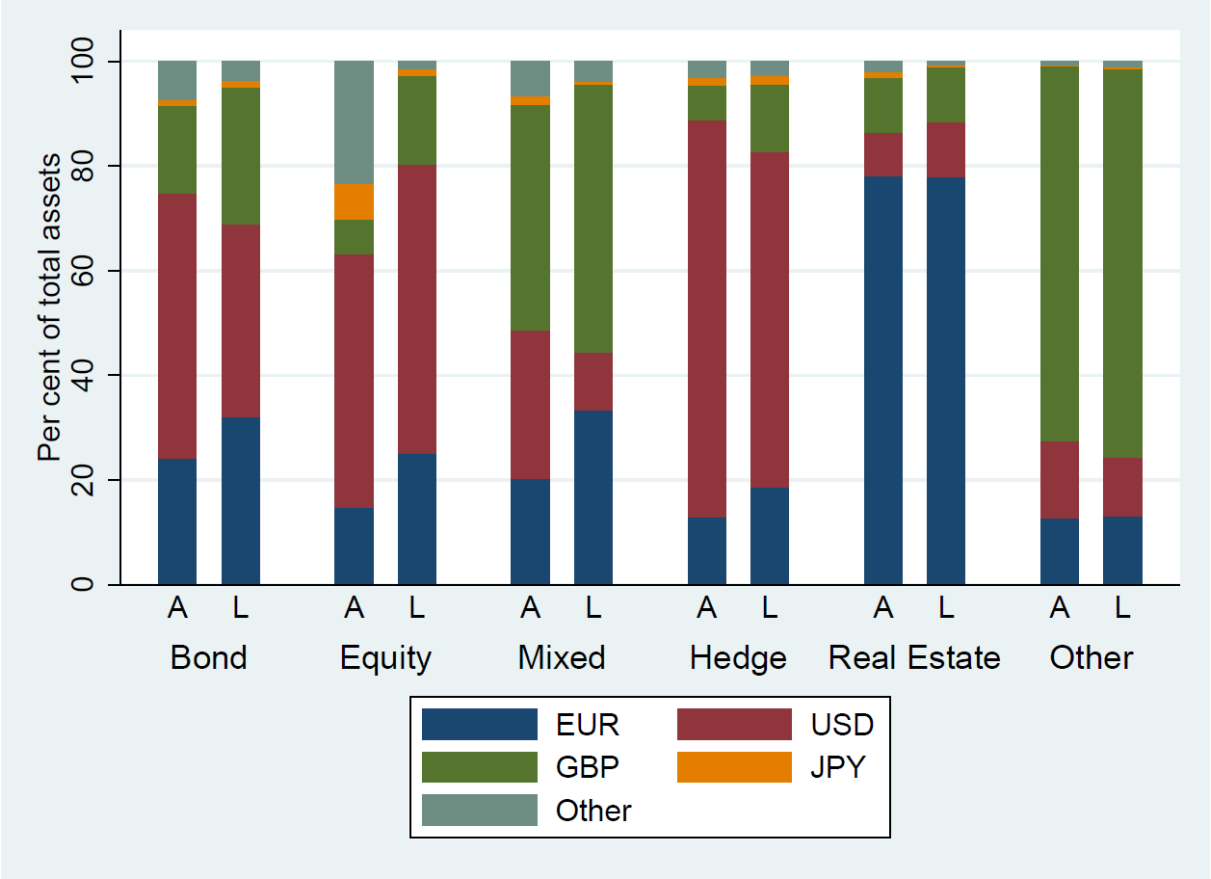


Figure 5 Assets of users and non-users of foreign exchange derivatives, by currency (Q1 2019)

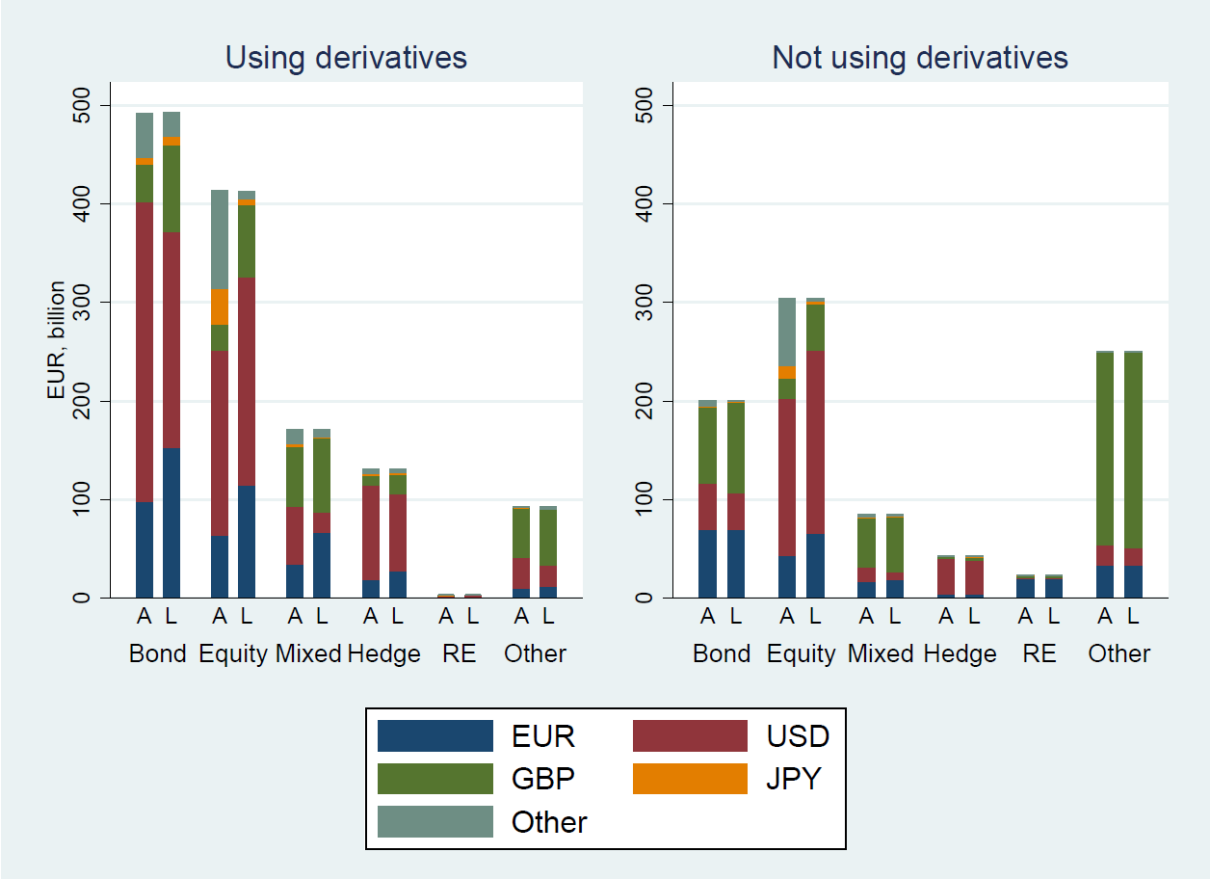


Figure 6 Valuation effects of users and non-users of foreign exchange derivatives, 2014q2 to 2019q1

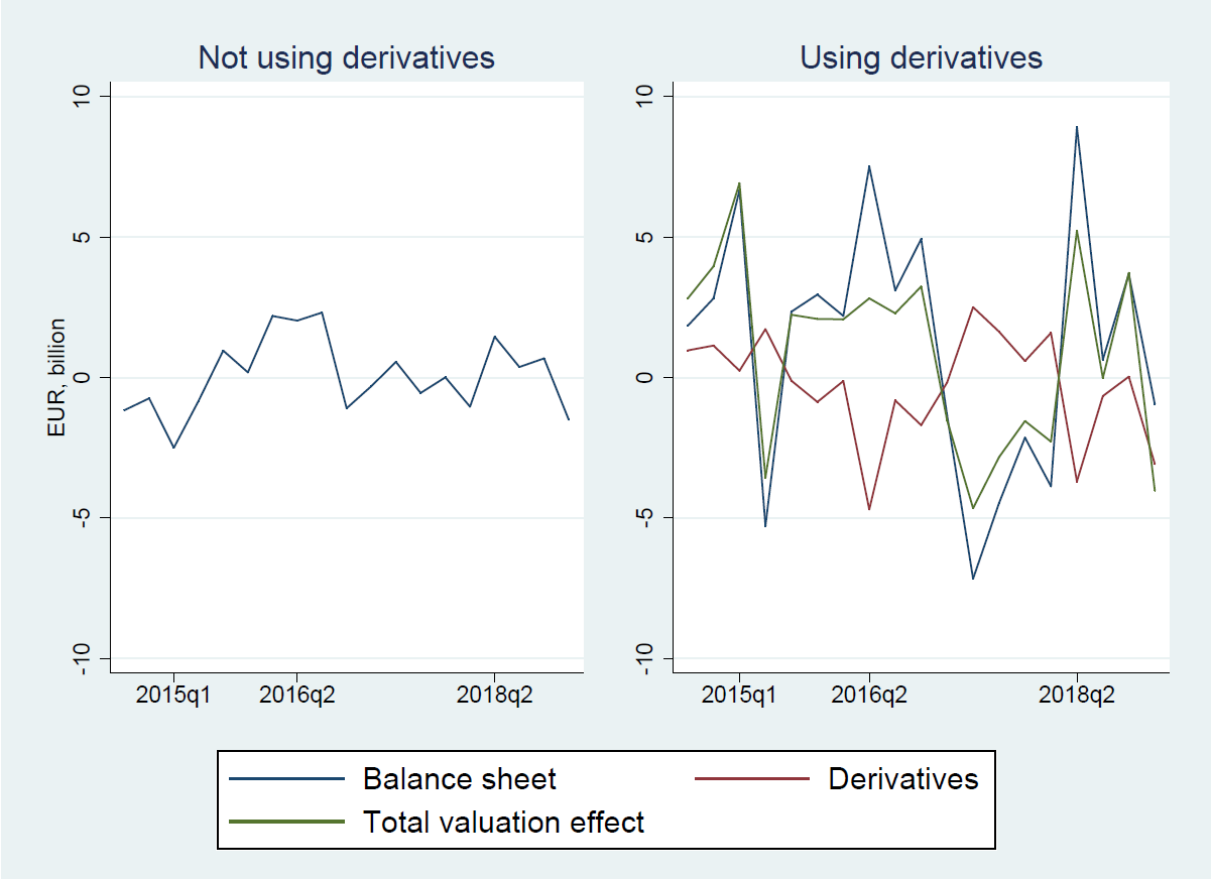


Figure 7 Valuation effects by type of fund, 2014q2 to 2019q1

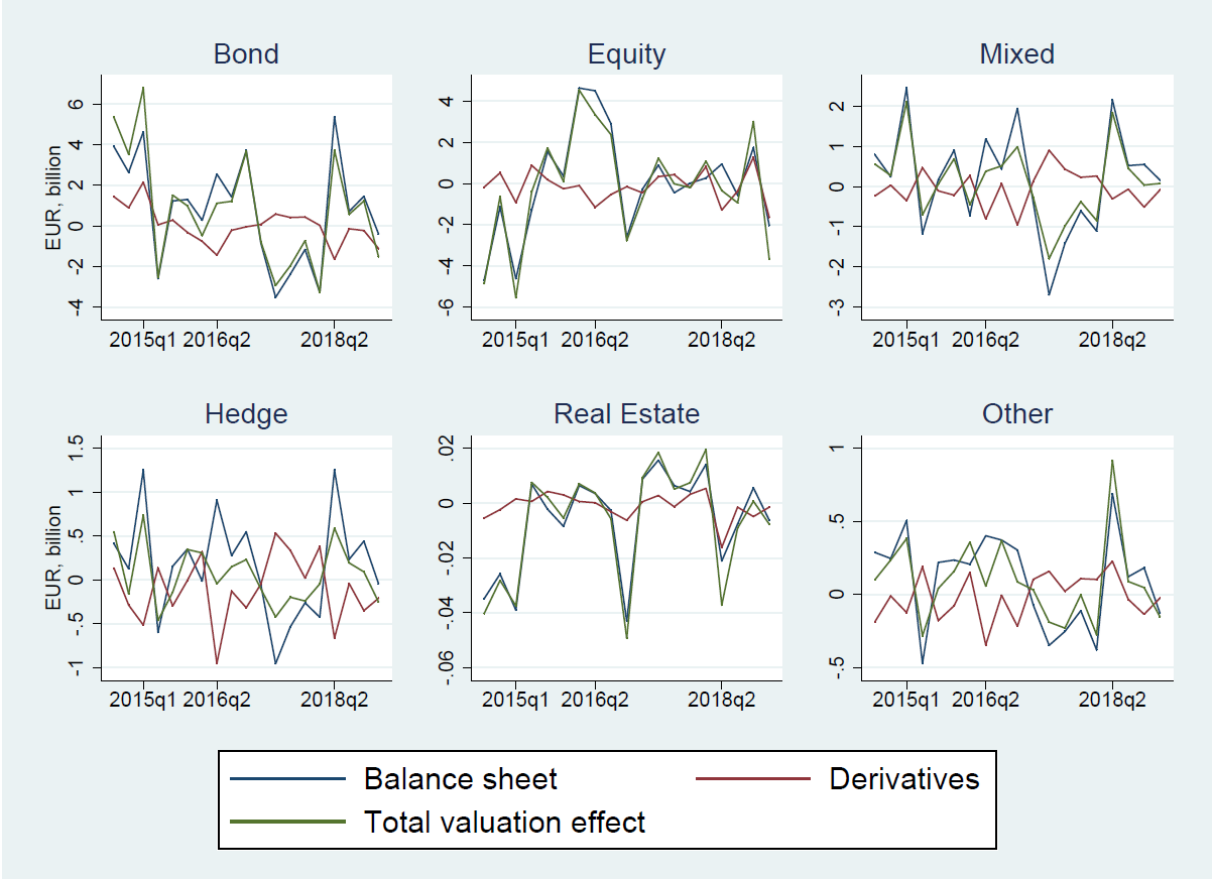
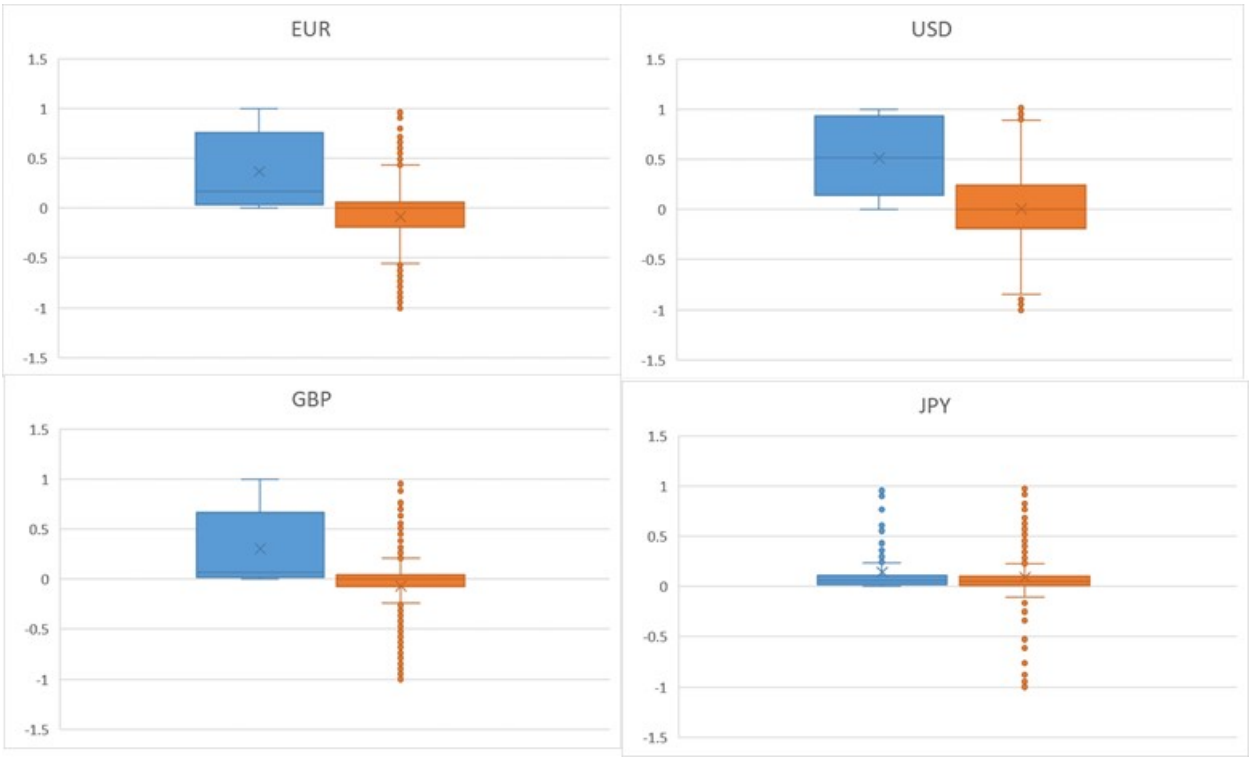


Figure 8 Distribution of asset shares and distribution of net asset shares, by currency (Q1 2019)



Notes: Blue bars represent the distribution of the net asset share. Orange bars represent the distribution of the net share (asset share minus liability share).

Figure 9 Distribution of net asset appreciation index of users and non-users of foreign exchange derivatives, 2014q1 to 2019q1

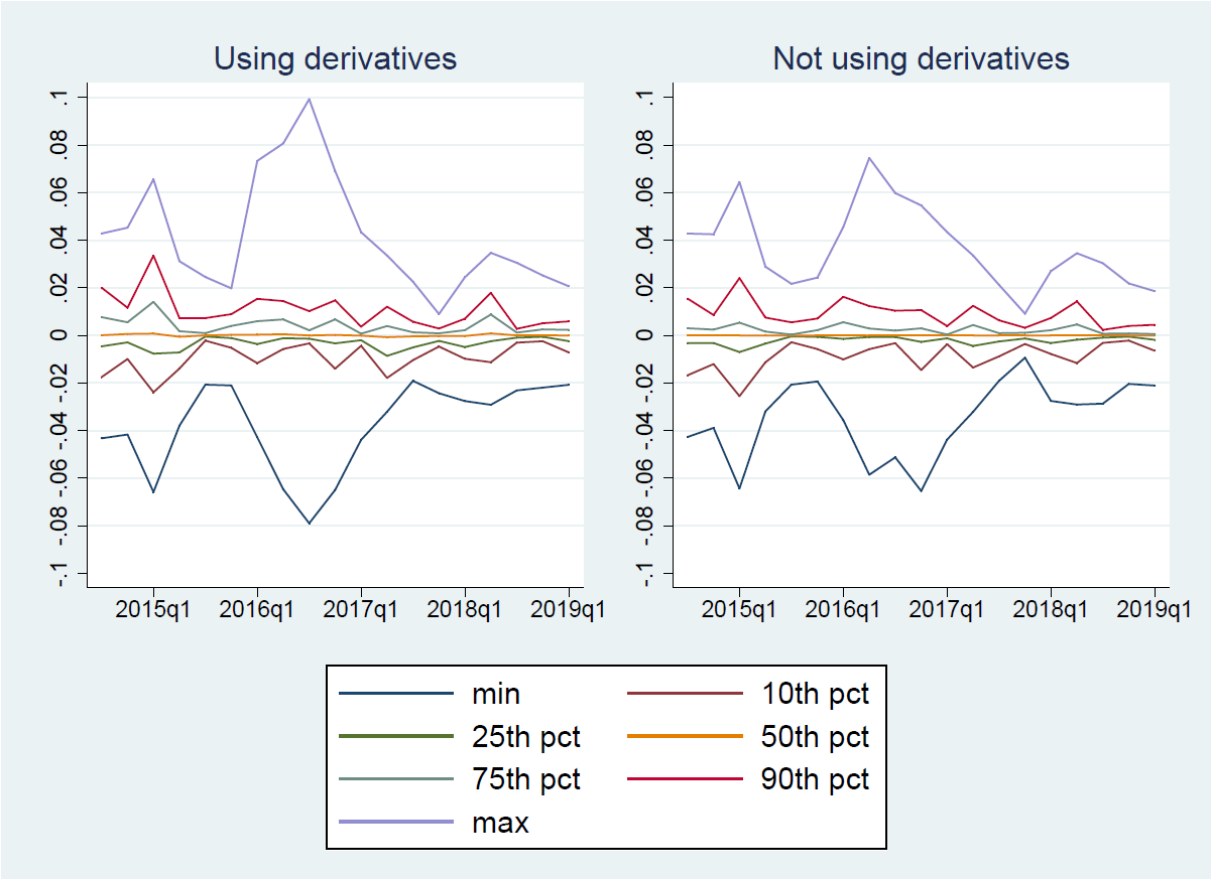
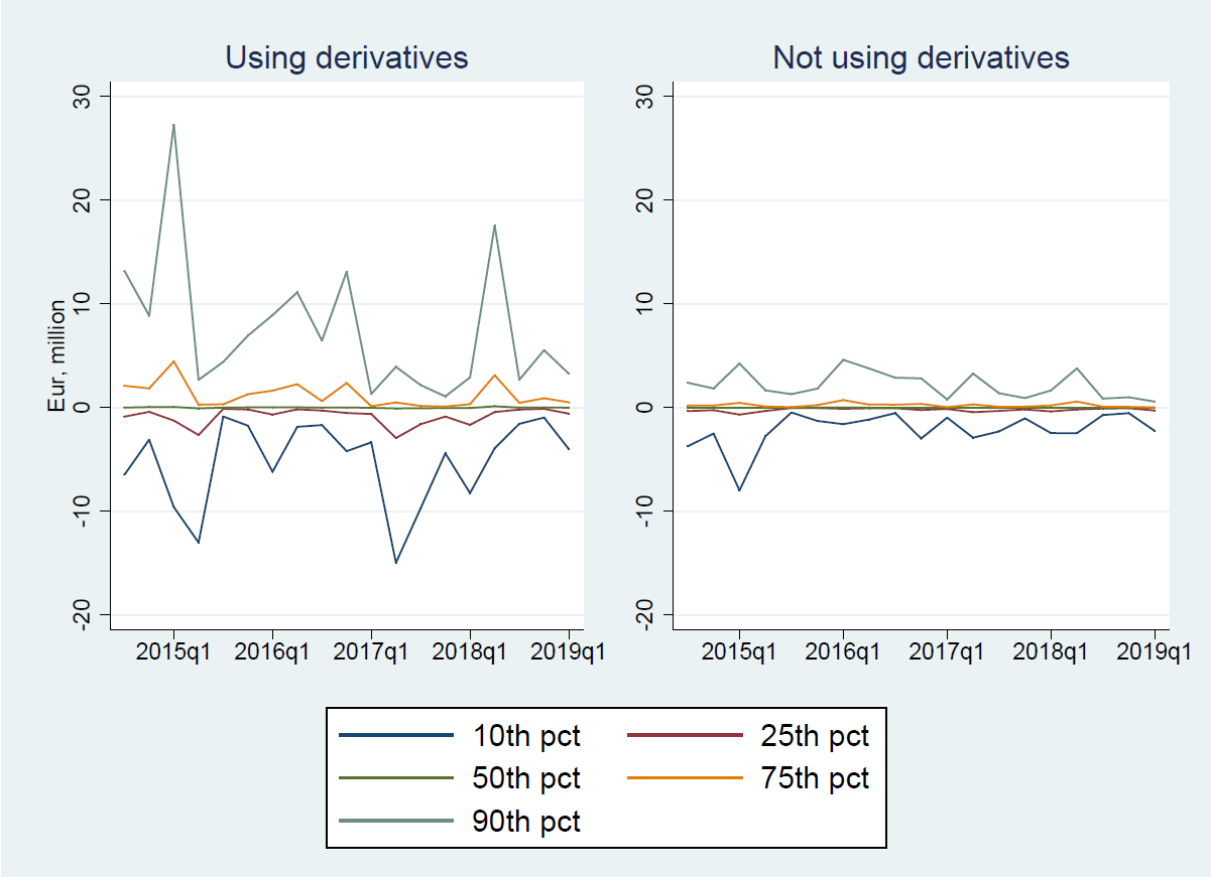


Figure 10 Distribution of valuation effects on balance sheet, 2014q2 to 2019q1



Notes: The distribution in the right panel refers to funds using foreign exchange derivatives. The distribution on the left panel refers to funds not using foreign exchange derivatives.

Figure 11 Distribution of balance sheet and total valuation effects, 2014q2 to 2019q1

Table 1 Currency matching: percentage of funds (Q1 2019)

Currency	Partially matched	Completely matched	No matching	Over-matched (short overall)
EUR	23%	6%	4%	33%
USD	34%	3%	4%	31%
GBP	19%	5%	4%	23%
JPY	14%	0%	2%	2%

Table 2 Exchange changes

	GBP-EUR	USD- EUR	USD-GBP
Average	0	1%	1%
2015q1	7%	13%	3%
2015q2	2%	-4%	-2%
2016q1	-7%	-4%	5%
2016q2	-4%	3%	-0.3%
2016q3	-4%	-1%	12%

Notes: Average excludes the selected quarters.

Table 3 Hedgers and amplifiers: percentage of funds

	Number of Funds		Asset weighted	
	Hedge	Amplify	Hedge	Amplify
Average	53%	37%	51%	40%
2015q1	53%	35%	49%	43%
2015q2	56%	32%	51%	42%
2016q1	51%	37%	46%	48%
2016q2	58%	31%	60%	33%
2016q3	54%	34%	53%	39%

Notes: Percentages do not add up to one because there are funds with no asset mismatch and funds with balanced derivatives positions (or not using derivatives). Average excludes the selected quarters.

Table 4 Hedging rates of the funds hedging the currency mismatch, selected quarters

	Valuation gain		Valuation loss	
	Hedging rate	Total FX effect	Hedging rate	Total FX effect
Average	-60%	1,166	-58%	-1,044
2015q1	-52%	3,797	-38%	-3,605
2015q2	-90%	146	-77%	-1,098
2016q1	-49%	1,630	-53%	-1,532
2016q2	-74%	1,777	-67%	-519
2016q3	-51%	1,422	-84%	-127

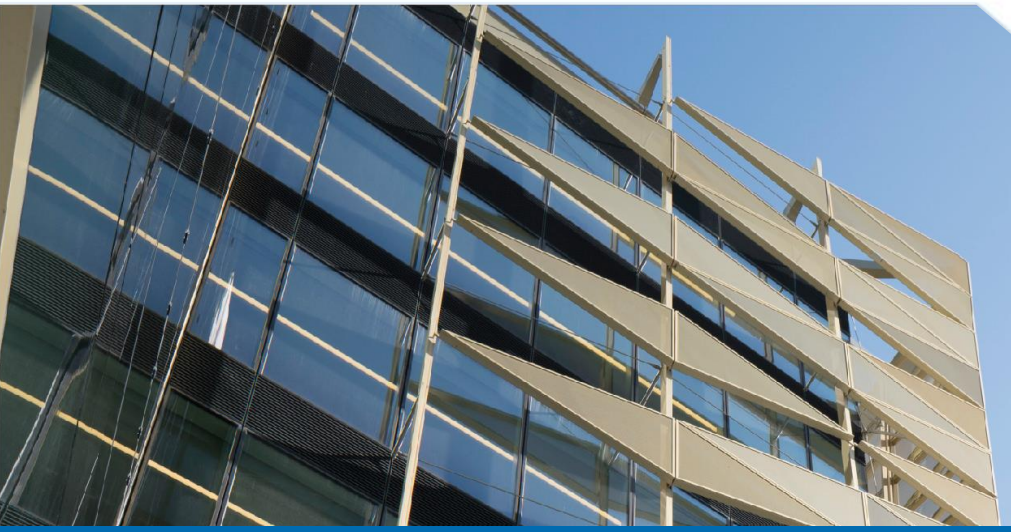
Notes: Hedging rate = derivatives valuation loss (gain) over asset valuation gain (loss). Average excludes the selected quarters.

Table 5 Valuation effects of the funds amplifying the currency mismatch, selected quarters

	Valuation gain				Valuation loss			
	On BS	Off BS	Total	On/Off	On BS	Off BD	Total	On/Off
Average	1,970	984	2,954	50%	- 1,835	- 781	- 2,617	43%
2015q1	8,010	2,836	10,846	35%	- 3,501	- 461	- 3,962	13%
2015q2	1,168	279	1,446	24%	- 3,146	- 961	- 4,108	31%
2016q1	3,959	1,246	5,206	31%	- 1,687	- 1,563	- 3,250	93%
2016q2	2,784	552	3,336	20%	- 637	- 885	- 1,522	139%
2016q3	1,516	418	1,934	28%	- 514	- 374	- 888	73%

Note: % Assets is the total valuation gain / loss as a percentage of total assets of funds in each group. Average excludes the selected quarters.

Banc Ceannais na hÉireann
Central Bank of Ireland
Eurosystem



Foreign exchange derivatives and currency mismatch in Irish investment funds

Benedetta Bianchi and Giovanna Bua

Goals and contributions

1. Currency composition of assets and liabilities of Irish-domiciled investment funds

   Micro data improve existing statistics

2. Use of foreign exchange derivatives: Hedging or amplifying currency risk?

   Empirical method extends framework on currency exposures

Estimating the impact of exchange changes

- $Assets\ Appreciation\ Rate_{it} = \sum_x (Share\ of\ Assets\ in\ currency\ x_{it} * \%\Delta E_{xt})$
- $Liabilities\ Appreciation\ Rate_{it} = \sum_x (Share\ of\ Liabilities\ in\ currency\ x_{it} * \%\Delta E_{xt})$

- $Net\ Appreciation\ Index_{it} = Asset\ Appreciation\ Rate_{it} * \frac{A}{A+L_{it}} - Liabilities\ Appreciation\ Rate_{it} * \frac{L}{A+L_{it}}$

- $Balance\ Sheet\ Valuation\ Effect_{it} = Net\ Asset\ Appreciation\ Index_{it} * (A+L)_{it}$

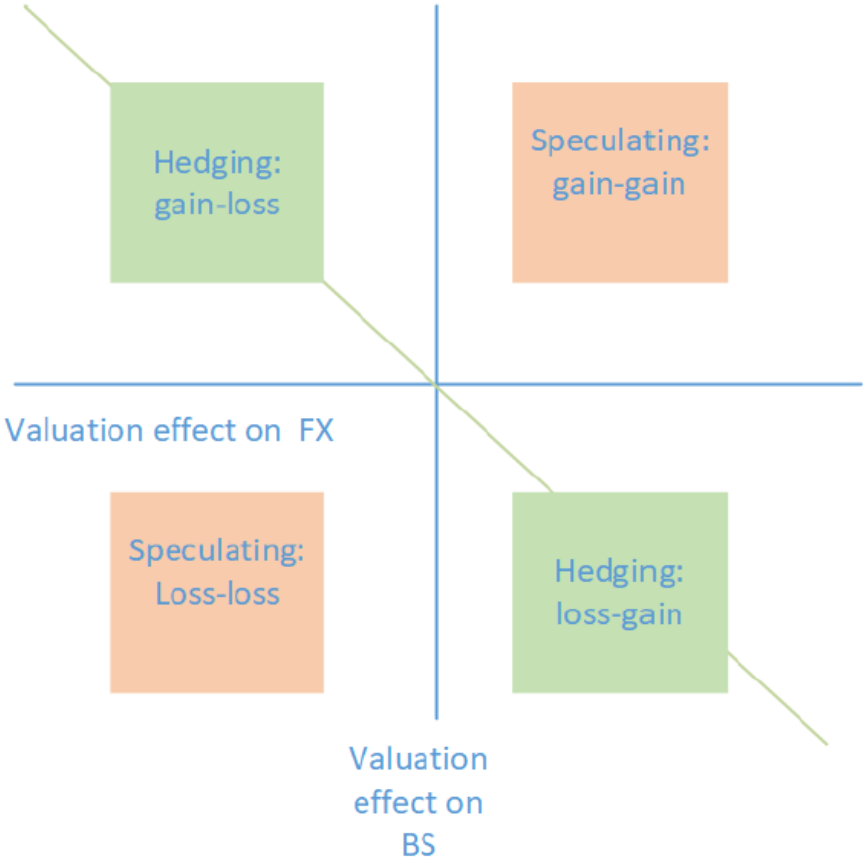
(Adaptation of Lane and Shambaugh, 2010)

Extension to include foreign exchange derivatives

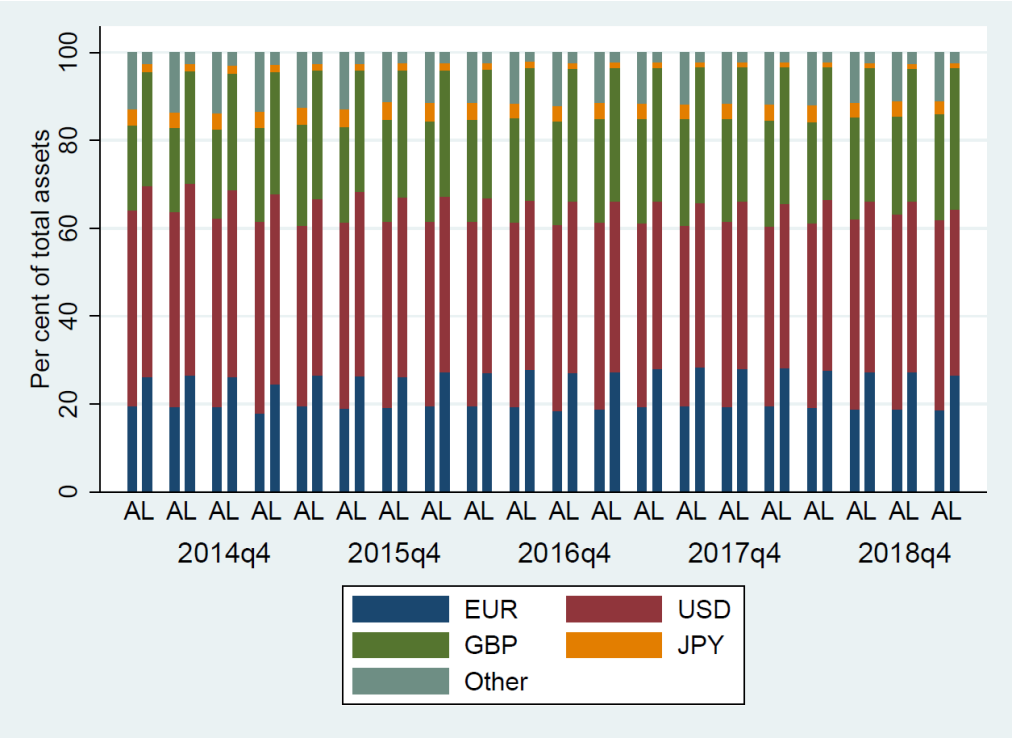
- $Derivatives\ Valuation\ Effect_{it} = \sum_d (Closing - Opening + Net\ transactions)_{d\,it}$
  - Change in market value
  - Settled and un-settled (incl. variation margin)

- $Total\ Valuation\ Effect_{it} = Balance\ Sheet\ Valuation\ Effect_{it} + Derivatives\ Valuation\ Effect_{\mathrm{it}}$

Hedging and speculating: Definitions

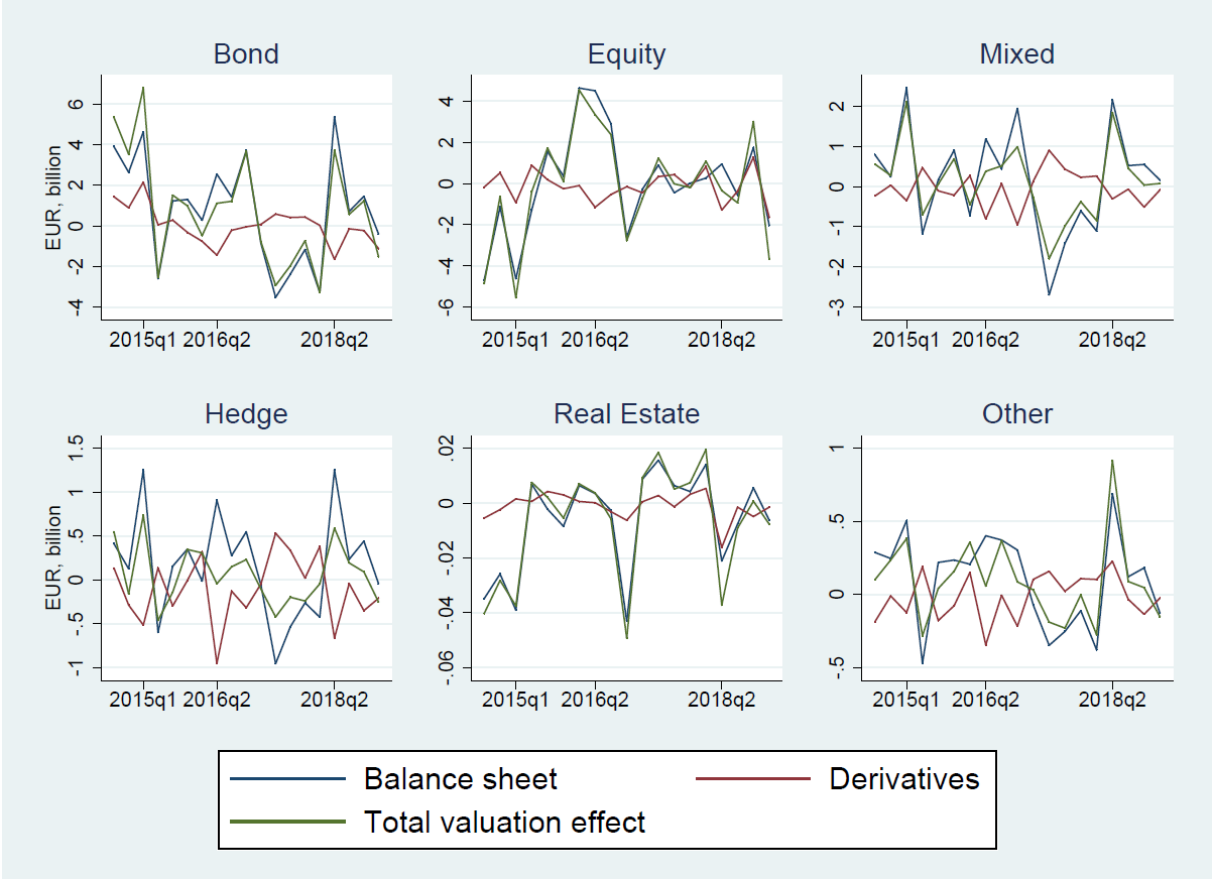


Currency shares of Irish investment funds assets and liabilities

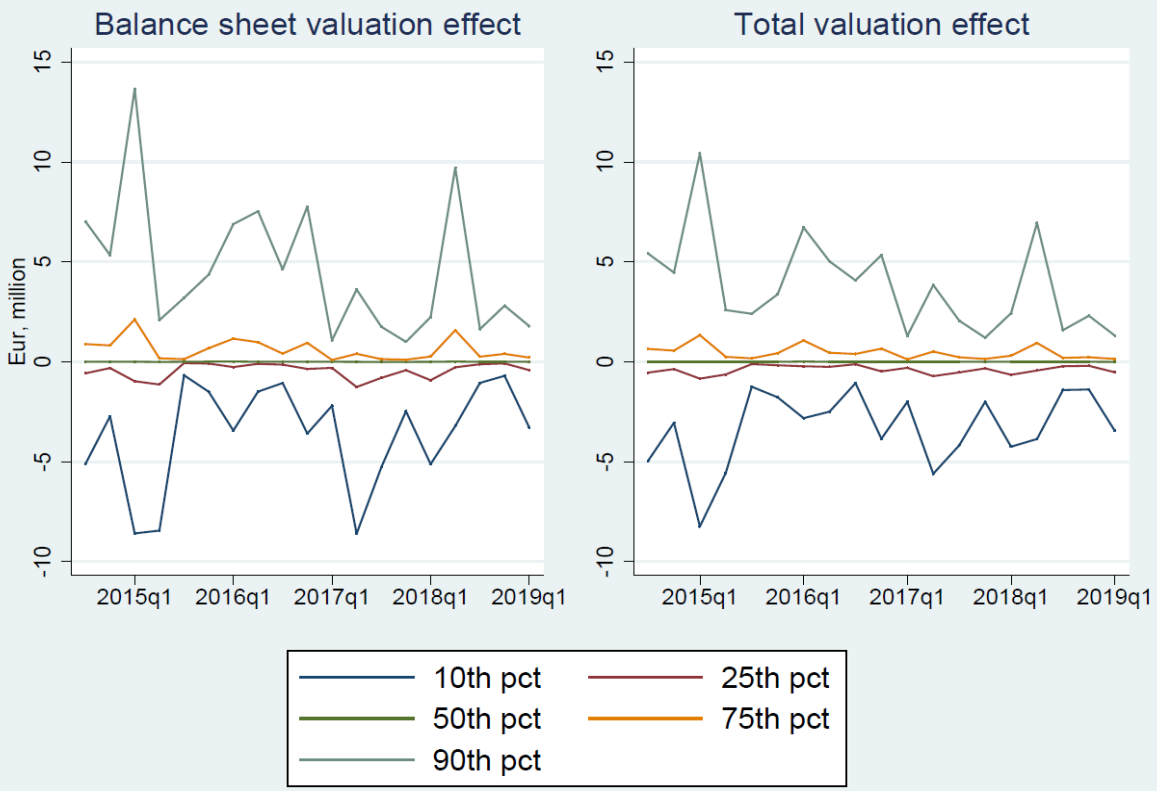


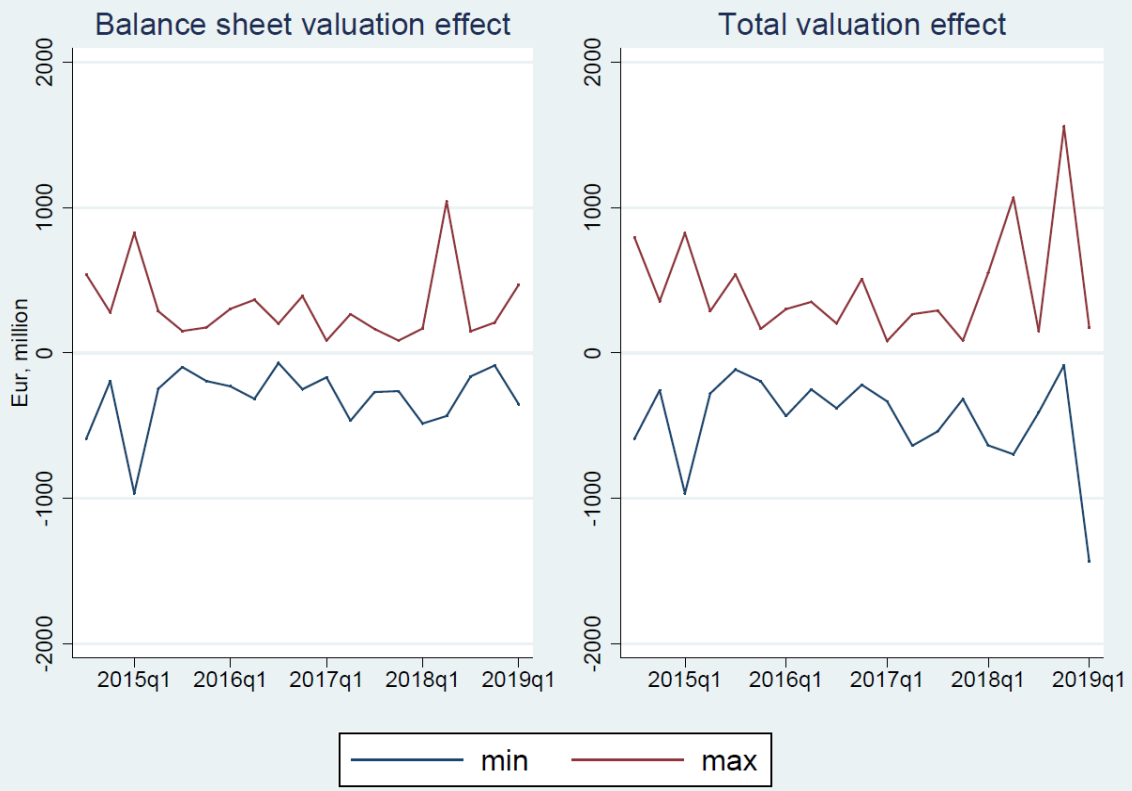
- Existing estimates of dollar-denominated foreign liabilities: EUR 524 billion (including all sectors)
- Our estimates: EUR 720 billion (non-MMF investment funds only)

Valuation effects by type of fund



Valuation effects: Cross-fund distribution





Event study

- Two episodes of large exchange changes
  - Q1 and Q2 2015 (ECB's Asset Purchase Programme)
  - Q1, Q2 and Q3 2016 (The Brexit referendum)

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Conclusions

Macro statistics

- Currency composition of IIP can be improved with micro data
- Intermediation: Where are the shareholders based?

Hedging or amplifying

- Hedging increases after large exchange changes
- Valuation effects reduced by derivatives, but increased in the tails