Twenty-Ninth Meeting of the
IMF Committee on Balance of Payments Statistics

Washington D.C., USA
October 24–26, 2016

BOPCOM—16/23

Experience in Compiling Data on Financial Derivatives

Prepared by the Nederlandsche Bank

Experience in compiling data on financial derivatives

Rini Hillebrand[1]

1. Introduction

The international investment position (IIP) and the balance of payments (BOP) are key statistics for analyzing the development of a country's financial linkages with the rest of the world. Financial derivatives are an important driver for the movements of the IIP and BOP as their revaluations and net transactions are both sizeable and volatile. In the Netherlands, revaluations in net financial derivatives have made up to 7% of GDP in one single quarter.

The financial crisis reemphasized the need for data of good quality in order to timely detect vulnerabilities and emerging risks. For instance, the IIP may help to identify potential risks early on, to prevent the emergence of harmful macroeconomic imbalances. That is why the IIP is one of the indicators being used by the European Commission in the macroeconomic imbalance procedure (MIP). Derivatives have a reputation for being highly complex and difficult to analyze, but in practice, with a few exceptions, this would seem to be a misconception. Although data on derivatives are by nature highly volatile, they are also very predictable. The vast majority of economic agents use derivatives in a predictable manner. Rather than to speculate, they mainly use derivatives to hedge their risks, which are quite stable. Derivatives are also commonly used by institutional investors to alter their investment portfolios, for example the duration of their portfolios.

Using the Dutch experience, this paper explores the possibilities for interpreting trends in the figures on financial derivatives, which is helpful for assessing data quality. This paper starts with a brief overview of data collection in the Netherlands. After that, a selection of the most used and important analyses are described in Chapter 3. At the end of this paper we take a look at some challenges when analyzing data on derivatives.

2. Data collection in the Netherlands

In the Netherlands data on derivatives are collected via direct reporting on a monthly basis as part of the integrated balance of payments and international investment position collection framework. The following types of derivatives are collected separately: purchased and written options, futures, interest rate swaps/forward rate agreements, cross-currency interest rate swaps and forward exchange contracts/other forward contracts. For these derivatives, the opening and closing balance for assets and liabilities are collected separately, as well as 'payments', 'receipts' and 'other changes' (with no distinction between assets and liabilities, because this distinction is very difficult to make for reporting agents). The counterparty institutional sector and country also need to be reported (domestic derivatives are excluded from the reporting obligation). Selected entities from all individual domestic sectors have a reporting obligation, with the exception of households and non-profit organizations serving households. Data of these two sectors are obtained from domestic clearing members. Figure 1 shows an example of the reporting form for IRS/FRA and CCIRS.

Diagram 1 OTC-derivatives IRS, FRAs and CCIRS concluded with non-resident counterparties

Derivative	Country of residence of the counterparty	Sector of the counterparty	Position at the beginning of the month		Changes during the month					Position at the end of the month	
					Transactions		Revaluation		Other changes		
			Assets	Liabilities	Payments	Receipts	Exchange rate changes	Price changes		Assets	Liabilities
Interest Rate Swaps (IRS) and Forward Rate Agreements (FRAs)											
Cross Currency Interest Rate Swaps (CCIRS)											

[1] The author works as economist with the Statistics Division of the Netherlands Bank (r.hillebrand@dnb.nl). The author thanks Pim Claassen (Head of Department, Balance of payments and securities statistics) and Erik Bieleveldt (economist) for their comments and suggestions.

With the introduction of a new collection framework, foreseen in 2020, several changes will be introduced. More types of derivatives will be collected separately, for instance credit default swaps. Also, forward exchange contracts and other forward contracts as well as interest rate swaps and forward rate agreements will be collected separately, instead of combined in one reporting line. 'Other changes' will be broken down into 'revaluations' and 'other changes in volume'. An important adjustment will be the inclusion of domestic derivatives in the reporting framework. The latter results from the cooperation between the Netherlands Bank and Statistics Netherlands, which provides for an integrated reporting framework serving both BOP and IIP and national account purposes.[2] The reporting frequency will be scaled back to once every quarter and transactions in financial derivatives for the monthly BOP will be forecasted using quantitative economic analysis (see Chapter 3.3 for possibilities to forecast transactions and revaluations).[3] In short: more detail and better quality with a lower frequency.

3. How to manage data quality for data on derivatives?

Just like for other types of data, it is sometimes difficult to determine if data on financial derivatives are correct or not. Data quality can be difficult to measure. For data on derivatives, though, there is a surprising number of possibilities for analysis, which can be useful for detecting questionable figures.

Each analysis starts more or less with two questions: "What do we expect to see?" and "Do the actual reported figures match our expectations?". If not, it is important to zoom in on the discrepancies. Are our expectations sound? Are there reasons to question reported data? Both questions can be asked on both micro and macro levels, although the primary focus in the Netherlands is on macro level. When issues are found on the macro level, the analysis shifts to the reporting agents that are responsible for this. As will be shown, the institutional framework in the Netherlands, in particular the importance of institutional investors, plays a key role in determining our expectations of what to see in the BOP and IIP.

The Dutch data quality management of derivatives data in the BOP and IIP can be split into three types of analyses: 1) missing data, 2) pattern analysis and 3) quantitative economic analysis. These three types of analyses are explained below. If sufficient detailed information is available, institutional sectors with the same risk characteristics are grouped and appropriate benchmarks are selected, sufficient analysis options are possible to gain a certain level of confidence in the quality of the derivatives data.

3.1 Missing data

'Missing data' refers to cases where individual reporting agents fail to report figures on derivatives. The goal of this type of analysis is to identify these missing figures. This type of analysis is relatively time-consuming and difficult to automate. It is often easier to detect wrong data than missing data.

The starting point for this type of analysis is to identify institutions that do not report any derivatives, where this would be expected on the basis of the characteristics of the institution. For instance, electricity companies, multinationals with Dutch headquarters that generate a relatively large proportion of their revenues in foreign currencies, institutional investors, banks, issuers of debt in foreign currency etc. These institutions are asked whether it is correct that they report no cross-border positions in derivatives.

A complicating factor in the Netherlands is the fact that, under the current reporting framework, only cross-border derivatives need to be reported. If no derivatives are reported, this can be because only domestic positions in derivatives are kept. If that is the case, than it is obviously correct when institutions do not report anything for the BOP and IIP.

[2] See 'Developing a new approach to compiling BOP in the Netherlands', Erik Bieleveldt and Pim Claassen, prepared for the IMF BOPCOM meeting of October 27 – 29, 2014.
[3] The Dutch monthly BOP is not published nationally. So-called monthly key items (like the total net financial derivatives transactions) are submitted to the ECB and Eurostat as a building block for the compilation of the euro area and EU BOP.

3.2 Remarkable patterns and atypical reports

This type of analysis aims to discover unusual, questionable patterns, without taking into account developments on financial markets. Solely by looking at individual and aggregated figures, the goal is to identify suspicious trends. Naturally, the figures may still turn out to be correct. Below, several examples of analysis are described.

- Outliers in net financial transactions at an aggregated level (time series analysis). Although thresholds must be set high, because of the volatility of transactions in financial derivatives, this is a simple and effective check for the identification of large reporting errors. The volatility of net financial transactions depends on the underlying type of derivative. For example, transactions on swap contracts with regular exchange of funds are less volatile than transactions on forward contracts with just one payoff at the end of a contract, so lower thresholds are justified for swap contracts.

- Comparing different sectors. For example, see Table 1 showing the revaluations of forward exchange and other forward contracts by sector. In the upper blue line the aggregated total for all Dutch sectors together is represented. A green cell indicates that the sign of the figure for an individual sector is equal to the total. Red cells show a different sign and require further research.

Table 1 Revaluations forward exchange and other forward contracts

EUR million	2014				2015				2016	
	I	II	III	IV	I	II	III	IV	I	II
	1.019-	2.298-	13.813-	2.650-	27.181-	13.912	1.587	6.868-	11.824	9.092-
Deposit-taking corporations except central bank	553-	333-	1.685-	1.097	2.473-	6.416	466-	45-	1.881	3.567-
Pension funds	195-	675-	4.512-	1.754-	9.027-	3.093	522	2.201-	3.350	2.035-
Insurance corporations	140	107-	148-	66-	417-	114	57	126-	140	29
Non-MMF investment funds	217	258	863-	185-	882-	303	12	350-	460	252-
Other financial intermediaries, except insurance corporations and pension funds	399-	1.421-	6.735-	1.818-	14.742-	3.868	1.650	3.735-	6.116	3.356-

Source DNB

- Peer group analysis within one sector can also help to identify atypical reports or remarkable patterns. As mentioned earlier, derivatives are often used to hedge risks and to diversify investment portfolios. Within a sector, derivatives are therefore often used in a similar manner. For instance, pension funds normally use derivatives to hedge the risk of a decline in interest rates. When an individual pension fund shows different behavior from its peers, this deserves further investigation.

- As financial derivatives are a zero-sum game on a global level, it is very difficult to structurally earn money using derivatives. If a reporting agent shows continuous net receipts or payments over a longer period of time, it is reason for further investigation. Obviously, persisting net receipts or payments are indeed possible when long-term trends occur, such as a long-term decline in interest rates.

- The market value of a derivative contract is the present value of all expected future payments and receipts. So, over a longer period, we can expect positive positions to be followed by net receipts and vice versa. If a reporting agent reports the combination of a net asset and persistent net payments (or a net liability in combination with net receipts) it is reason for further investigation.

- Positions without any transactions and/or very stable positions are suspicious since market values are usually volatile and when a position occurs, most derivatives have flows on a regular basis.

- With regard to purchased options, paid premiums are expected to be relatively stable compared to received premiums. The opposite holds for written options: premiums receipts should be relatively stable compared to premiums paid. This is because options have an asymmetric payoff: on purchased options the upside potential is greater than the downside risk, and vice versa for written options. Large receipts/profits are thus possible on purchased options and large payments/losses on written options. If we detect a pattern that is different from the expected one described above, this deserves further

investigation.

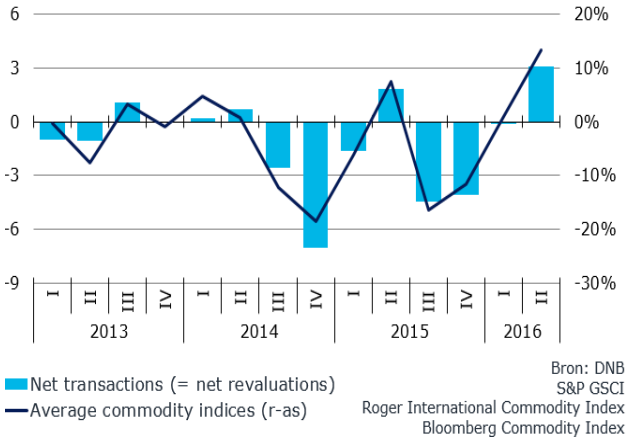
3.3 Quantitative economic analysis

In this kind of analysis, figures are plotted against different benchmarks. The first important step is to find appropriate benchmarks. As will be shown, the suitability of specific benchmarks greatly depend on the type of derivative and the applicable institutional sector. This type of analysis aims to identify 'suspect figures' given external developments, for example on financial markets. This can be done in an automatic fashion. In the following paragraphs an overview is presented of several analyses regularly conducted by the Netherlands Bank. The analyses are grouped by type of derivative.

3.3.1 Futures

Institutional investors strive for a diversified investment portfolio. They mainly invest in shares, debt instruments and real estate, but also often select commodities to maintain a diversified portfolio. Another incentive for investing in commodities is the anticipated hedge against unexpected rises in inflation, above all for 'storable' commodities (e.g. metals). Futures are commonly used to take positions in commodities, as there are various disadvantages associated with the acquisition of physical commodities such as storage costs and insurance.

Figure 1
Net transactions (EUR bln) / average commodity indices (% change)



There are many major institutional investors active in the Netherlands, partly due to the sizeable pension fund sector. These institutional investors primarily follow a long-only strategy, where they expect to benefit from rising commodity prices. The aggregated numbers from the BOP/IIP reports confirm this, as shown in Figure 1. It shows the link between net paid or received variation margins (transactions) and commodity prices, after correction of initial errors detected through this kind of analysis. The net paid or received variation margins are in the case of futures equal to the revaluations, due to the daily settlement which is typical for futures. In practice, one may therefore analyze either revaluations or transactions.

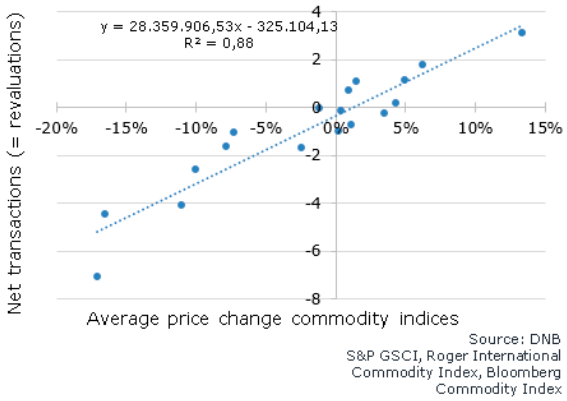
In analyses such as these it is important to identify appropriate benchmarks. This is difficult to do for futures because there are various benchmarks for commodities, which sometimes differ considerably from each other. In addition, also shares, interest rates and currencies can be traded via futures. The Netherlands Bank currently uses an average of three general indices for commodity prices, but this may not be appropriate for all sectors. Different groups of institutional sectors usually call for specific benchmarks and returns-based style analysis can be used to find the most appropriate benchmark. For example, deposit-taking corporations are more likely to use futures to manage interest rate movements and non-financial corporations do not necessarily adopt long-only positions. Agricultural producers, for example, may hedge against a fall in the value of their crops. Due to the dominance of the institutional investors in the Netherlands, the relationship illustrated in figure 1, which includes all sectors, is strong.

Due to the strong correlation between net transactions in futures and commodity prices, it is possible to forecast transactions fairly accurately on the basis of the development of commodity prices. Table 1 below shows net forecasted transactions (Z) based on commodity price benchmark (X) which are compared with actual net reported figures (Y). This provides for a better assessment of the plausibility of the reported figures. Figure 2 shows the correlation between transactions and the development of commodity prices.

Table 2 Forecasted and actual transactions
EUR thousand

	Indices X	Net reported transactions Y	Forecast Z	Difference
2012 Q1	3,5%	-211.655		
Q2	-7,9%	-1.633.448		
Q3	4,9%	1.149.927		
Q4	1,1%	-724.325		
2013 K1	0,2%	-971.857		
Q2	-7,3%	-1.039.320		
Q3	1,5%	1.088.784		
Q4	-1,2%	-9.368		
2014 Q1	4,3%	192.884		
Q2	0,9%	709.715		
Q3	-10,0%	-2.566.910		
Q4	-17,1%	-7.022.222		
2015 Q2	-2,5%	-1.638.844		
Q2	6,2%	1.808.479		
Q3	-16,5%	-4.458.940		
Q4	-11,1%	-4.089.425	-3.415.706	-673.719
2016 Q1	0,3%	-97.115	-188.134	91.019
Q2	13,4%	3.114.709	3.611.550	-496.841

Figure 2
2012 Q1 - 2016 Q2 - EUR bn



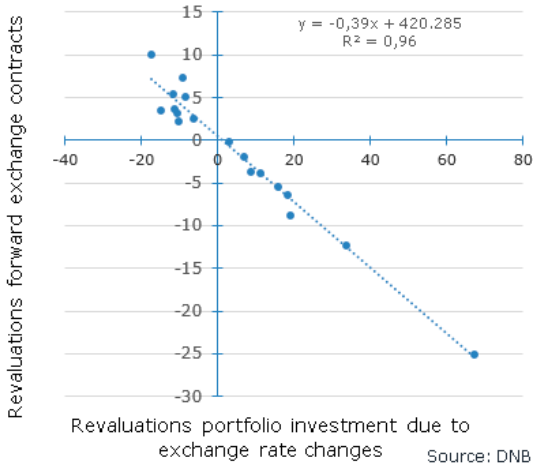
3.3.2 Forward exchange and other forward contracts

Data on forward exchange and other forward contracts are currently collected jointly which makes analysis more difficult. However, reported data indicates that most of this category relates to currency contracts. Most reporting agents have the euro as functional currency, while they are exposed to foreign currencies (the US dollar being the most important). Dutch institutional investors for example have sizeable positions in financial assets that are not denominated in euros. Table 3 shows that revaluations on forward exchange and other forward contracts of financial corporations other than MFIs can be forecasted fairly accurately by looking at the revaluations of portfolio investments due to exchange rate changes of the same group of companies (as recorded in the BOP/IIP framework as well). This relationship is also illustrated in Figure 3.

Table 3 Forecasted and actual revaluations financial corporations other than MFIs
EUR thousand

	Revaluations portfolio investment X	Revaluations forward exchange Y	Forecast	Difference
2012 Q1	-8.577.354	5.003.951		
Q2	19.137.362	-8.761.124		
Q3	-6.152.123	2.508.176		
Q4	-11.247.199	3.666.744		
2013 K1	8.606.324	-3.755.233		
Q2	-14.863.615	3.445.941		
Q3	-11.554.269	5.380.460		
Q4	-10.433.590	3.136.093		
2014 Q1	3.267.778	-236.945		
Q2	7.039.049	-1.946.435		
Q3	33.536.291	-12.258.563		
Q4	11.128.820	-3.823.202		
2015 Q2	67.149.009	-25.064.907		
Q2	-9.192.950	7.375.715		
Q3	-10.368.612	2.237.277		
Q4	18.370.261	-6.410.488		
2016 Q1	-17.313.899	10.063.646	6.698.907	3.364.739
Q2	15.961.571	-5.613.355	-5.751.440	138.085

Figure 3
2012 Q1 - 2016 Q2 EUR bn



Hedging against currency risks lessens shocks to the IIP from exchange rate movements. The regression shows that only a portion of the currency positions are hedged. Any major differences between reported figures and previous estimates, such as in 2016 Q1, give cause for further examination of the data on both portfolio investment as well as forward exchange and other forward contracts.

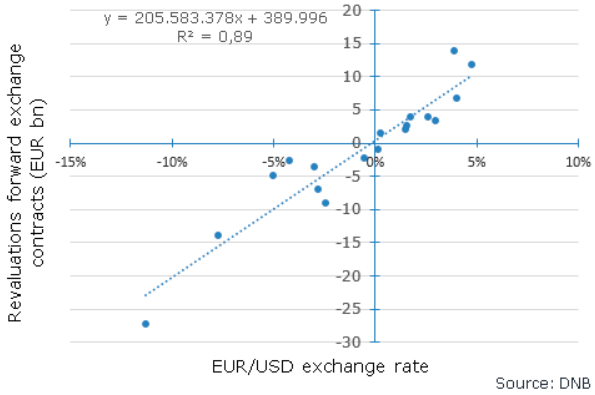
Table 4 shows the revaluations on forward exchange and other forward contracts of Dutch residents and the corresponding EUR/USD exchange rate change. The strong correlation between these two variables is illustrated in Figure 4. The figures indicate that many institutions hedge their currency risks. Based on data for 2012 Q1 – 2016 Q2, an appreciation of the euro by 1% vis-a-vis the US dollar would generate an estimated profit of around EUR 2.5 billion on forward exchange and other forward contracts. Which

makes sense: US dollar denominated assets, as well as activities in US dollars, will be negatively affected by the appreciation of the euro. Here too, any major differences between the estimated value and reported value, as was the case in the last quarter, requires further examination.

Table 4 EUR/USD exchange rate change and revaluations currency forwards Dutch residents
EUR thousand

	EUR/USD X	Revaluations Y	Forecast	Difference
2012 Q1	2,9%	3.412.297		
Q2	-5,1%	-4.908.154		
Q3	1,5%	2.659.121		
Q4	2,6%	3.871.640		
2013 Q1	-3,0%	-3.634.564		
Q2	1,5%	2.088.268		
Q3	4,0%	6.686.455		
Q4	1,7%	4.002.660		
2014 Q1	0,1%	-1.019.460		
Q2	-0,6%	-2.297.822		
Q3	-7,8%	-13.812.801		
Q4	-4,2%	-2.649.753		
2015 Q1	-11,3%	-27.180.957		
Q2	3,9%	13.912.269		
Q3	0,3%	1.587.361		
Q4	-2,8%	-6.867.693		
2016 Q1	4,8%	11.823.988	10.057.333	1.766.655
Q2	-2,4%	-9.091.984	-4.250.321	-4.841.663

Figure 4
2012 Q1 - 2016 Q2 EUR bn



This analysis can still be further refined, by not only looking at the EUR/USD exchange rate, but also by considering other currencies and sector-specific characteristics. For institutional investors, it is primarily their investments in non-euro denominated securities that are relevant, but for issuers of non-euro denominated debt securities, the currency of issuance is relevant. Again, it is clear that different benchmarks may be necessary for groups of entities, for institutional sectors as a whole or for groups of institutional sectors.

3.3.3 Options

The analysis of Dutch data on options needs to be further developed. Possibilities in this respect are currently limited by a lack of underlying information. Whereas purchased and written options are reported separately, no information is reported about the underlying value and whether it concerns a call or put option.

One possible economic analysis could be to compare price movements of options with volatility indices. For example, if there is turbulence on financial markets, revaluations on options may also be expected to increase. However, such analysis would also require the determination of appropriate volatility indices. The latter s is not easy since options can relate to securities, exchange rates, interest rates etc., while no information on the underlying is reported in the Netherlands.

3.3.4 Cross-currency interest rate swaps

The use of quantitative economic analysis to assess the quality of Dutch data on cross-currency interest rate swaps (CCIRS) has not yet been fully developed. It is difficult to construct one single benchmark for positions in CCIRS, because there are two variables - interest and currency - to take into account.

CCIRS are mainly used by institutions that issue debt securities in non-domestic currencies. In the Netherlands, the cross border market for CCIRS is dominated by deposit-taking corporations and by SPEs (special purpose entities with little or no connections to the Dutch economy). In general, CCIRS are used for hedging purposes. For instance, one may expect an institution that has issued a floating rate note in USD, to enter into a ‘receive floating USD and pay fixed EUR’.

An possibility we are currently exploring is an institutional sector-level analysis. Many deposit-taking corporations in the Netherlands issue debt securities not only in EUR but also in USD, which you would expect to result in revaluations of cross-border CCIRS that are correlating with the change of the EUR/USD exchange rate and interest rate changes.

Another possibility is to use data from the Central Securities Database (CSDB) of the ECB to develop and to assign appropriate benchmarks for issuers of debt securities which enter into CCIRS. Especially the currency of issued debt securities and the interest term are relevant in this respect: is the debt security denominated in EUR or USD and is the issuer paying a floating or fixed rate?

3.3.5 Interest rate swaps and forward rate agreements

As with most types of derivatives, the institutional landscape in the Netherlands is a determining factor in the development of the market value of interest rate derivatives. The Netherlands has a sizeable pension fund sector and it houses a number of relatively large deposit-taking corporations. This is reflected in the data.

For pension funds, a decline in interest rates is unfavorable (their future pension obligations rise due to a lower discount rate) while an interest rate increase is unfavorable for deposit-taking corporations (they typically borrow at short maturities and lend long). The effect of these opposing interests is shown in the graphs below. Figure 5 shows the cross-border market value of interest derivatives of deposit-taking corporations and financial corporations other than MFIs and Figure 6 shows the revaluations of these derivatives.

Figure 5
Net position IRS/FRA (EUR bn)

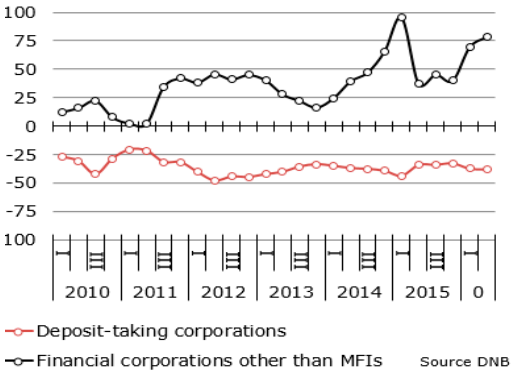
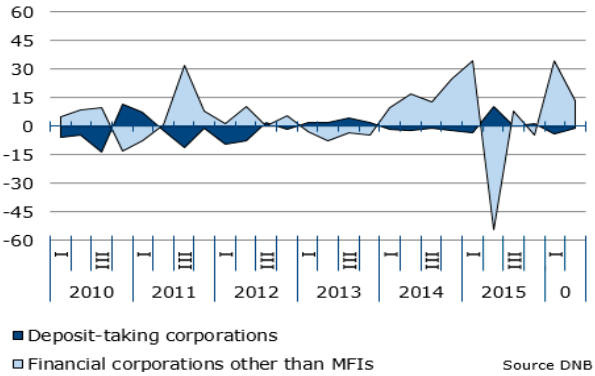


Figure 6
Revaluations IRS/FRA (EUR bn)



It is remarkable that this mirroring pattern changed in early 2014. The interest rate sensitivity of the derivatives held by financial corporations other than MFIs seems to be increasing and of those held by deposit-taking corporations seems to be declining. The latter is also shown in Figure 7 and Figure 8 by the angle of inclination. Note that in recent years the 20-year swap rate gives a slightly better fit, while the 10-year swap rate gave the best fit during the years 2008-2012.

Table 7
2008 - 2012 Deposit-taking corporations

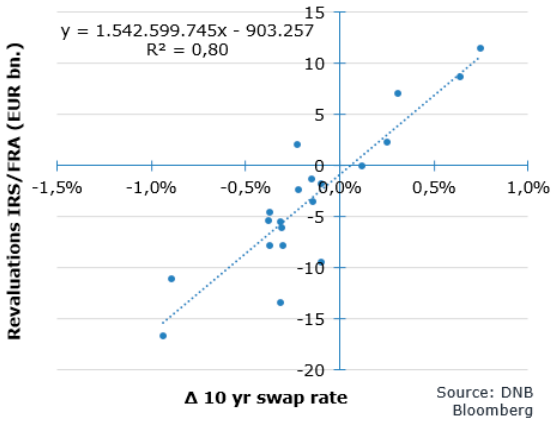
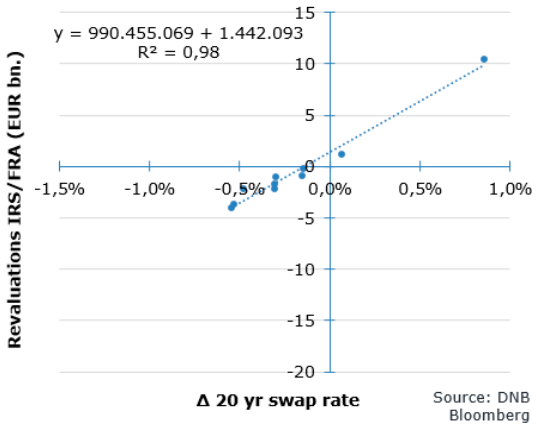


Table 8
2014 - 2016 Deposit-taking corporations



To understand the underlying cause of such a trend change, it can be helpful to make scatter charts on the level of individual reporting agents and to compare these with the institutional sector to which they belong to locate the source of the trend change. In our experience, reporting agents are often very interested in this type of analysis and are willing to explain any deviations from its peers and/or trend reversals. One reporter recently explained that a drastic change in their interest sensitivity was simply due to a reorganization of tasks: the long-term interest rate management had been transferred to a subsidiary in another country. So, in some cases observed trends in this analysis cannot be explained by developments on financial markets, but by one-off institutional factors.

4. Challenges

Financial derivatives have their specific characteristics affecting the availability of certain data. Particularly for swap contracts with several payoffs, it is too difficult to provide data on transactions in assets and liabilities separately, so the reporting of net transactions has to be accepted. It also difficult to break down revaluations into price and exchange rate changes. However, both are not essential to analyze data on derivatives.

Besides this limited availability of some financial derivatives data, data of certain specific reporting agents can also be hard to interpret because they are difficult to relate to financial market developments. For example, market-neutral hedge funds can shift their positions very quickly. In addition, in the Netherlands there are examples of very large multi-issuance companies that hedge all issuances by entering into hedging contracts with foreign group companies. These hedging contracts are accompanied by large premiums paid upfront, which could be seen as a way to pass the proceeds to group companies. In contrast to other intercompany positions, intercompany-held derivatives are methodologically not part of foreign direct investment, although from an analytical point of view this would probably, in some instances, be preferable.

Figures on financial derivatives can also strongly be influenced by the concept of residency and the way a company is structured. Borders are relatively unimportant for multinational companies, but for the BOP the distinction between resident and non-resident is essential. So it may be that an individual bank holds seemingly atypical positions in interest rate derivatives, compared to its peers. But the simple explanation could be that, for example, interest rate derivatives are managed by a foreign subsidiary. At the level of the global company its data on derivatives are very plausible, but when residency is taken into account, the figures of this reporting agent are difficult to interpret.

5. Conclusion

External statistics like the BOP and IIP are instrumental in analyzing a country's financial linkages with the rest of the world. Financial derivatives, with their sizable transactions and revaluations, play an important role in BOP and IIP developments in many countries. High data quality of financial derivatives data is therefore important. Even though data on derivatives may seem difficult to analyze, this paper shows how data on financial derivatives can be assessed in a meaningful way, using the Dutch case as an example. The vast majority of reporting agents uses derivatives in a predictable manner, a fact easily to be used in data quality management. Three types of quality checks have been presented: the search for missing data, the search for remarkable patterns or atypical reports of reporting agents and the use of quantitative economic analyses. This latter can be used to forecast revaluations and to a lesser extent transactions. This helps in labeling figures as suspicious and can improve the data quality of derivatives, also when limited reported data is available.

Still, to perform these analyses, the availability of a sufficient level of detailed information on derivatives is important. Numerous useful analyses can be carried out if sufficiently detailed data are collected, for either checking the plausibility of reported figures, or interpreting trends in financial derivatives in the BOP and IIP. But to be able to do so, it is equally important to define appropriate benchmarks, given the different types of derivatives and reporting agents. If these preconditions are met, data on derivatives are highly predictable, even more than other functional categories in the balance of payments.

Nevertheless, considering the fast developing world of financial derivatives, we plan a further strengthening of our analyses. New potential data sources are emerging, for example from new requirements for the reporting of derivative contracts under the European Market Infrastructure Regulation (EMIR), and are waiting to be explored. In the Netherlands the possibilities for analysis will increase further since derivatives with domestic counterparties will be added to the reporting framework. At the same time, the new integrated reporting framework provides for a more detailed breakdown of derivatives (such as credit default swaps), which also creates new opportunities for meaningful data analysis and quality checks.