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Euro-area derivatives markets: structure, dynamics and challenges[1]

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

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Abstract

Thanks to the reporting obligation established by the European Market Infrastructure Regulation (EMIR), EU regulators have now access to an unprecedented amount of data on derivatives markets through authorised trade repositories (TRs). EMIR data are a precious information source to monitor financial stability; after more than 2 years, however, a number of challenges still prevent their wide-spread use for macro-prudential policy purposes. First, as they reflect an intrinsically complex and fast-changing market, EMIR data are difficult to analyse; second, the data collection process established by EMIR and the significant data volume pose a number of technical challenges; finally, data quality concerns still discourage users from working with the dataset. As a result, there is so far relatively little empirical research in this field.

The objective of this paper is twofold. First, it aims at investigating the evolution of the structure and the dynamics of the euro area derivatives market between 2014 and 2017. The analysis focuses on the effect of the implementation of EMIR obligations, such as those on clearing and risk mitigation, as well as the impact of other institutional and economic developments in the EU. Furthermore, it relies on techniques from network theory to monitor the connectivity and stability of the market over time. The results lay the ground for further work, aimed at monitoring the network of main market participants and developing early warning indicators for supervisory purposes. Second, the paper reviews and analyses the main challenges linked to the use of EMIR data – from data quality to data volume and data integration – that, once overcome, will allow financial stability authorities to fully and systematically use this dataset in the implementation of their respective mandates.

Keywords: derivatives, EMIR, network analysis, financial stability

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Introduction

Crises are often regarded as a powerful trigger for non-incremental public policy change.[1] From this viewpoint, it is easy to recognise in the far-reaching reform program of the over-the-counter (OTC) derivatives trading and post-trading rules a "child" of the 2008 economic crisis. Starting from the commitment taken by G20 leaders in Pittsburgh in 2009, regulators at global and national level have developed – and are still in the process of developing – a new framework to ensure a more transparent and resilient functioning of OTC derivatives markets.[2]

The Pittsburgh commitment encompassed five elements: (1) reporting of all OTC derivatives contracts to trade repositories; (2) moving of all standardised OTC contracts on exchanges; (3) clearing obligation through central counterparties (CCPs); (4) introduction of margin requirements for non-cleared trades and (5) periodic assessment of the reforms' implementation.[3] Almost eight years later, according to the Financial Stability Board (FSB),[4] progress has been substantial in all areas, with legislation on trade reporting, central clearing and margin requirements for non-cleared trades now in force in most G20 countries.

In the European Union, Regulation (EU) 648/2012 of the European Parliament and of the Council of 4 July 2012 on OTC derivatives, central counterparties and trade repositories, or European Market Infrastructure Regulation (EMIR) established the contours of the new EU regime for OTC trading and post-trading. EMIR established a clearing obligation for most trades and risk-mitigation techniques for non-cleared trades and introduced, since 2014, the obligation to report all OTC and exchange-traded derivatives transactions. As correctly pointed by Abad et al. (2016), what used to be one of the most opaque markets suddenly became one of the most transparent: to date, over 60 authorities across the EU have access to granular data on derivatives transactions according to the policy and geographical scope of their mandates.

Through EMIR, the European Central Bank (ECB) is entitled to access transactional-level EMIR data for all counterparties established in the euro-area and all contracts where the reference entity is located within the euro area or where the reference obligation is sovereign debt of a euro area member.[5] The objective of this paper is to assess, almost three years after the entry into force of the EMIR reporting obligation, how and to which extent EMIR data can be used to monitor euro area OTC derivative markets, and to take stock of the challenges linked to this uniquely complex and large dataset. In a first section, we review the state of play and the challenges of the data collection. In a second step we walk through the data cleaning process, which allows us in a third section to briefly describe the characteristics of three derivatives asset classes. The fourth section is a short analysis of the state of the clearing obligation as viewed from the data, while the fifth and final section presents some first results of the network analysis of EMIR data.

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1 See among the others Nohrstedt and Weible (2010).

2 See ECB (2016) for more information on the background of the post-crisis reforms of OTC derivatives markets.

3 "All standardized OTC derivative contracts should be traded on exchanges or electronic trading platforms, where appropriate, and cleared through central counterparties by end-2012 at the latest. OTC derivative contracts should be reported to trade repositories. Non-centrally cleared contracts should be subject to higher capital requirements. We ask the FSB and its relevant members to assess regularly implementation and whether it is sufficient to improve transparency in the derivatives markets, mitigate systemic risk, and protect against market abuse." Pittsburgh Summit Leader's Statement, 2009, pp. 8-9.

4 See FSB (2017).

5 The ECB is also entitled to access position-level data for euro-denominated derivative contracts. However, due to the lack of clear guidance on position definition, these data are so far de facto unavailable.

1. The EMIR data: state of play and challenges

1.1 The EMIR reporting framework

After the entry into force of the EMIR reporting obligation in February 2014, EU competent authorities gained access to an unprecedented amount of granular data mapping the derivatives trade activity of all counterparties established in the EU.

The information to be reported in compliance to EMIR is comprehensive and includes so-called "counterparty data", pertaining to each counterparty individually considered, and "common data", i.e. information about the contract that are expected to be the same for both counterparties.[6] The EMIR reporting template in force before 1 November 2017 is summarised in Table 1.

Overview of EMIR reporting fields — Table 1

Counterparty data	
Timestamps (reporting, execution, clearing…)	Counterparty side (buy or sell)
Counterparty ID/name	Broker, reporting entity, beneficiary ID
Counterparty nature (financial or non-financial) and sector	Valuation and collateral information
Contract (or common) data	
Contract type	Product and underlying IDs, notional/deliverable currencies
Details on the transaction	Trade ID[7], execution venue, maturity/settlement/termination date, price, notional, delivery type etc.
Risk mitigation/reporting	Confirmation means and timestamp.
Clearing	Clearing status/obligation/timestamp, CCP identifier, intragroup transaction.
Interest rates	Interest rates, payment frequencies, day count conventions, reset frequencies for both trade legs.
FX	Exchange rate, exchange rate basis, forward exchange rate.
Commodities	Commodity base, further details on energy derivatives.
Options	Option type/style, strike price.
Modification to the contract (life-cycle)	Action type (e.g. new, modify, error, cancel, compression, valuation).

Source: ECB, based on Regulation (EU) 1247/2012 and Regulation (EU) 148/2013

When both counterparties are subject to the reporting obligation, EMIR establishes a "double-reporting" regime, by which both of them are bound to individually report the same transaction after agreeing on the content of common fields.[8]

6 Regulation (EU) 1247/2012, Regulation (EU) 148/2013 and the respective amendment acts, Regulation (EU) 105/2017 and Regulation (EU) 104/2017.

7 Trade and Product IDs are expected to be replaced by uniform global unique transaction identifier (UTI) and unique product identifier (UPI), once developed. See below Section 1.2.1.

Information is currently collected by six authorised trade repositories (TRs) that validate and stock the data submitted by market participants and share it with competent authorities.[9] Furthermore, alongside the confidential dataset accessible by competent authorities, TRs also have to publish weekly aggregate data on their websites, with the objective to increase transparency also towards the general public.

Therefore, together with the traditional BIS semi-annual and triannual surveys, researchers and authorities investigating the European derivatives markets obtained access to two new data sources, the EMIR "confidential" data and the EMIR "public" data (see Table 2).

Comparison of main existing data sources on OTC derivatives markets — Table 2

Data source	Subject scope	Content scope	Frequency
BIS semi-annual and triannual survey on OCT derivatives	c. 400 banks and other derivatives dealers based in 13 countries (incl. 8 EU Member States and 6 euro-area countries) and 33 countries (incl. 18 EU Member States and 11 euro-area countries).	Notional and market value of OTC derivatives of all 5 asset classes	Semi-annual and triennial
EMIR confidential TR data	All euro area residents. All euro area reference entities. All reference obligations being sovereign debt of euro area member countries.	85 (129 as of November 2017) data fields for OTC and ETD contracts of all 5 asset classes	Daily
EMIR public data	All EU-residents.	Transaction volumes, outstanding notional values and market values of OTC and ETD contracts of all 5 asset classes	Weekly

Source: BIS (2016) and Osiewicz et al. (2015)

Thanks to the depth and breadth of their coverage, EMIR data offer a unique and unprecedented viewpoint on European derivatives markets that allow monitoring the accumulation of risks at market and counterparty level, to follow developments in market structure, and to develop tools for macro-prudential policies.[10]

At the same time, three years after the entry into force of the reporting obligation, the usability of EMIR data by competent authority is still hindered by a number of challenges, which we review and analyse in the rest of this section.

1.2 EMIR data: challenges and way forward

1.2.1 Data quality and comparability across TRs

One of the distinguishing features of EMIR data is surely their complexity and the variety and intricacy of the quality issues they pose to researchers.

8 While this provision increases the volume of data and poses some reconciliation issues, especially when counterparties report their trade to two different TRs, it is still regarded by regulators as a useful tool to validate and complement information.

9 These are (i) CME Trade Repository Ltd. (CME), (ii) DTCC Derivatives Repository Ltd. (DDRL), (iii) ICE Trade Vault Europe Ltd. (ICE), (iv) Krajowy Depozyt Papierów Wartościowych S.A. (KDPW), (v) Regis-TR S.A. (Regis-TR), and (vi) UnaVista Limited (UnaVista). A new TR, Bloomberg Trade Repository Ltd, was authorised by ESMA with effect from 7 June 2017 but at the time of writing does not report any transaction.

10 See Abad et al. (2016).

The detailed content and format of EMIR reports was established by delegated regulations and implementing acts (e.g. Regulation (EU) 1247/2012 and Regulation (EU) 149/2013). The provisions included in these pieces of legislation, however, did not prove entirely effective in guaranteeing a sufficient level of standardisation in the main data elements (i.e. counterparty and product ID, trade ID and valuation information) to ensure comparability within and across TRs. Furthermore, the lack of sufficiently stringent data validation procedures by TRs resulted in a significant volume of missing or misreported information, especially at the earliest stages of the reporting obligation.[11]

While current data still suffer from these "original sins", regulators have been working to gradually overcome the abovementioned problems both by amending EU legislation and guidelines and by supporting international work on OTC derivatives data standardisation.

In fact, a multilateral process coordinated by the Committee on Payments and Market Infrastructures (CPMI) and the International Organisation of Securities Commission (IOSCO) is set to deliver detailed guidelines for unique trade and product identifiers.[12] Once implemented, these standards are expected to substantially improve data quality at national level and, in the medium term, allow for global aggregation of OTC derivatives data. The further diffusion of other internationally agreed standards – most prominently the legal entity identifier (LEI) and the international security identification numbers (ISIN) – will also substantially contribute to increase the robustness and facilitate the use of EMIR data.

Furthermore, the adoption of the revised delegated and implementing acts (Regulation (EU) 104/2017 and Regulation (EU) 105/2017) laid the ground for data quality improvements from 1 November 2017, also by making sure that the EU reporting regime incorporates global standards (such as LEI or ISIN codes) to the maximum extent practicable and as timely as possible. Table 3 summarises the content of Regulation (EU) 104/2017 and Regulation (EU) 104/2017 and their impact on data quality.

11 In order to improve the quality of reporting, ESMA published two sets of validation rules to be performed by TRs. See https://www.esma.europa.eu/policy-rules/post-trading/trade-reporting.

12 This work is being coordinated by the CPMI-IOSCO Harmonisation Group (HG), under the auspices of the FSB. The HG is working to enhance the use of open standards, including the UPI (unique product identifier) and the UTI (unique transaction identifier), by drafting recommendations in each of these areas. UTI and UPI Technical Guidance documents have been recently published. Subsequently, the group will also develop a proposal for a governance framework of these standards. See http://www.bis.org/cpmi/index.htm.

Summary of the main new features of EMIR reporting standards

Table 3

Reporting field	Change in reporting standards	Expected result
Counterparty ID	Mandatory use of LEI. Introduction of a LEI/client code flag for the other counterparty.	Significant improvement in counterparty identification.
Corporate sector	Introduction of dedicated taxonomies for financial and non-financial corporation.	Significant improvement in identification of sectors.
Counterparty nature	Introduction of "CCP" and "Other", alongside "financial" and "non-financial" types.	Possibility to easily and clearly identify CCPs.
Counterparty side	Introduction of specific criteria to identify buyer/seller according to the instrument type.	Fundamental improvement as mandatory criteria for the buyer/seller identification are currently lacking.
Value of contract	Format specification (negative sign, decimal mark), and introduction of a distinctive tag for CCP valuation.	Significant improvement in the interpretation of contract value. However, heterogeneous valuation practices among counterparties may still result in conflicting information.
Margin and collateral	Detailed indication of initial, variation margin (received and posted) as well as of excess collateral.	Significant improvements to ensure correct and robust margin calculation.
Contract type	Establishment of a unique taxonomy.	Significant facilitation vis-à-vis current situation, where contract and product information are reported in the same field.
Product classification and identification (incl. underlying)	Restriction of taxonomies to CFI and UPI for classification and ISIN and AII for identification.	Significant clarification. Further standardisation expected with implementation of the UPI guidance.
Trade ID	Mandatory use of UTI. In the meantime, unique code.	Implementation of UTI guidance to facilitate trades pairing and matching.
Venue of execution	Introduction of mandatory use of MIC codes.	Significant improvement.
Price (incl. for options)	Introduction of mandatory indication of price notation (units, percentage or yield).	Significant improvement to ensure correct interpretation of reported values.
Notional	Format specification (negative sign, decimal mark).	Useful improvements to avoid misreporting and decrease the number of outliers.
Timestamps	In general, clarification of the timestamp format to be used.	Useful improvements linked to format standardisation.
Rates	Clarification of rate format (percentage, negative sign, decimal mark).	Crucial improvement for interest rate derivatives analysis.
Rate payment and reset frequency	Specification of the time period (year, month, week, day).	Significant improvement to obtain correct tenor data.
Floating rate	Introduction of a non-exhaustive list of the most common indexes.	Facilitation of floating rate identification.
Exchange rates	Clarification of rate formats (decimal mark, negative sign).	Crucial improvement to increase usability of rates data for FX derivatives.
Option type	Clarification of criteria to report swaptions.	Useful complement to the existing rules.
Credit derivatives	Introduction of dedicated data fields to identify contract seniority, underlying, payment frequency…	Significant improvement that will allow better understanding of credit derivatives data.
Action types	Introduction of specific action types for correction and early termination of trades. Introduction of specific indication on the trade vs. position level of the contract modification.	Significant improvement that will allow more robust analysis of trade activity reports.

Source: ECB, based on Regulation (EU) 104/2017 and Regulation (EU) 105/2017.

Finally, it can also be assumed that some "economies of learning" will come into play both on the side of authorities and on the one of reporting entities and TRs: in this regard, a well-structured and coordinated feedback process involving all EMIR data users seems crucial to ensure coordination and address the most widespread data quality issues in a timely and efficient manner.

1.2.2 Data volume and accessibility

Another issue that still prevents a widespread use of EMIR data by competent authorities is the very large size of datasets. The ECB, for instance, receives reports including tens of millions of observations on a daily basis, which is far beyond the size of other datasets traditionally processed and utilized by regulators. Due to the amounts of data, most of the authorities have so far embarked mostly on ad hoc analyses, limited to specific asset classes and limited periods. Only by building state-of-the-art infrastructures and using appropriate big-data techniques that allow for distributed storing and computing it will be possible to use EMIR data to monitor markets and counterparties on a regular basis, e.g. through real-time indicators.

Another technical challenge to the use of EMIR data is the one of accessibility. Currently, data are shared by TRs with competent authorities on an individual basis. In practice, this means that each authority needs to establish connection with six TRs, sometimes operating on different systems with different technical specifications. As a result, the margins to improve efficiency by avoiding duplication of work within and across authorities that have access to different subsets of the EU EMIR dataset are very high. The revised technical standards under Article 81 of EMIR offer some solutions to this suboptimal state of play,[13] in particular by introducing uniform XML templates and specifying the technical requirements for data transmission from TRs to authorities.

[13] The amended technical standards were adopted by the European Commission as Commission Delegated Regulation (EU) No 2017/1800 on 29 June 2017.

2. Putting EMIR data to the test

Notwithstanding the significant challenges outlined in Section 1, EMIR confidential data have attracted significant interest and European authorities have started explorative research work to test their potential.

In this section, we first present the euro area dataset accessible to the ECB, and show concretely through our analysis how the complexity of the EMIR reporting framework impacts on the usability of EMIR data. Subsequently, we describe in detail the cleaning and filtering process that, starting from the voluminous and intricate files provided by TRs, leads to a subset of data, fit for analytical purposes. The result of this process will be the analysed in Sections 3 to 5.

2.1 Narrowing the scope of the analysis

We focus our analysis on OTC trades for the three largest derivatives asset classes: interest rate, credit, and currency derivatives.[14] Figures 1.1 and 1.2 show the breakdown of the trades collected by TRs between April 2015 and March 2017, as resulting from the data published online by the six EU TRs.[15] When considering the total notional outstanding, interest rate derivatives are the largest asset class, followed by currency and credit derivatives. It is interesting to note a jump in the notional value of currency derivatives from the second half to the end of 2015 and in the first quarter of 2017: the increase, as highlighted below in Figure 2, is generated by two specific TRs and seems likely to be due to outlier values rather than to actual changes in market structure. In this regard, it is useful to recall that concerns on the quality of EMIR public data are well known[16] and were the object of the ESMA consultation on a proposal for new technical standards.[17]

Figure 1 also shows that, although interest rate derivatives account on average for the largest share of the total OTC derivatives outstanding notional, currency derivatives are traded in higher volumes: this confirms previous findings that the currency market is more fragmented and characterised by high number of contracts of relatively low value.[18]

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14 See BIS (2016). EMIR also mandated ETD transactions' reporting; however, this analysis only focuses on OTC data.

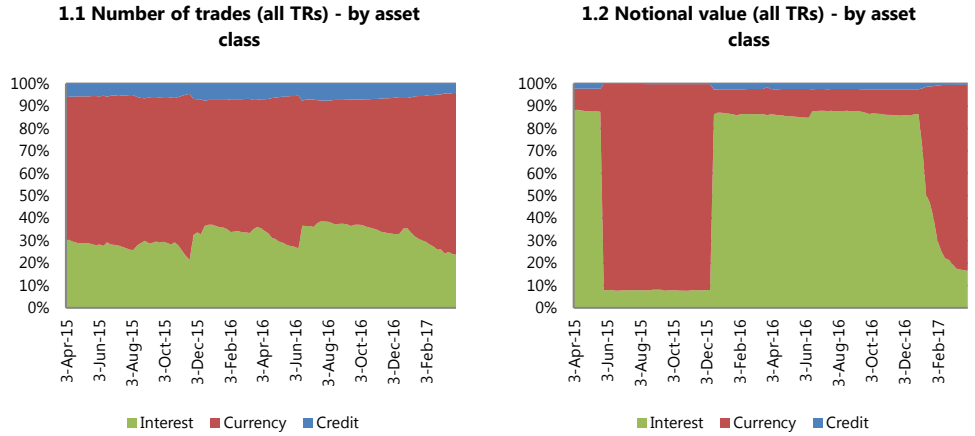
15 The obligation for TRs to publish weekly aggregates entered into force in April 2015.

16 As highlighted by Osiewicz et al. (2015), TR public data present a number of data quality concerns. In the case of currency derivatives, in particular, the series of one of the TRs (UnaVista) seems to include a number of disproportionately high notional values that may need to be treated as outliers.

17 See ESMA Final Report on the draft technical standards on data to be made publicly available by TRs under Art. 81 of EMIR, available at https://www.esma.europa.eu/sites/default/files/library/esma70-151-370_final_report_tr_public_data_under_emir.pdf.

18 See Abad et al. (2016)

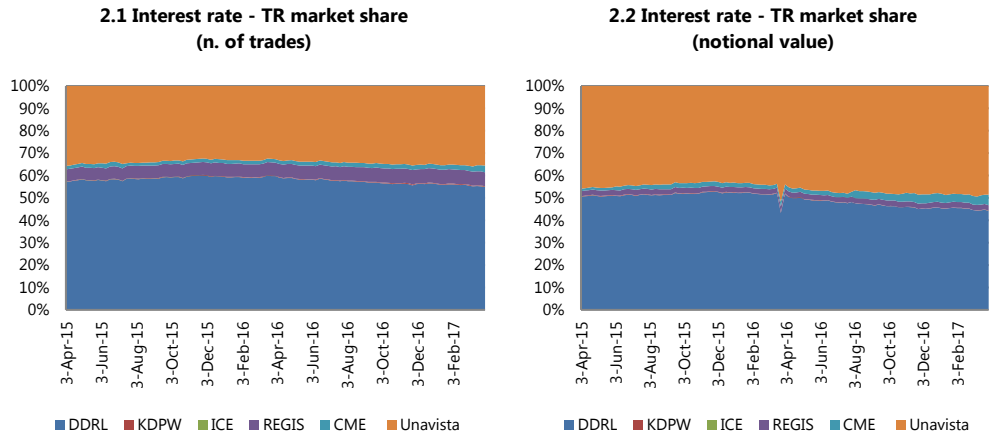
Figure 1: Breakdown of the dataset by asset class.



Source: ECB calculations based on weekly data published by the six authorised EU TRs.

The lack of standardisation in reporting standards among TRs makes inter-TR analysis complex and subject to potential mistakes in aggregation and misinterpretations. With a view to selecting a representative TR, we plot in Figures 2 to 4 the relative share of each of the six authorised EU TRs in the three asset classes under consideration.[19]

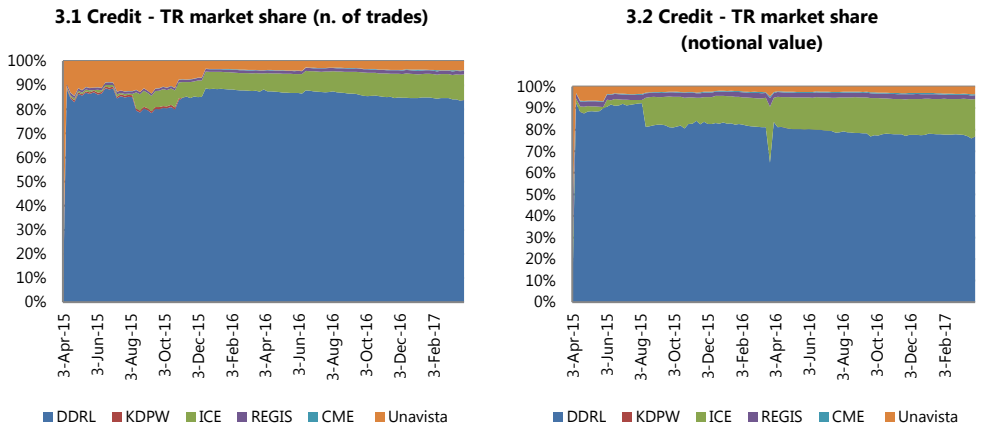
Figure 2: TR shares in the interest rate derivatives reporting market.



Source: ECB calculations based on weekly data published by the six authorised EU TRs.

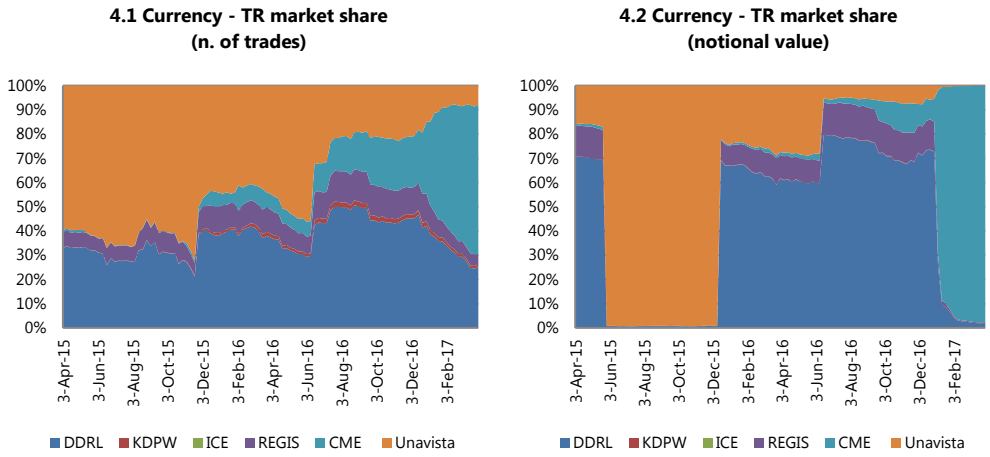
[19] The methodology followed in computing the data presented in Figures 2 to 4 is the following: (1) we keep all trades labelled by TRs as "double-sided", as TRs are expected to pair the two legs and report the net value themselves; (2) we count half of the "single-sided" trades between EEA counterparties, assuming that they are duplicate because of unsuccessful pairing and thus their inclusion would lead to double-counting; (3) we keep all trades labelled as "single-sided" when one of the counterparties is non-EEA, as the reporting obligation only covers EEA-based counterparties.

Figure 3: TR shares in the credit derivatives reporting market.



Source: ECB calculations based on weekly data published by the six authorised EU TRs.

Figure 4: TR shares in the currency derivatives reporting market.



Source: ECB calculations based on weekly data published by the six authorised EU TRs.

DDRL appears as the TR with the largest share across the three markets, although UnaVista has a comparable weight in the currency trades. Focusing on DDRL data also allows for comparability with previous works that have followed the same approach.[20]

DDRL provides different trade reports, the main ones being the "trade-state", a snapshot of all outstanding transactions at a given moment (usually at the end of the day), and the "trade-activity", that records all new transactions as well as modification of existing transactions (e.g. through compression, termination etc.).

As our objective is to sketch and analyse the euro-area OTC derivatives market structure, we concentrate on trade state data, which seem better fit for purpose. In particular, we use end-of-month trade state reports issued between October 2014 and March 2017.[21]

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20 See among the others Abad et al. (2016), Kenny et al. (2015) and Cielinska et al. (2017).

21 The ECB started collecting TR data in April 2014. However, in light of the low data quality of early reports – where, in particular, data on market value are almost completely missing – we restrict the scope of our analysis to a shorter period, starting from October 2014.

2.2 The de-duplication procedure

One of the distinguishing features of the EU reporting regime is the obligation for *both* counterparties to a trade to report it to TRs. Also in the context of a single-TR analysis, it is therefore necessary to account for the double-reporting and "de-duplicate" the dataset so that each trade appears only once in the dataset.

In a context of improving data quality, the double-sided reporting obligation has proven effective for regulators to match and validate reported information. At the same time, however, it poses some analytical complications, especially as – due to the lack of a global UTI – it is sometimes difficult to reconcile the information on the two sides of the trades within and across different TRs. It is therefore important to establish some consistent criteria in de-duplicating data. In this regard, we assume that the most recent reports, which should include modification or correction of previous reports, shall be more reliable and therefore retained in case of conflicts and inconsistencies.

Based on this assumption, we proceed first to drop the duplicates where a same trade identifier is associated to two trades with the same common data. In cases when different common data are associated to the same trade identifier, we retain the information provided by the latest report. We also find some occurrences when the same trade is reported more than twice: in this cases, if the report in excess is generated by the same counterparty, all but the latest report from that counterparty are dropped; if, on the other hand, the multiple reports are issued by multiple counterparties, the most recent reports from the buyer and the seller are retained.

2.3 Dataset overview

Our de-duplicated dataset includes a total of 90 end-of-month trade state reports, 30 for each asset class. Table 4 compares the total notional outstanding for the three asset classes resulting from our dataset with the corresponding data from the BIS semi-annual OTC derivatives dataset.[22] While the comparison is methodologically somewhat inaccurate due to the differences in product and subject scope, this raw comparison highlights the implausibility of the content of some EMIR reports, especially the oldest ones. In fact, EMIR data would seem to have a substantially higher aggregate notional value than the global aggregate collected by the BIS.

Comparison between BIS global aggregates and EMIR notional outstanding

Notional value before cleaning – ratio of EMIR to BIS semi-annual survey total — Table 4

	Dec-14	Jun-15	Dec-15	Jun-16
Credit derivatives	521%	628%	810%	818%
Interest derivatives	10,829%	1,623%	1,590%	1,202%
FX derivatives	2,002%	44%	38%	46%

Source: ECB calculations, based on DDRL EMIR confidential data and BIS semi-annual survey on OTC derivatives (global aggregate).

[22] As outlined in Fache Rousová et al. (2015), the comparison between EMIR and BIS OTC derivatives data is subject to a series of caveats due to the different product (e.g. BIS only collects information for CDS and not for other credit derivatives) and subject scope (e.g. BIS collects data from large dealers on a global scale, while EMIR gathers data from EU counterparties).

2.4 Cleaning process

Based on the contribution by Abad et al. (2016), we design a two-stage cleaning procedure for the three asset classes: first, we apply some general cleaning rules, valid across different asset classes; subsequently, we clean the three datasets based on further asset-specific features.

2.4.1 First stage: general cleaning across asset classes

The first stage of the cleaning process focuses on four elements: the value of contract, the notional value, the counterparty identifier and the execution timestamp. For each of them, based on existing regulatory provision and following Abad et al. (2016), we develop a number of cleaning rules.

Value of contract

Under EMIR, financial counterparties and non-financial counterparties above the clearing threshold are obliged to report the mark to market or, when appropriate, mark to model value of outstanding contracts on a daily basis. As outlined in ESMA's EMIR Q&A,[23] the mark to market value should be based on the end of day settlement price of the market (or CCP) from which the prices are taken as reference. For transactions cleared by a CCP, the CCP shall make the results of its valuation available to the counterparties, who shall individually report it.

In light of the heterogeneity of needs and practices across the market, no further valuation guidance is in force; as a result, when both counterparties are bound to report the contract value, their valuation can be different, especially when contracts are marked-to-model. Furthermore, some ambiguity persists on the format, with some counterparties reporting the contract value as an absolute value and others, more appropriately, as a positive or negative value depending on their role in the contract.

In order to account for inconsistencies in double reports, we compute a relative difference measure to capture the spread between the two counterparties' valuations.[24] As differences stemming from different valuation techniques, valuation times and exchange rates fluctuations are legitimate, we set a tolerance threshold and drop only observations where the relative difference between the two absolute values is higher than 5%.

Most importantly, we find a high number of missing values in the value of contract fields; ECB (2016) reports that the issue is mainly due to counterparties' failure to notify the cancellation of cancelled trades, and TRs failing to incorporate cancellation in the repository. Therefore, we drop those trades where no valuation is available from neither of the counterparties.

Notional value

All counterparties covered by EMIR are bound to report the notional value of the contracts they trade. In the context of the EMIR reporting framework, the notional is a common variable that counterparties should agree upon and report consistently.

Further to being used as the main indicators of derivatives' markets size, the notional is also important from a regulatory point of view, as in accordance with Article 11 of Regulation (EU) 149/2013 the clearing thresholds – that define the scope of the clearing obligation for non-financial counterparties – are computed on the basis of notional values.

Based on these considerations, we drop the contracts where the notional value is missing or, in case of double-sided reports, mismatching. Figures 1 and 2 highlight the presence of

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23 See https://www.esma.europa.eu/questions-and-answers

24 The relative difference measure is computed as: (counterparty 1 valuation – counterparty 2 valuation)/average valuation. All values are converted in EUR using the exchange rates published by the ECB at the last day of each month.

outliers in the notional fields; we therefore follow Abad et al. (2016) and set a lower bound (EUR 1,000) and an upper bound (EUR 10 billion) to discard contracts with implausible notional values, including negative and zero values.[25]

Counterparty ID

The adoption of Commission Implementing Regulation (EU) 105/2017 established the mandatory use of the LEI in EMIR reporting starting from November 2017. The LEI allows a punctual identification of counterparties and, via the integration with commercial datasets, of their characteristics (including sector, country of establishment etc.). Furthermore, the LEI allows to track an entity's belonging to a group or holding, an important information to obtain an accurate picture of large and systemic counterparties' activities and exposure.

However, not all counterparties have – or used to have – an LEI, and are therefore partially or completely unidentifiable. After dropping observations where the counterparty ID is not an LEI, in order to gather the information on sector, country and – if applicable – of the group that has ultimate ownership of the counterparty, we merge the remaining observations with the Global Ultimate Ownership information of the ORBIS dataset.[26]

Timestamps

When they report their trade to TRs, counterparties must indicate the exact time and date when the transaction was executed. In some cases, the reported execution date is later than the report date or unrealistic. Therefore, we drop all observations with unrealistic execution timestamp (i.e. later than the report date or earlier than 1990) and those where the execution timestamp is missing, suggesting possible cancellation or termination of the trade.

Results

As highlighted by Figure 5, the monthly number of observations after the implementation of the cleaning procedure is relatively stable over time across the three asset classes. We still observe, however, a drastic increase in the number of credit derivatives trades in 2015 accompanied by a peak in notional value, probably due to outlier values. It is difficult to link the movements observed in the dataset to specific market events, due to concerns over data quality, especially at the earliest stages of the reporting obligation. At the same time, the stability of the dataset both in terms of notional value and in terms of number of reported trades since 2016 points to an overall improvement in data quality that may allow for more robust analyses.

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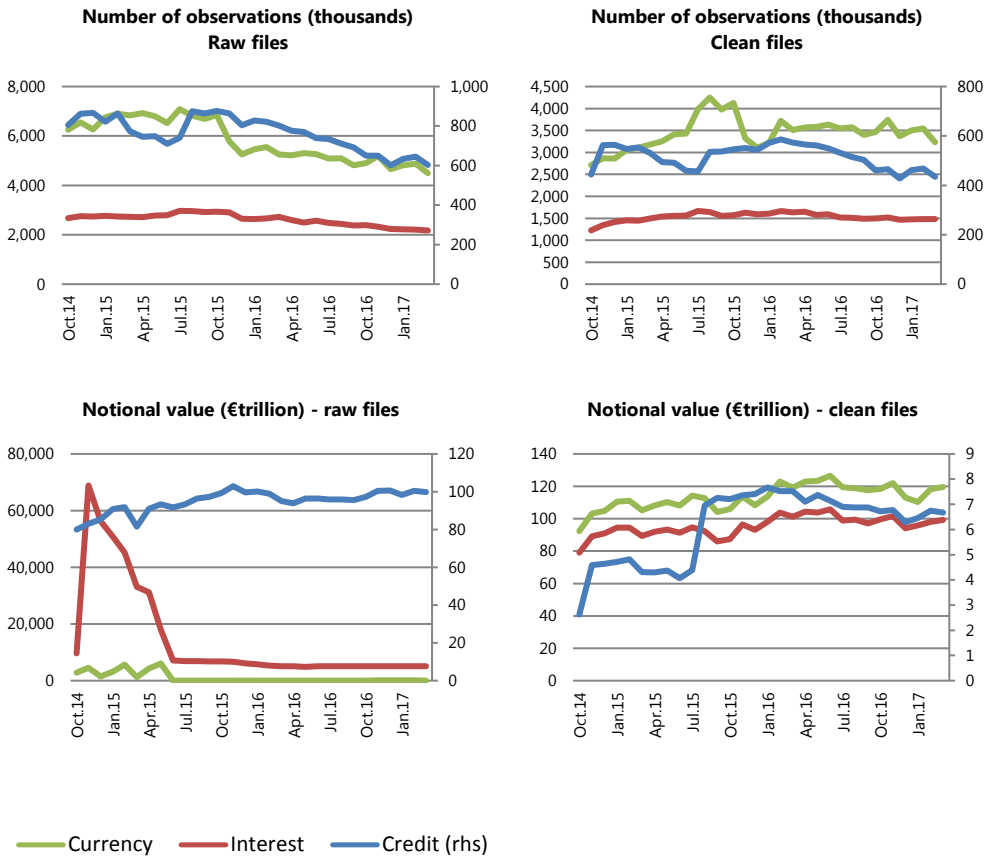
[25] All values are converted in EUR using the exchange rates published by the ECB at the last day of each month.

[26] See https://www.bvdinfo.com/en-gb/our-products/company-information/international-products/orbis

Figure 5: Raw vs. clean files comparison, all asset classes.



Source: ECB calculations, based on DDRL EMIR confidential data.

Figure 6 digs further into the composition of misreported trades, i.e. the shares of observations dropped at each step of the cleaning process.

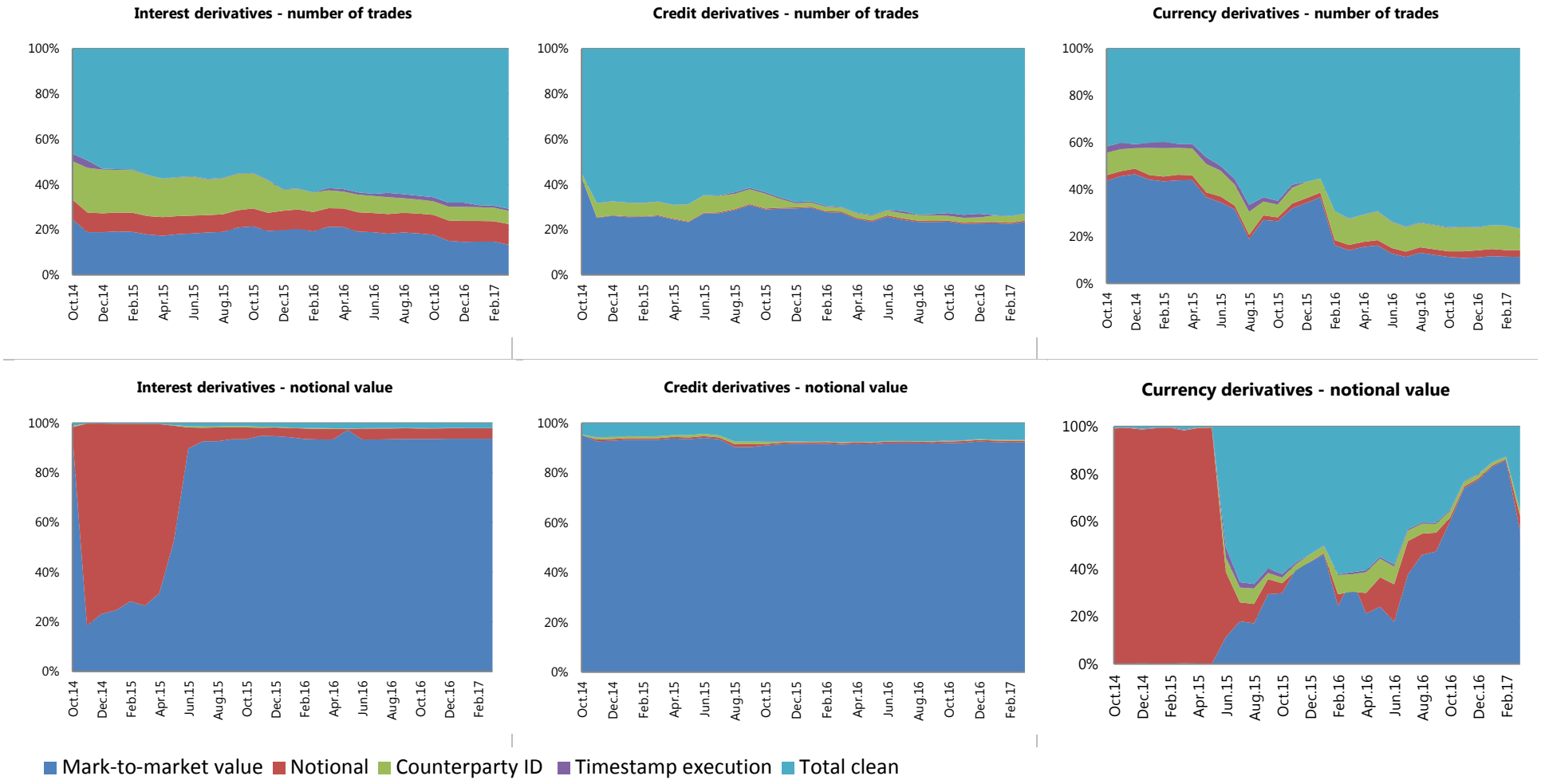
In terms of number of trades, misreporting of contract values seems responsible for the largest part of data quality concerns. This finding is consistent with previous literature.[27] Interestingly, we find that those trades have an extremely high notional value, suggesting that they also account for a significant share of observations with outlier notionals. Another interesting feature emerging from Figure 6 is the significant number of outlier notional values in 2014 and early 2015 interest rate and currency derivatives reports. The jump in the time series after June 2015 maybe explained by the introduction of new TR validation rules or to the correction of previously misreported trades by reporting entities.

Figure 6 and Table 7 also show a gradual but steady improvement in the quality of EMIR data over time. In the case of interest rate and credit derivatives, this trend seems to result from broader use of LEIs as counterparty IDs, a practice that will become mandatory as of November 2017.[28] The number of outlier notional values has also decreased sensibly both for interest rate and currency derivatives. On the other hand, while the number of missing or misreported market value has declined for all asset classes, it still remains high: stricter TR validation rules as well as further regulatory clarifications aimed at ensuring harmonised valuation and reporting practices will be key to improve the quality and reliability of the EMIR data in the coming months and years.

[27] See e.g. Abad et al. (2016), ECB (2016).

[28] See Art. 1 of Regulation (EU) 105/2017.

Figure 6: Observations (number and notional value) dropped at each step of the first stage of the cleaning procedure.



Source: ECB calculations, based on DDRL EMIR confidential data.

Maximum, minimum and average number of observations and notional value dropped at each step of the first stage of the cleaning procedure

Table 5

	2014 4Q						2015						2016						2017 1Q						Overview					
Interest	N.of observations			Notional outst.			N.of observations			Notional outst.			N.of observations			Notional outst.			N.of observations			Notional outst.			Clean number of observations			Clean notional outstanding		
	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
Starting value	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%						
Mark-to-market value	18.8%	20.7%	24.5%	17.1%	44.8%	94.8%	17.3%	19.1%	21.5%	24.6%	67.9%	94.8%	14.6%	18.6%	21.3%	93.4%	93.7%	95.3%	13.4%	14.2%	14.7%	93.6%	93.7%	93.7%						
Notional	8.4%	8.6%	8.8%	3.6%	54.6%	82.7%	7.7%	8.1%	8.6%	3.3%	30.8%	75.1%	8.2%	8.7%	9.2%	3.7%	4.2%	4.3%	9.1%	9.1%	9.2%	4.2%	4.2%	4.2%						
Counterparty ID	16.9%	18.7%	19.7%	0.1%	0.2%	0.4%	9.3%	16.1%	18.9%	0.1%	0.3%	0.5%	6.0%	7.2%	9.1%	0.1%	0.1%	0.2%	5.9%	6.0%	6.1%	0.1%	0.1%	0.1%						
Timestamp execution	0.4%	2.3%	3.3%	0.0%	0.0%	0.1%	0.2%	0.2%	0.4%	0.0%	0.0%	0.0%	0.2%	1.3%	1.9%	0.0%	0.1%	0.1%	0.9%	0.9%	1.0%	0.0%	0.0%	0.0%						
Total clean	**46.4%**	**49.6%**	**53.1%**	**0.1%**	**0.5%**	**1.2%**	**53.2%**	**56.5%**	**62.1%**	**0.2%**	**1.0%**	**1.6%**	**61.6%**	**64.3%**	**68.0%**	**0.2%**	**1.9%**	**2.1%**	**69.1%**	**69.7%**	**70.7%**	**2.0%**	**2.0%**	**2.0%**						
Credit	N.of observations			Notional outst.			N.of observations			Notional outst.			N.of observations			Notional outst.			N.of observations			Notional outst.			Clean number of observations			Clean notional outstanding		
	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
Starting value	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%						
Mark-to-market value	25.2%	31.5%	43.1%	92.8%	93.7%	95.3%	23.3%	27.2%	30.9%	90.4%	92.5%	94.1%	22.5%	24.9%	29.7%	91.4%	91.8%	92.6%	22.5%	22.9%	23.4%	92.2%	92.3%	92.4%						
Notional	0.2%	0.2%	0.2%	0.0%	0.4%	0.6%	0.2%	0.4%	0.5%	0.6%	0.7%	1.2%	0.5%	0.5%	0.6%	0.6%	0.6%	0.7%	0.6%	0.6%	0.6%	0.6%	0.7%	0.7%						
Counterparty ID	1.5%	4.6%	6.2%	0.1%	0.6%	0.9%	1.8%	6.0%	7.6%	0.2%	0.8%	1.0%	1.8%	2.2%	2.6%	0.2%	0.2%	0.2%	2.7%	2.8%	2.9%	0.3%	0.3%	0.3%						
Timestamp execution	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.1%	0.3%	0.7%	0.0%	0.1%	0.1%	0.2%	0.7%	1.5%	0.0%	0.1%	0.1%	0.2%	0.2%	0.2%	0.0%	0.0%	0.0%						
Total clean	**55.0%**	**63.6%**	**68.3%**	**4.6%**	**5.3%**	**5.7%**	**61.4%**	**66.1%**	**69.0%**	**4.4%**	**5.9%**	**7.4%**	**67.5%**	**71.8%**	**73.5%**	**6.4%**	**7.2%**	**7.7%**	**72.9%**	**73.5%**	**73.9%**	**6.7%**	**6.8%**	**6.8%**						
Currency	N.of observations			Notional outst.			N.of observations			Notional outst.			N.of observations			Notional outst.			N.of observations			Notional outst.			Clean number of observations			Clean notional outstanding		
	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
Starting value	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%						
Mark-to-market value	43.7%	45.3%	46.5%	0.1%	0.2%	0.3%	18.8%	34.7%	44.2%	0.1%	15.8%	43.0%	10.9%	15.1%	36.7%	17.8%	42.7%	77.3%	11.2%	11.4%	11.6%	56.0%	74.9%	85.7%						
Notional	2.2%	2.3%	2.4%	98.5%	98.9%	99.3%	1.6%	2.0%	2.4%	0.6%	45.7%	99.4%	2.0%	2.4%	3.1%	5.4%	5.9%	15.8%	2.8%	2.9%	3.0%	0.5%	2.4%	6.2%						
Counterparty ID	8.7%	9.2%	9.7%	0.0%	0.1%	0.1%	5.5%	9.4%	12.1%	0.0%	2.5%	6.5%	6.0%	10.4%	12.3%	1.6%	5.1%	8.7%	9.0%	9.8%	10.3%	1.0%	1.6%	2.5%						
Timestamp execution	1.7%	2.4%	2.7%	0.2%	0.2%	0.2%	0.1%	2.0%	3.0%	0.2%	1.2%	4.4%	0.1%	0.2%	0.3%	0.2%	0.5%	0.9%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%						
Total clean	**40.2%**	**40.8%**	**41.6%**	**0.3%**	**0.6%**	**1.0%**	**39.8%**	**51.8%**	**66.5%**	**0.3%**	**34.9%**	**66.3%**	**55.3%**	**71.9%**	**76.0%**	**20.0%**	**45.8%**	**62.2%**	**75.1%**	**75.7%**	**76.7%**	**12.6%**	**20.9%**	**35.2%**						

Source: ECB calculations, based on DDRL EMIR confidential data.

Table 6 compares the datasets resulting from the stage-one cleaning procedure with the corresponding ones from the BIS semi-annual survey. As highlighted in Table 6, the dimension of our dataset seems now realistic in relation to the global BIS aggregates; at the same time, the significant jump experienced by credit and currency derivatives data, in 2014 and 2015 respectively, suggests that the quality level of EMIR data may have reached a satisfactory level only starting from the second part of 2015.[29]

Comparison between BIS global aggregates and EMIR notional outstanding after cleaning

Table 6

Notional value after cleaning - EMIR/BIS semi-annual survey	Dec-14	Jun-15	Dec-15	Jun-16
Credit derivatives	28%	28%	60%	61%
Interest derivatives	18%	21%	24%	25%
Currency derivatives	18%	23%	22%	28%

Source: ECB calculations, based on DDRL EMIR confidential data and BIS semi-annual survey on OTC derivatives (global aggregate).

2.4.2 Second stage: asset class specific cleaning

After implementing the general cleaning rules based on the main reporting fields, we move further and, following Abad et al. (2016), we develop asset class-specific cleaning procedures.

Interest rate derivatives

One of the defining elements of interest rate derivatives is the underlying benchmark. The lack of a detailed benchmark taxonomy in current reporting rules results in a series of ambiguities and mistakes due to trivial typos or abbreviations.[30] Following Abad et al. (2016), we attempt to overcome such misreporting issues through manual cleaning for the major benchmarks (EURIBOR, EONIA, LIBOR, inflation, etc.).

After that, we identify all non-standard contracts, including forward-starting swaps, swaps with embedded options, contracts with spread on the floating leg, contracts with upfront payment, float-to-float and fixed-to-fixed contracts. At this stage, we also compute the contract tenors, as the difference between the maturity date and the date in which the contractual obligation became effective, both part of the EMIR reporting template. Finally, based on the global ultimate ownership identifier, we flag intra-group trades.

We then proceed to filter out all non-EURIBOR, non-fixed to float interest rate swaps, and intragroup trades. In order to facilitate the analysis, we focus on the four most frequent tenors: one, six, nine and twelve months. Table 7 summarises the cleaning and filtering process for interest rate derivatives for a sample trade state report (September 2016).

[29] The comparison between BIS and EMIR data is subject to a series of caveats. See footnote 22.

[30] A detailed taxonomy will be implemented in November 2017. See Annex to Regulation (EU) 105/2017.

Cleaning and filtering of interest rate derivatives

Table 7

Interest derivatives - Sept 2016	N. of obs.	%	Notional (€ bn)	%
Original number of observations	2,374,904	100.0%	5,004,686	100.0%
Value of contract				
Missing value of contract	382,162	16.1%	4,680,000	93.5%
Mis-matching value of contract (buyer/seller relative difference > 5%)	109,371	4.6%	2,540	0.1%
Notional				
Different notionals	202,292	8.5%	13,000	0.3%
Missing notional	775	0.0%	0	0.0%
Outliers	6,984	0.3%	202,000	4.0%
Counterparty ID				
Buyer or Seller or both ID are non LEI	146,173	6.2%	4,280	0.1%
Timestamp execution				
Execution date missing	22,482	0.9%	2,460	0.0%
Execution date after trade state report date	70	0.0%	2	0.0%
Execution year before 1990	17,802	0.7%	1,140	0.0%
Subtotal (clean dataset)	**1,486,793**	**62.6%**	**99,264**	**2.0%**
Filter				
Non-swap	205,343	8.6%	23,500	0.5%
Float-to-float	121,327	5.1%	8,500	0.2%
Fix-to-fix	10,670	0.4%	272	0.0%
Forward starting	254,584	10.7%	20,000	0.4%
Cross-currency	1,975	0.1%	29	0.0%
Upfront payment	2,173	0.1%	60	0.0%
Spread floating	96,082	4.0%	5,290	0.1%
Embedded option	723	0.0%	21	0.0%
Intragroup	69,479	2.9%	3,750	0.1%
Non-EURIBOR	559,748	23.6%	25,900	0.5%
Tenor different from 1M, 3M, 6M, 12M	1,202	0.1%	42	0.0%
Total (filtered dataset for network analysis)	**163,487**	**6.9%**	**11,900**	**0.2%**

Source: ECB calculations, based on DDRL EMIR confidential data.

Credit derivatives

Current rules allow for some flexibility in the choice of the underlying identifiers. As a result, it is sometimes difficult to identify the underlying to a credit derivative and, subsequently, the issuer of the underlying security.[31]

In this context, it seems wise to drop all observations where the underlying reference entity is not univocally identifiable (i.e. not identified by an ISIN code) or missing. Following Abad et al. (2016), we also filter out contracts written on index or baskets as they do not include information on the underlying index or basket content.[32] As in the case of interest rate derivatives, we also filter out intra-group trades. Table 8 summarises the cleaning and filtering process for credit derivatives for a sample trade state report (September 2016).

31 See Regulation (EU) 1247/2012 and Regulation (EU) 148/2013.

32 Regulation (EU) 105/2017 will introduce the obligation to report an index product code, that will allow to identify this increasingly popular type of credit derivatives.

Cleaning and filtering of credit derivatives

Table 8

Credit derivatives - Sept 2016	N. of obs.	%	Notional (€ bn)	%
Original number of observations	692,696	100.00%	95,495	100.00%
Value of contract				
Missing value of contract	114,976	16.60%	87,200	91.31%
Mis-matching value of contract (buyer/seller relative difference > 5%)	49,292	7.12%	429	0.45%
Notional				
Different notionals	13	0.00%	0	0.00%
Missing notional	1	0.00%	0	0.00%
Outliers	3,399	0.49%	626	0.66%
Counterparty ID				
Buyer or Seller or both ID are non LEI	17,991	2.60%	225	0.24%
Timestamp execution				
Execution date missing	2,907	0.42%	72	0.08%
Execution date after trade state report date	2	0.00%	0	0.00%
Execution year before 1990	1,021	0.15%	15	0.02%
Subtotal (clean dataset)	503094	**72.63%**	**6,928**	**7.26%**
Filter				
Non-swap	7,403	1.07%	239	0.25%
Intra-group transactions	51,989	7.51%	1,060	1.11%
Missing reference entity	2,695	0.39%	38	0.04%
Index or basket	103,909	15.00%	3,540	3.71%
Non-ISIN	13,870	2.00%	97	0.10%
Problematic ISINs	24,190	3.49%	105	0.11%
Total (filtered dataset for network analysis)	**299,038**	**43.17%**	**1,850**	**1.94%**

Source: ECB calculations, based on DDRL EMIR confidential data.

Currency derivatives

The key variable of interest for currency derivatives analysis is the currency pair. As in the case of interest rate derivatives benchmarks, we proceed to manually clean and correct reporting mistakes in this field. In particular, we drop observations where currency pairs that are missing, numerical or composed by the same identical currency. Also here, we filter out intra-group trades. Table 9 summarises the cleaning and filtering process for currency rate derivatives for a sample trade state report (September 2016).

Cleaning and filtering of currency derivatives

Table 9

Currency derivatives - Sept 2016	N. of obs.	%	Notional (€ bn)	%
Original number of observations	2,442,662	100.0%	47,230	100.0%
Currency pair clean				
Wrong currency pair	28,813	1.2%	444	0.9%
Missing currency pair	93,027	3.8%	2,997	6.3%
Value of contract				
Missing value of contract	158,566	6.5%	19,900	42.1%
Mis-matching value of contract (buyer/seller relative difference > 5%)	137,091	5.6%	2,470	5.2%
Notional				
Missing notional	432	0.0%	0	0.0%
Outliers	57,802	2.4%	3,740	7.9%
Counterparty ID				
Buyer or Seller or both ID are non LEI	250,692	10.3%	1,730	3.7%
Timestamp execution				
Execution date missing	70	0.0%	1	0.0%
Execution date after trade state report date	70	0.0%	0	0.0%
Execution year before 1990	6,310	0.3%	236	0.5%
Subtotal (clean dataset)	**1,709,789**	**70.0%**	**18,190**	**38.5%**
Filter				
Intragroup	303,461	12.4%	1,400	3.0%
Non-fwd	155,405	6.4%	2,560	5.4%
Non-EUR/USD	925,497	37.9%	9,700	20.5%
Total (filtered dataset for network analysis)	**325,426**	**13.3%**	**4,530**	**9.6%**

Source: ECB calculations, based on DDRL EMIR confidential data.

2.4.3 Summary of the results

The application of relatively basic cleaning procedures considerably reduces the size of EMIR confidential datasets. In particular, missing contract valuations, outlier notional values and wrong counterparty IDs account for the largest share of misreported observations.

Alongside the reporting mistakes and the missing values, it is interesting to note the weight of insufficient or incorrect use of global standards such as LEI and, in the case of credit instruments, ISIN codes. This finding suggests that the finalisation of the work for the implementation of new global identifiers (UPI and UTI) coupled with stricter validation rules and a wider use of LEI and ISIN codes would have the potential to dramatically improve the quality of EMIR data.

While data quality continues being an obstacle to the full use of EMIR data, we also observe a considerable improvement over time: the average "survival" rate (i.e. the share of observation retained after the cleaning procedure) in the last year went from c.50% in 2014 up to almost 70% in the first quarter of 2017. Reporting agents' increasing knowledge and compliance with reporting obligations, the implementation of stricter TR validation rules, as well as the adoption and implementation of new ESMA regulatory and implementing standards or guidelines surely all contributed to this positive trend.

In conclusion, subject to the quality caveats outlined above, EMIR data are a unique information source, that will continue to be improved and will be used more and more often in the years to come.

In the following sections, we will zoom into the datasets we have obtained and outline some interesting insights on the structure of euro area OTC derivatives markets.

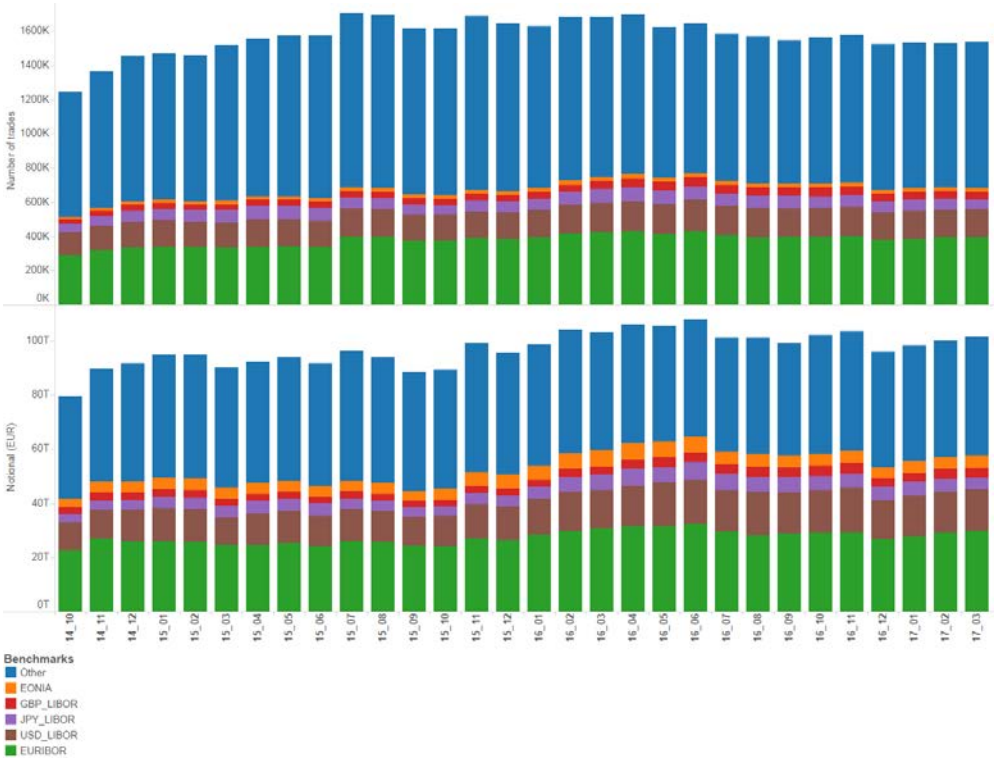
3. Dataset overview

3.1 Interest rate derivatives

Figure 7 below depicts the evolution of the composition of benchmarks in the interest rate derivatives market. In line with Abad et al. (2016), we group benchmarks that account for less than 1% of total notional or number of trades into the category "Other".

In March 2017, euro area OTC interest rate derivatives market was worth almost EUR 100 trillion in terms of notional value, approximatively a quarter of the global aggregate.[33] As highlighted by Figure 7, EURIBOR is the benchmark accounting for the greatest market share (up to 25%), followed by USD LIBOR (10.8%), JPY LIBOR (3.9%), GBP LIBOR (2.9%), and EONIA (1.5%). Other benchmarks account for the remaining 55% of the market, suggesting that – apart from the few "blockbusters" – the market for interest rate derivatives is very heterogeneous. This result seems stable over time and valid not only when measured in relation to the number of outstanding trades, but also to the total outstanding notional.

Figure 7: Interest rate derivatives - breakdown by floating leg benchmark.

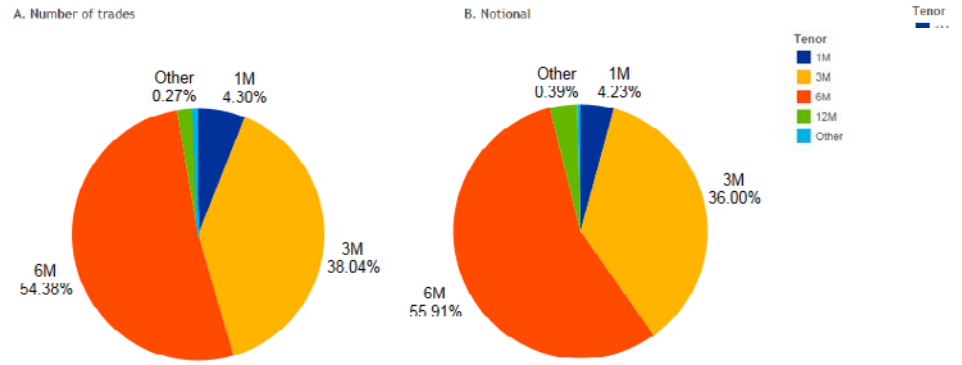


Source: ECB calculations, based on DDRL EMIR confidential data.

Figure 8 shows the breakdown of interest rate derivatives on EURIBOR by tenor at the latest available date (end-March 2017). The 6 month tenor is the most prevalent, both in terms of number of trades and of notional value. This confirms the finding by Abad et al. (2016) also for the euro area market.

[33] According to BIS (2016), the aggregate global notional outstanding of OTC interest derivatives at the end of June 2016 was c.418 trillion USD.

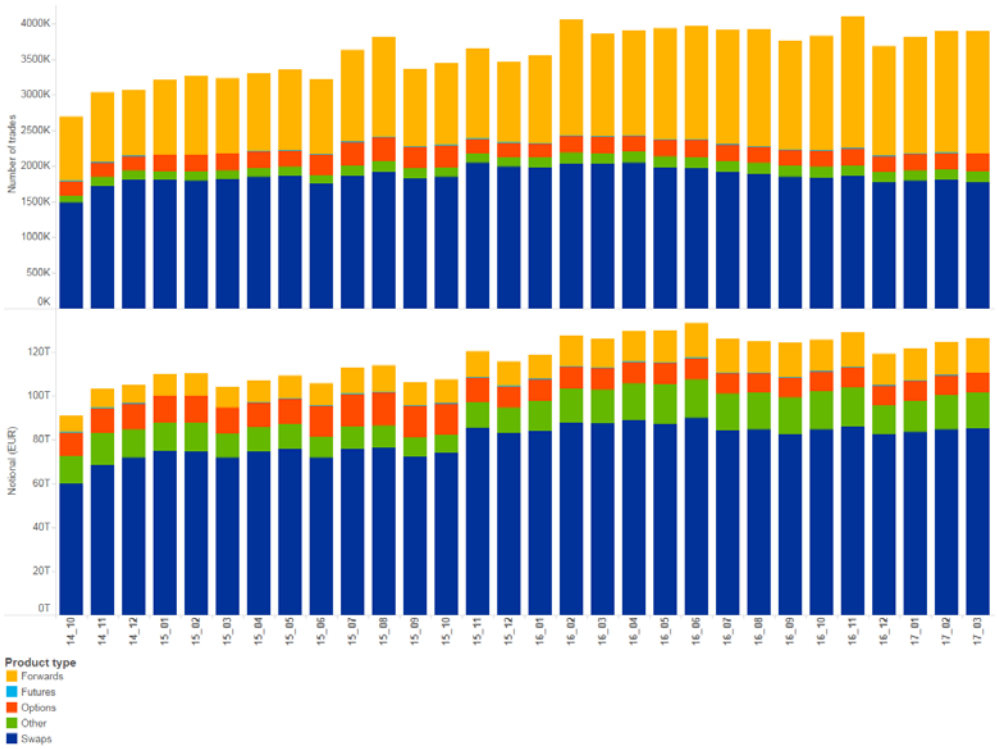
Figure 8: Breakdown of EURIBOR interest rate derivatives by tenor (March 2017).



Source: ECB calculations, based on DDRL EMIR confidential data.

Figure 9 presents the breakdown of the interest rate derivatives market by product type. As expected,[34] most of the contracts are swaps, c.86% of total trades.[35] The remainder includes options (5.2%), forward rate agreements (4.3%), forwards (0.3%) and various other contract types (3.8%). It is interesting to note that, when we look at the breakdown in terms of notional, swaps account for a lower share (76.6%), as opposed to forward rate agreements that account for a significantly higher share (14.3%). This is consistent with the BIS global aggregate, where swaps account for c.74% of total notional outstanding.[36]

Figure 9: Interest rate derivatives - breakdown by product type.



Source: ECB calculations, based on DDRL EMIR confidential data.

[34] See Abad et al. (2016).

[35] The percentages refer to the last available observation, i.e. end of March 2017.

[36] See BIS (2016).

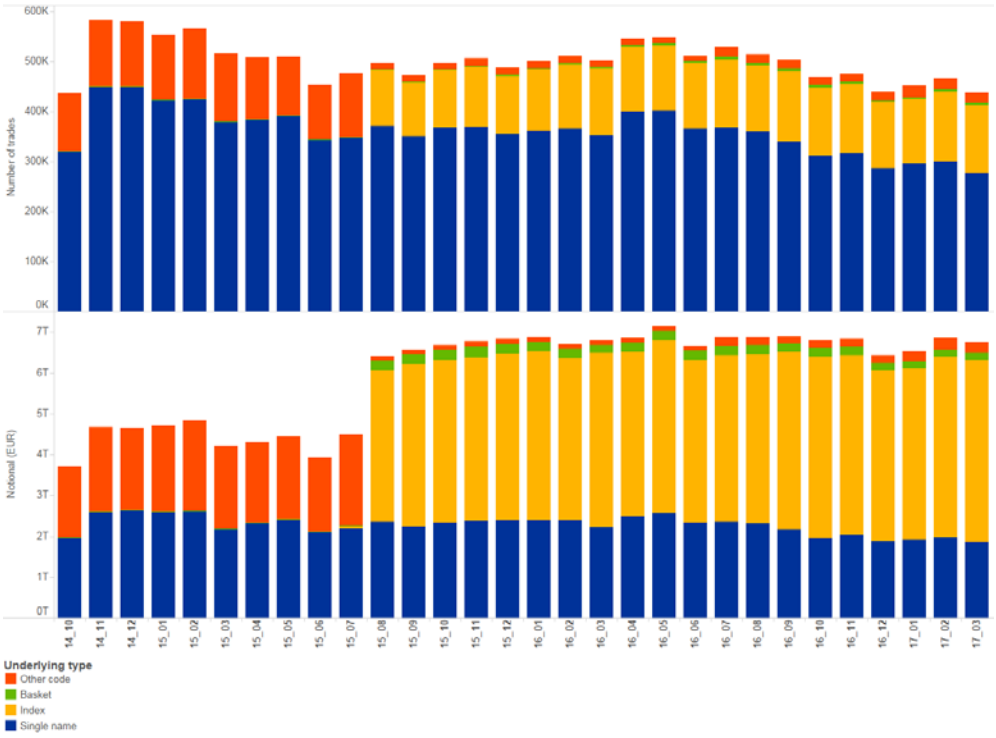
3.2 Credit derivatives

Moving to the credit derivatives market, our data confirm that swaps account roughly for 95-98% share both in terms of notional and number of trades over the time series.[37] The market for credit derivatives is worth c. EUR 7 trillion in terms of notional value and is on a contraction path, consistently with the global trend highlighted by BIS (2016) and partially justified by the contraction of the intra-dealer market segment.

Figure 10 shows the breakdown of contracts by type of underlying. The underlying can be an index, a basket, or a single-name security, such as a bond issue of a G16 dealer.[38] Interestingly, contracts written on indexes account for more than 60% of total notional outstanding, but only for c. 20% of total number of trades. This result suggests that in the euro area, index products account for a larger share of credit instruments as compared to the global aggregate published by BIS, where index products account for c.41% of total CDS notional outstanding.[39]

Figure 10 also shows a significant jump in the time series, indicating a sudden increase in total outstanding notional between July and August 2016. The reconciliation of those developments with market events or with technical issues linked to reporting practices go beyond the scope of this paper and warrant further investigation.

Figure 10: Credit derivatives - breakdown of by underlying type.



Source: ECB calculations, based on DDRL EMIR confidential data.

37 See Abad et al. (2016) and Ali et al. (2016)

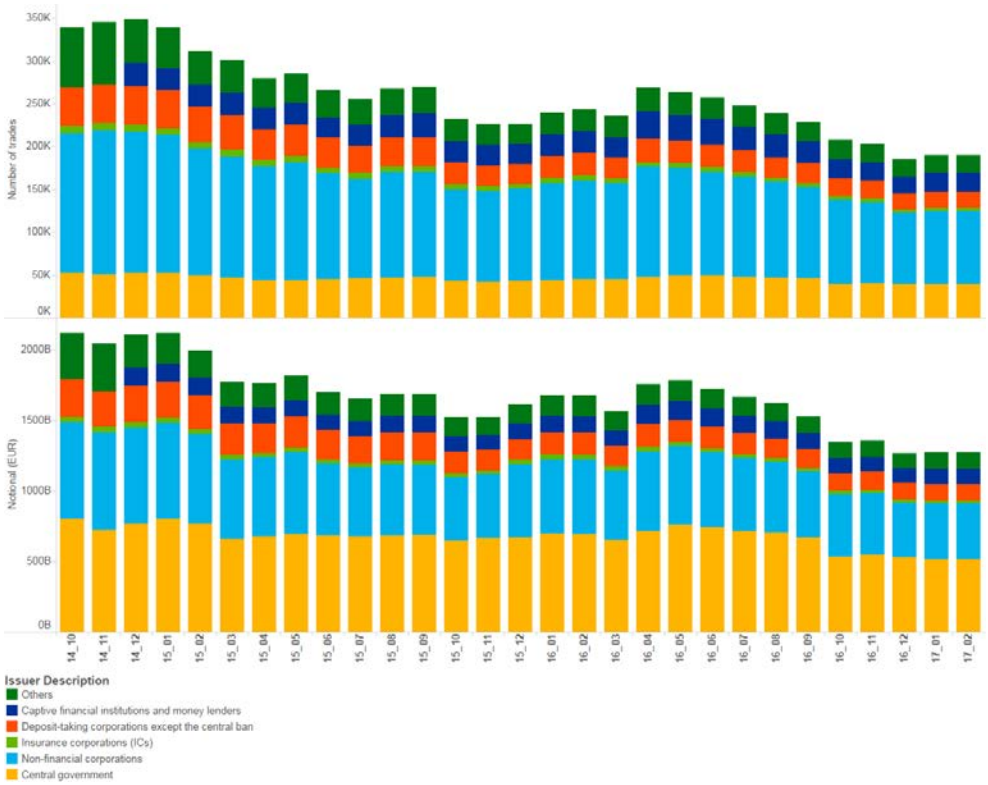
38 The group of the sixteen largest derivatives dealers (G16) includes Bank of America, Barclays, BNP Paribas, Citigroup, Crédit Agricole, Credit Suisse, Deutsche Bank, Goldman Sachs, HSBC, JPMorgan Chase, Morgan Stanley, Nomura, Royal Bank of Scotland, Société Générale, UBS, and Wells Fargo.

39 The comparison between EMIR and BIS semi-annual survey data on credit derivatives is subject to a number of caveats: BIS only covers CDS – while EMIR covers the whole credit derivatives product range, of which swaps represent more than 90% - and distinguish between multi-name and index based instruments – while EMIR only provides for a general "Index" flag. See footnote 22.

While current reporting standards do not allow tracking detailed information about underlying indexes and baskets, the integration of EMIR reporting with other databases allows gathering useful insights on the nature of single-name underlying securities' issuers. The ECB Centralised Securities Database (CSDB)[40] provides detailed information on securities, including with regards to the issuer ESA 2010 sector classification code.[41] Therefore, by merging our dataset with the CSDB, we obtain the breakdown outlined in Figure 11.

Non-financial corporations, sovereign entities and banks account for the largest part of total underlying securities to euro area CDS. Other significant sectors in the market include captive financial institutions, money lenders and other financial intermediaries, which represent c.25% of the market both in terms of notional and number of trades.

Figure 11: Credit derivatives - breakdown of single-name CDS by sector of the underlying security issuer.



Source: ECB calculations, based on DDRL EMIR confidential data.

3.3 Currency derivatives

Figure 12 shows the breakdown of outstanding contracts (and the related notional value) by currency pair. For clarity, we group pairs of "mirroring" currency pairs (e.g. EUR/USD and USD/EUR) and we assign pairs including a major currency (i.e. EUR, USD, JPY, GBP) and a non-major currency to the residual "Other" category.

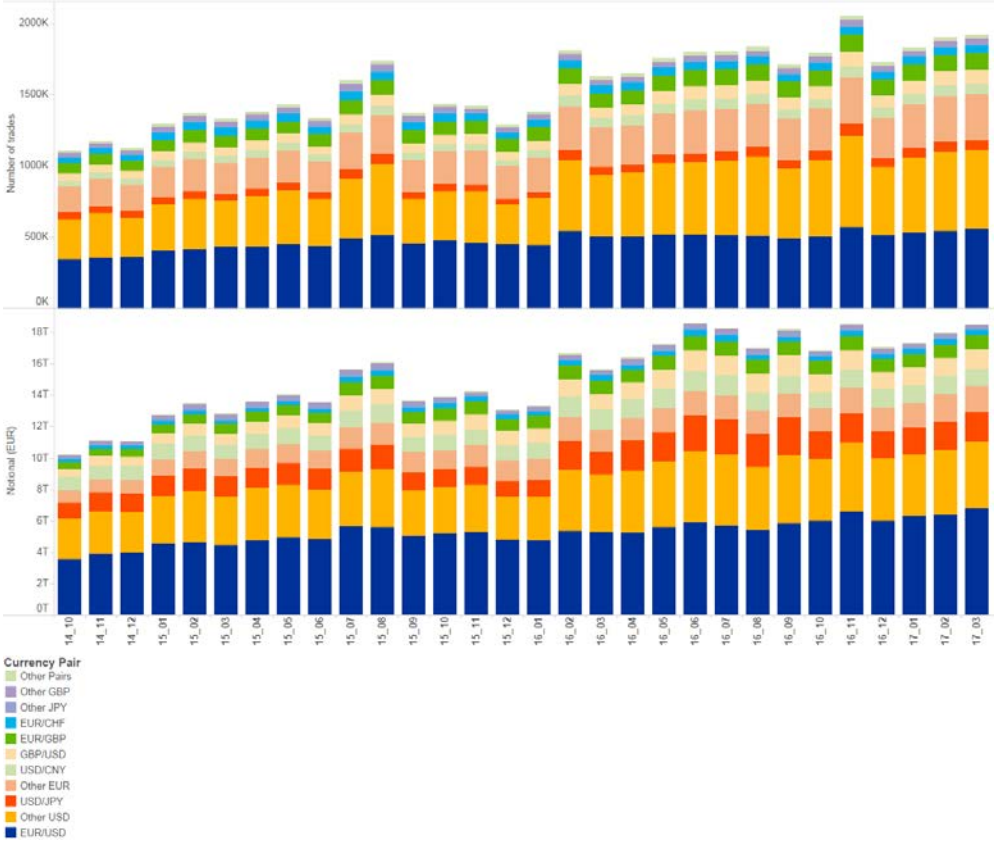
Overall, the euro area currency OTC derivatives market was worth c. EUR 20 trillion at the end of March 2017, and showed a slightly expanding trend.

[40] For a description of the structure and content of the CSDB, see ECB (2010).

[41] See http://ec.europa.eu/eurostat/web/esa-2010

Expectedly, EUR/USD contracts account for the largest share of euro area OTC derivatives, followed by other USD pairs. Contracts written on USD/JPY, GBP/USD, USD/CNY were the other most frequently traded ones.

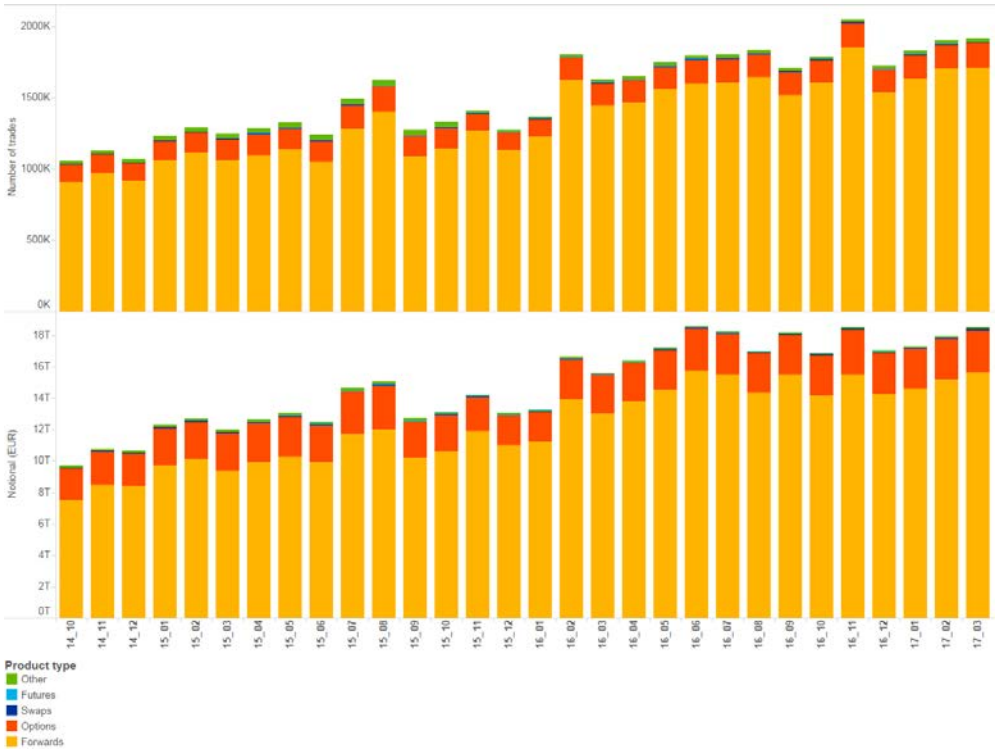
Figure 12: Currency derivatives - breakdown by currency pair.



Source: ECB calculations, based on DDRL EMIR confidential data.

With regards to the product breakdown, we find that majority of contracts are forwards (89% of total trades), with the remaining 11% being mostly options and various other contract types (see Figure 13).

Figure 13: Currency derivatives - breakdown by product type.



Source: ECB calculations, based on DDRL EMIR confidential data .

4. Clearing analysis

One of the pillars of the Pittsburgh reform agenda was the introduction of mandatory clearing for OTC derivatives. In the EU, EMIR established an obligation to clear certain contracts with adequate liquidity, standardisation and information availability.[42] Table 10 shows the timeline for the implementation of the clearing obligation.

Timeline for the implementation of the EMIR clearing obligation — Table 10

Category[43]	IRS in G4 currencies[44]	Index CDS[45]	IRS and FRAs in NOK, PLN, SEK[46]
Clearing obligation starting dates			
Cat. 1	21/06/2016	09/02/2017	09/02/2017
Cat. 2	21/12/2016	09/08/2017	09/07/2017
Cat. 3	21/06/2017	09/02/2018	09/02/2018
Cat. 4	21/12/2018	09/05/2019	09/07/2019
Frontloading dates			
Cat. 1	21/02/2016	09/10/2016	09/10/2016
Cat. 2	21/05/2016	09/10/2016	09/10/2016

Source: readapted from ECB (2016).

At the time of writing, the obligation to clear interest rate swaps in all major currencies as well as index CDS is already in force for the biggest dealers. In order to compute the share of cleared trades, we divide the total number of outstanding cleared trades by the total number of outstanding trades for each period. We do the same for the value of cleared trades' notional.

Figure 14 shows the evolution of clearing rates in the euro area interest rate OTC derivatives market. At the end of February 2017, 46.4% of all outstanding trades – accounting for more than 60% of the total notional outstanding – were cleared. A consistently increasing trend, starting at the end of 2015 – when Regulation (EU) 2205/2015 entered into force – is evident both in the volume and value of cleared contracts.[47] However, it is interesting to notice that more than 20% of trades were already cleared in 2014, well before the entry into force of the clearing obligation; this suggests that the clearing practice was already common in the market and justifies the non-exponential increase in clearing rates following the entry into force of the clearing obligation.

42 See Article 5(2) of Regulation (EU) 648/2012.

43 Category 1 includes clearing members; category 2 includes other financial counterparties and alternative investment funds above the group-level threshold of non-cleared derivative positions (EUR 8 billion); category 3 includes other financial counterparties and alternative investment funds below the EUR 8 billion threshold; category 4 includes other non-financial counterparties.

44 Regulation (EU) 2205/2015.

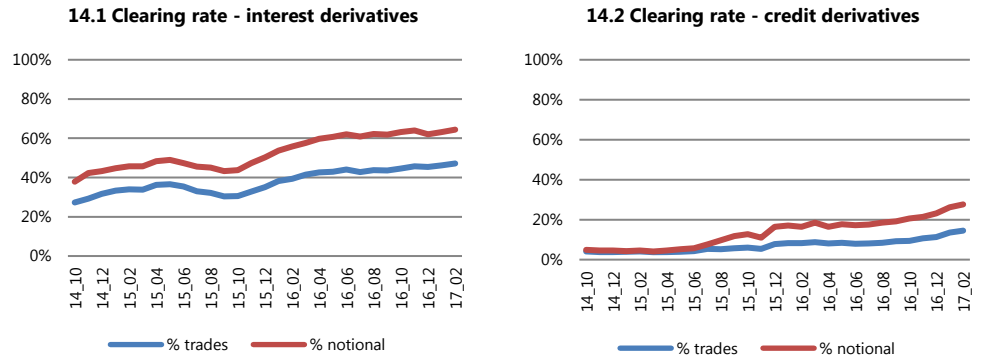
45 Regulation (EU) 592/2016.

46 Regulation (EU) 1178/2016.

47 The jump in the share of trades cleared by CCPs from October to November 2014 does not seem related to any institutional or market change. A possible explanation lays in the implementation of the level 1 validation rules, in force since October 24th 2014. Updated information on ESMA validation rules is available at: https://www.esma.europa.eu/press-news/esma-news/esma-updates-emir-qa-and-validation-rules

Expectedly, G16 dealers and banks account for the largest share of cleared trades, reflecting the overall participation in the interest rate derivatives market. On the other hand, other financial counterparties (including investment funds) account for a smaller but increasing share of cleared trades (c. 1.4%).

Figure 14: evolution of clearing rates in OTC interest rate and credit derivatives markets

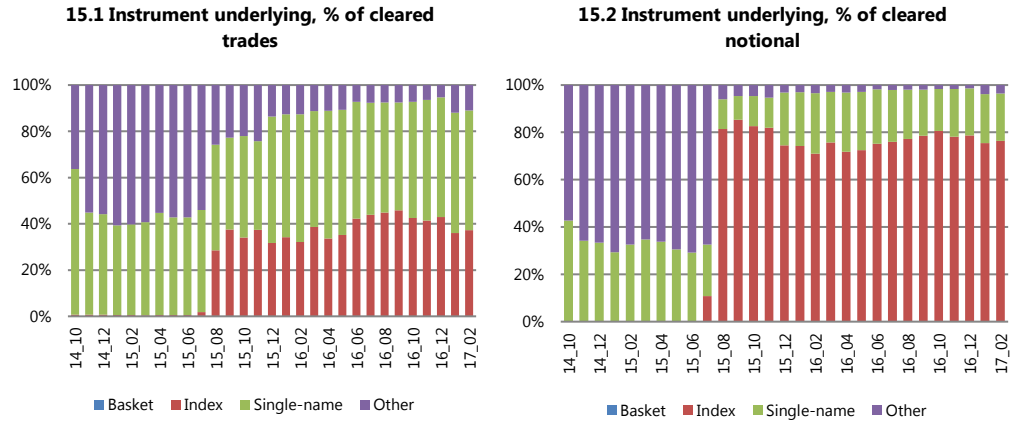


Source: ECB calculation based on DDRL EMIR confidential data.

Moving to credit derivatives, we observe that no or very low clearing activity took place until mid-2015. Afterwards, however, an increasing number of contracts has been cleared, up to 20% of total trades (and c.40% of total notional outstanding as of end March 2017). The lower values vis-à-vis interest rate derivatives are explained by the timeline and to the scope of the clearing obligation, which does not cover single-name CDS and entered into force only in February 2017.

Nevertheless, as shown in Figure 15, counterparties are also clearing a significant amount of single-name credit derivative contracts, even though they are not covered by a clearing obligation. Their relative importance, however, is smaller than index products, especially in terms of notional value.[48]

Figure 15: breakdown of cleared credit derivative trades by type of underlying.



Source: ECB calculation based on DDRL EMIR confidential data.

[48] The jump in the time series between July and August 2015 was highlighted in Section 3 and seems related to changes in the reporting practices or TR validation rules rather than to market events.

5. Preliminary insights from a network analysis

Network analysis is now considered a standard tool to measure interconnectedness and assess contagion risks in inter-banking markets; however, due to the limited availability of data, it is only recently that researchers have extended their work to the derivatives market, including through the confidential EMIR data. In the last few years, an increasing number of studies has been published: Kenny et al. (2015) used Bank of Ireland data to investigate the CDS network, focusing on the activity of the shadow banking system. In the UK, Ali et al. (2016) explored the structure of the CDS market and Cielinska et al. (2017) carried out an event study to capture the effects of the Swiss Franc depegging on the FX derivatives network. Finally, Abad et al. (2016) conducted a broad investigation on the topology of the interest rate swaps (IRS), credit default swaps (CDS) and currency forwards in the EU.

Building on these contributions, we sketch the evolution of euro area OTC derivatives' market structure over time. This is particularly interesting in a context of significant regulatory activity and institutional changes: as highlighted in Section 1, between 2012 and 2017 the EU derivatives markets underwent far reaching reforms whose effect on market microstructure has not yet been fully investigated.

In order to achieve a smaller and homogeneous dataset, we focus on the filtered data obtained following the methodology outlined in Section 2 and including IRS on EURIBOR with a 6 month tenor, single-name CDS, and EUR-USD forwards. Our analysis spans between the relatively short period from January 2016 to March 2017; in fact, the data quality concerns highlighted in Section 1 and Section 2 suggest concentrating on recent reports.

For each trade state we construct a network whose nodes represent the active counterparties to transactions and whose links capture the outstanding positions between each counterparty pair. Links are in turn weighted by the gross notional outstanding. While EMIR reports include a field dedicated to flagging the buyer/seller nature of the reporting counterparty, our analysis has identified a number of inconsistencies – most probably linked to different interpretation of the existing technical standards. Against this background, we build an undirected network.

5.1 A static view of selected derivatives submarkets

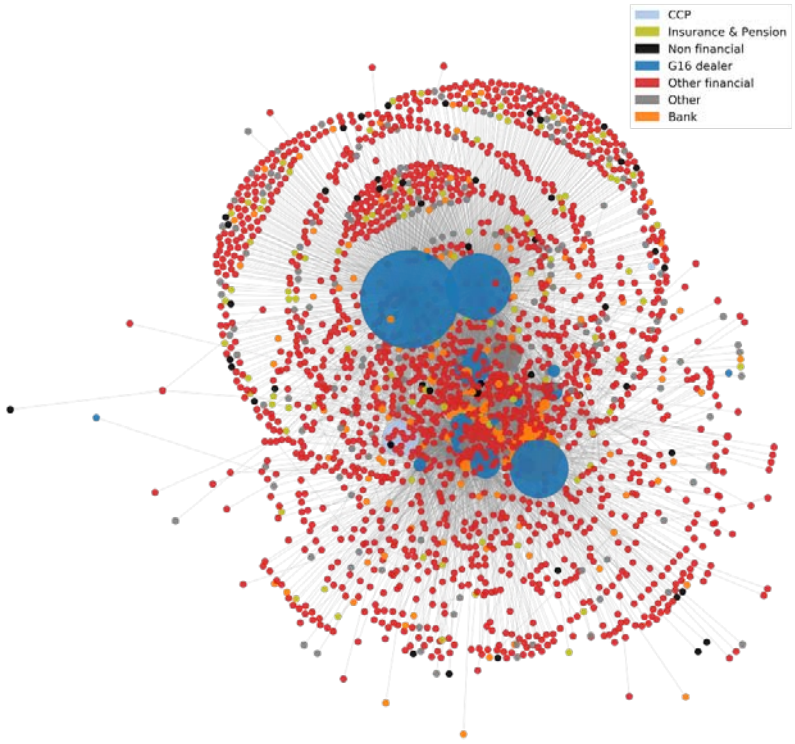
Before moving to the analysis of the market dynamics over time, we analyse the structure of the three networks statically, at the end of March 2017.

The network represented in Figure 16 shows the EURIBOR 6M interest rate swaps market. The high clearing rates highlighted in Section 4 increase the systemic importance of CCPs: in fact, the largest node outlined in the figure is a CCP. Figure 16 also shows the intermediary role played by banks and G16 dealers; this also implies that peripheral nodes (mostly non-banks and non-financial counterparties) get access to the core of the network via larger banks or G16 dealers that often clear trades on behalf of their clients.

Figure 16: Network of gross notional links between counterparties in euro area EURIBOR 6M interest rate swaps market (March 2017).

Source: ECB calculation based on DDRL EMIR confidential data.

Figure 17: Network of gross notional links between counterparties in euro area single-name CDS market (March 2017).



Source: ECB calculation based on DDRL EMIR confidential data.

As outlined by Figure 17, the structure of the single-name CDS market is different from the one of EURIBOR IRS: first, the lower clearing rates outlined in Section 4 imply a lower relative importance of CCPs; G16 dealers and banks, on the other hand, seem to have a crucial intermediation role, which increases their exposure and, subsequently, the size of their nodes. Finally, we also note that the CDS network appears denser than the IRS, meaning that each node trades with more counterparties and is therefore more linked to the rest of the nodes.

Figure 18: Network of gross notional links between counterparties in euro area EUR/USD FX forwards (March 2017).

Source: ECB calculation based on DDRL EMIR confidential data.

The EUR/USD FX forwards market structure reflects on the one hand the lack of clearing obligation – in fact, no CCP is visible in the core of the network – and, on the other hand, the relatively higher presence in the market of non-financial counterparties (the black nodes in Figure 18). It is also interesting to note how peripheral nodes connect to the core of the network through the intermediation of small banks and other financial counterparties, which are in turn connected to large banks and G16 dealers at the core of the network. Opposite to the CDS network, the one represented in Figure 18 is sparser and closer to the EURIBOR IRS in terms of density.[49]

[49] See also paragraph 5.2 below.

5.2 Evolution in network structure by asset class

While static market visualization gives useful indications, the value added of granular data such as EMIR's also lies in their ability to capture changes in market structure over time. In order to leverage this opportunity, we compute a number of commonly used measures, whose definition and meaning is summarised in Table 11.

List of network measures and their definition — Table 11

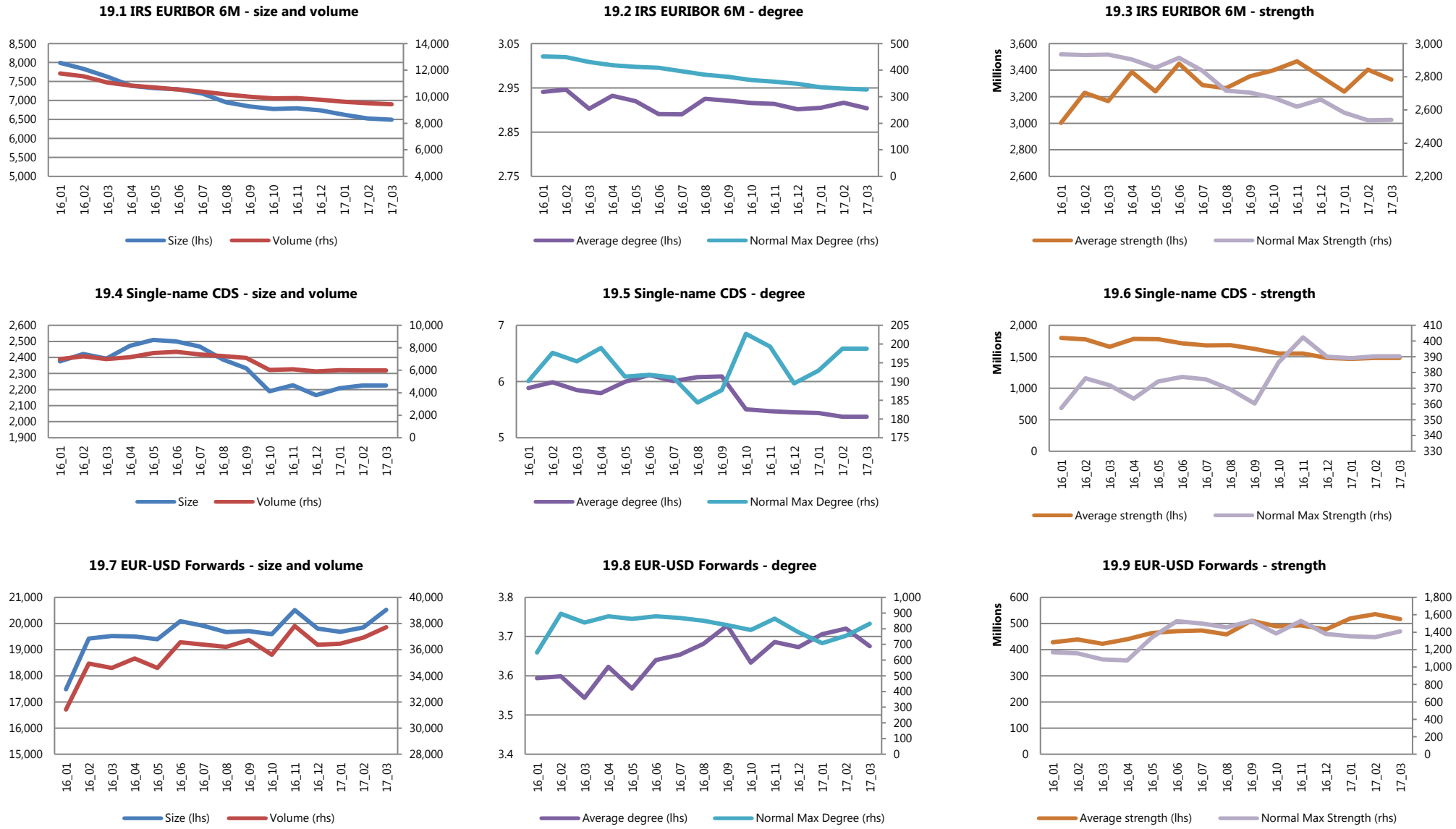
Measure	Definition
Network size	The number of nodes (i.e. counterparties) in the network.
Network volume	The number of links (i.e. outstanding trades) between nodes in the network.
Network degree (average and maximum)	The number of links connected to a node, i.e. the number of counterparty each node trades with.[50]
Network strength (average and maximum)	The sum of weights of all links connected to a node, i.e. the aggregate outstanding notional value of all trades a counterparty is involved in.[50]
Network density	The fraction of present connections to possible connections. In an undirected network it is equal to: $\frac{2(\text{Network Volume})}{\text{Network Size} \times (\text{Network Size}-1)}$.

Source: Adapted from Iori et al. (2008)

As a result, we obtain a time series composed by thirteen monthly observations for each measure and for each asset class. Before commenting on the outcome of the analysis, a number of caveats need to be highlighted: first, the ECB access rights limit the representativeness of the network, as they fail to capture other non-euro area countries that are major players in the EU derivatives markets; second, and perhaps most importantly, the relatively low frequency of the observations does not allow to capture "real-time" movements in the markets linked to specific events. In fact, as our time series is composed of end-of-month snapshots, it is prone to a number of biases and random effects that decrease their representativeness. On the other hand, our methodology highlights the general trend in market structure, and reflects to a certain extent regulatory and institutional changes in the EU OTC derivatives regulatory framework.

[50] In order to facilitate comparability across asset classes, we normalize the maximum degree and divide it by the average degree.

Figure 19: Evolution of selected measures for a subset of interest rate, credit and currency derivatives networks.



Source: ECB calculation based on DDRL EMIR confidential data.

Figure 19.1 shows that the number of counterparties to EURIBOR 6M IRS and the number of connections among them has decreased over time, going from about 8,000 to 6,500 counterparties and from about 12,000 to 9,500 links (c. 20%) respectively. As this trend, however, does not correspond to any decrease in outstanding notional,[51] it points towards an increase in density – a proxy of interconnectedness – and in market concentration. In fact, we find that the network density increases by c. 20% over the period, although the market remains very sparse in absolute terms: as indicated by Figure 19.2, the average network degree is lower than 3, meaning that on average each counterparty trades with only 3 other counterparties. On the other hand, the average strength of the network increased by c. 10% over time, suggesting that existing nodes become "heavier" in terms of notional. This result might be linked to the implementation of the clearing obligation although, perhaps due to the high clearing rate in the IRS market already before of the entry into force of EMIR clearing obligations, we don't see any radical shift at the frontloading and clearing obligation dates.[52] Figures 20.1 and 20.2 show the systemic importance of CCPs, that have the highest strength among active counterparties, although – in line with the practices in the clearing market, where clearing is delegated by smaller counterparties to bigger banks or G16 dealers that are usually clearing members to a CCP – a lower but increasing number of links as compared to G16 dealers. The decrease in the average degree of G16 dealers is an interesting trend, which deserves further analysis.

Moving to the single-name CDS dataset, we see a smaller network, both in terms of size and in terms of volume compared to the EURIBOR 6M interest rate swaps network. In terms of dynamics, we observe that starting from June 2016 and until October 2016 the network shrunk in terms of number of counterparties by 11% and, even more, in terms of number of links (-16%). This is consistent with the gradual increase in clearing rates for single-name CDS highlighted in Figure 15.1 and with the general decrease in the average network degree (in October 2016, each counterparty traded on average with 5 other counterparties, down from 6 in September 2016).[53] The increase in the clearing activity also emerges from Figures 20.3 and 20.4: the average degree and strength of CCPs have been increasing, especially after the entry into force of the clearing obligation for index CDS in February 2017.[54] The network density measure also confirms the finding outlined in Figure 17: the CDS network is the densest among the three asset classes we analyse (c. 0.25% over the entire period). Furthermore, we observe that the average strength decreases over time, i.e. the average outstanding position of each node becomes lower in terms of notional value.

Finally, the network for EUR-USD forwards appears to be the largest among the three analysed, both in terms of volume and size. This reflects the fact that, while the interest rate swaps and CDS market are dominated by big financial entities, there are many other financial and non-financial institutions that need to manage exchange rate risk.[55] The upward – although somewhat volatile – trend in the network size and volume shows that the number of unique counterparties and links increases over time (about 20%). Furthermore, the network density remains stable over the period analysed, as also reflected by the evolution of the average degree; in particular, as compared to the two other asset classes, we observe that the EUR-USD forward network density is comparable to the one of the EURIBOR 6M interest rate swaps market (c. 0.04%) and significantly lower than the single-name CDS network. As evident from the high values of degree and strength outlined in Figures 20.5 and 20.6, G16 dealers and banks - as already anticipated in Figure 18 - function as central nodes of the network.

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51 See Figure 7 in Section 3 above.

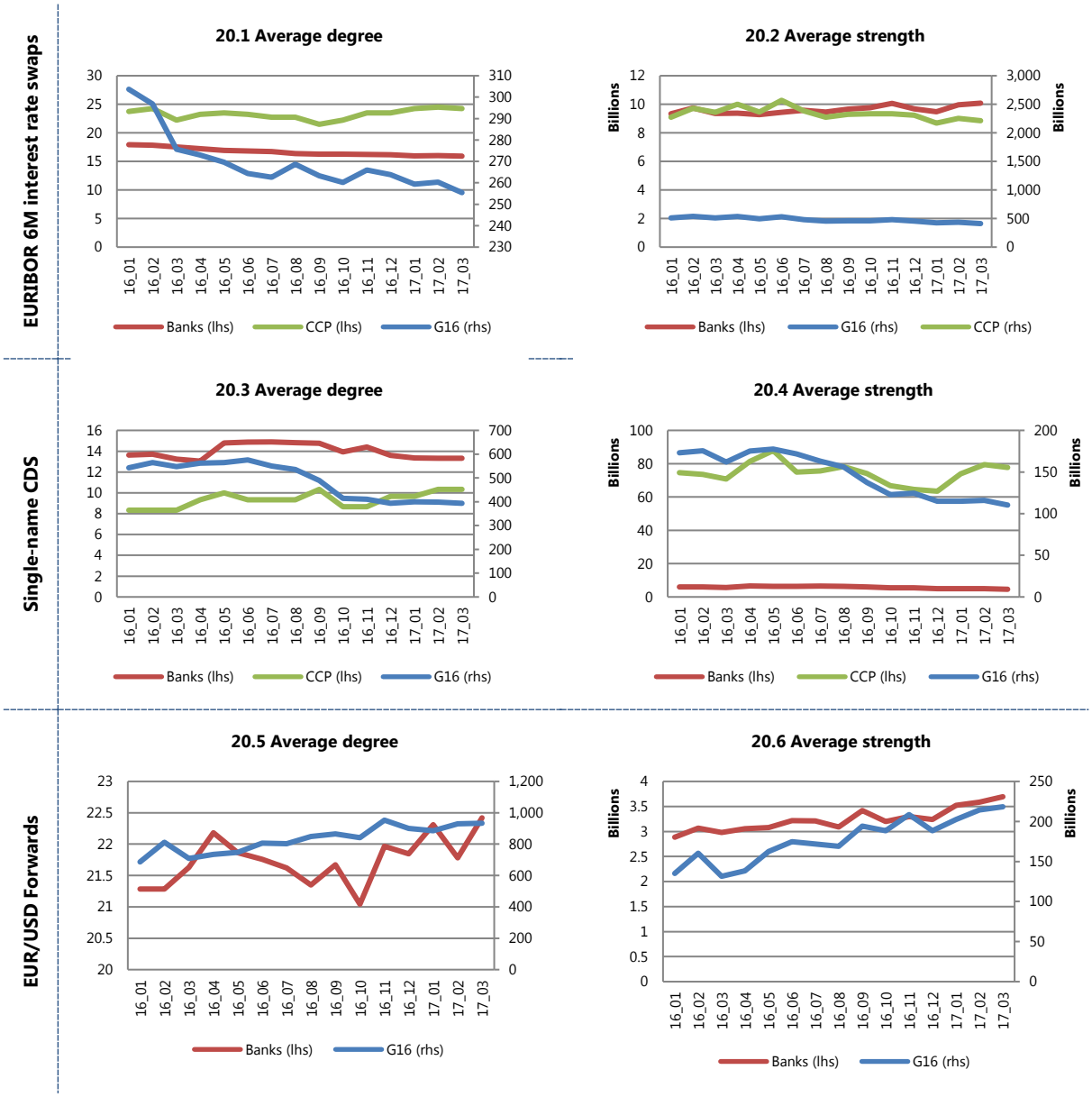
52 See Section 4.

53 The entry into force of the frontloading provision established by Regulation (EU) 592/2016 for the clearing of index-CDS was in October 2016. While no direct causality can be established – our dataset excludes the contracts flagged as "Index" in EMIR – the decrease in the average degree coupled with the increase in the maximum degree suggests that some form of concentration has impacted the core – i.e. the most active part - of the network.

54 As a reminder, the clearing obligation only applies to index CDS. However, some form of spill-over effect on other types of instruments may occur.

55 See Figure 18 above. This result is consistent with the one of Abad et al. (2016).

Figure 20: Average degree and average strength by counterparty type.



Source: ECB calculation based on DDRL EMIR confidential data.

Conclusions

The objective of this paper was twofold: first, we aimed at taking stock on EMIR data, almost three year after the entry into force of the reporting obligation in the EU; second, we tried to map and follow the developments in the euro area OTC derivatives markets with the purpose of concretely assessing the potential and challenges of EMIR data.

With regards to our first objective, we found that EMIR reporting framework, which needs to capture a complex and wide set of products with diverse characteristics and to rely on multiple private entities – the TRs – for data collection and validation, can be effective only if combined with clear, detailed and enforceable reporting rules. While the current situation shows significant margins for improvement, the entry into force of Regulation (EU) 104/2017 and of Regulation (EU) 105/2017 on 1 November 2017 is expected to bring some important progress.

The abovementioned data quality concerns affected our ability to identify trends and events affecting EMIR OTC derivatives markets, especially for the least recent periods. At the same time, existing data allow to capture the characteristics of the markets and the general trends following institutional changes such as the introduction of the clearing obligation. The use of network analysis techniques also provides useful insights on the features of the market and highlights the differences between sub-markets.

EMIR data are a uniquely source of information for macro-prudential policy makers: both the intrinsic characteristics of the derivatives market and the reporting policy choices and implementation history, however, pose a series of important challenges. In the coming years, only a wider use of the dataset, more investments in IT infrastructure and resources as well as more frequent opportunities for the research community to exchange views and share experience on the challenges met and the solutions found in the use of EMIR data will help create the necessary knowledge and conditions for them to unleash their full potential.

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BANK FOR INTERNATIONAL SETTLEMENTS

IFC-National Bank of Belgium Workshop on "*Data needs and Statistics compilation for macroprudential analysis*"

Brussels, Belgium, 18-19 May 2017

Euro-area derivatives markets: structure, dynamics and challenges[1]

Mario Ascolese, Annalisa Molino, Grzegorz Skrzypczynski, Julius Cerniauskas and Sébastien Pérez-Duarte,
European Central Bank

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

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Euro area derivatives markets: structure, dynamics and challenges.

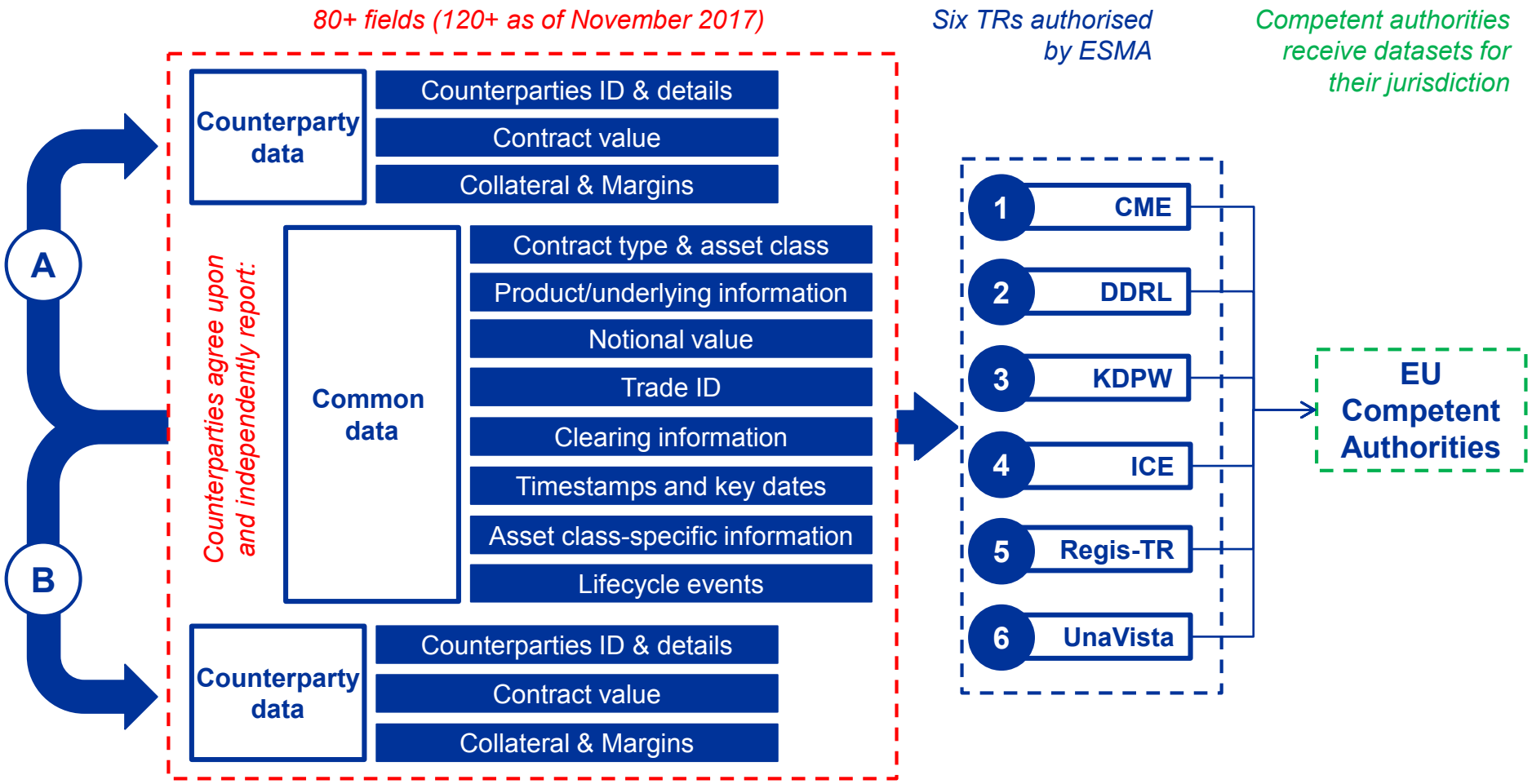
IFC-NBB Workshop

Data needs and statistics compilation for macroprudential analysis

19 May 2017, Brussels

Overview

EMIR confidential data collection process



Challenges and way forward

	CHALLENGES	WAY FORWARD
Data quality & aggregation	Unidentifiable products and trades	UPI & UTI guidance
	Unidentifiable counterparties and underlying	Mandatory use of LEIs/ISINs
	Missing and outlier values	Stricter validation and enforcement
	Inconsistent reporting of rates, contract value, currencies, benchmarks…	Clearer technical standards
Data volume and accessibility	Data volume and data access infrastructure	Uniform TR technical specifications and big data infrastructure (efficiency from interinstitutional coordination)

Dataset and cleaning process

Dataset

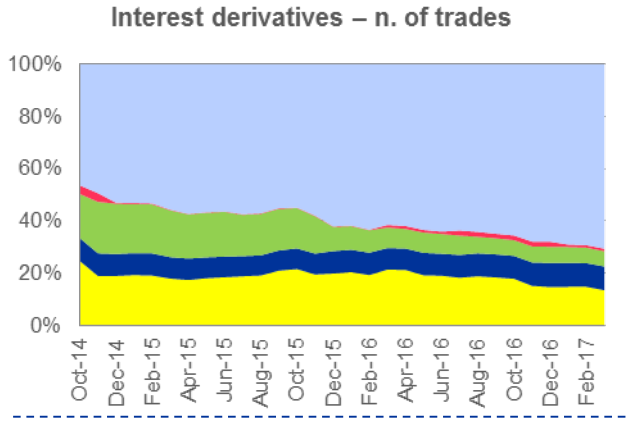
- TR: DDRL trade-state reports (euro area)
- Period: Oct 2014 to Mar 2017
- Asset classes: interest rate, credit, currency derivatives
- De-duplication based on trade ID and common data

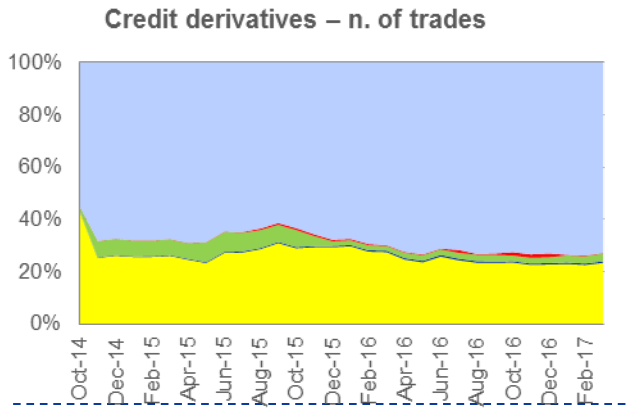
Cleaning procedure

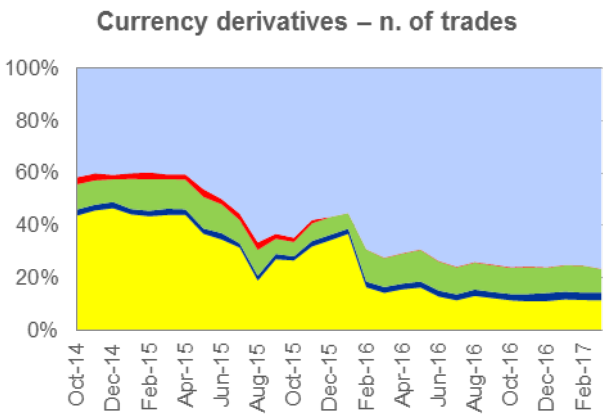
- Sequentially drop observations with:
  1. Missing or unrealistic contract value (🟡)
  2. Missing or unrealistic notional value (🔵)
  3. Unidentifiable counterparties (🟢)
  4. Wrong timestamps (🔴)
  5. As a result, we obtain a clean dataset (🔵)
- Subsequently filter out:
  - Missing or irretrievable benchmarks (interest rate)
  - Missing or irretrievable underlying issuer (credit)
  - Missing or irretrievable currency pairs (currency)

Results

- Positive trend in data quality, but “survival” rate still 60%
- UPI/UTI/LEI/ISIN crucial for better data quality
- Need for stricter validation by TRs







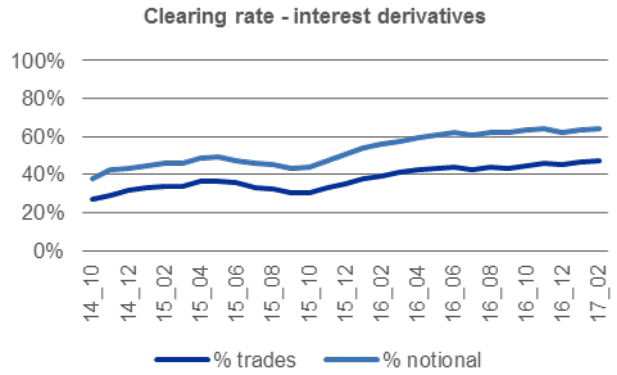
The euro area OTC interest rate derivatives market

Main characteristics

- Largest asset class, with a **total notional outstanding of over €100 trillion** (March 2017), c.25% of global BIS aggregate;
- Slightly decreasing in size since 2016;
- **Top product** types are swaps (86%), options (5%) and forward rate agreements (4%);
- **Top benchmarks** are EURIBOR (25%), USD LIBOR (11%) and JPY LIBOR (4%);
- **High and increasing clearing rates** (c.45% of trades and 60% of notional outstanding).

Sub-market (EURIBOR 6M IRS) network visualisation

- **CCPs at the core** of the network;
- Significant **intermediation role of G16 dealers and banks** (delegation of clearing);
- **Sparse network** with many small participants.



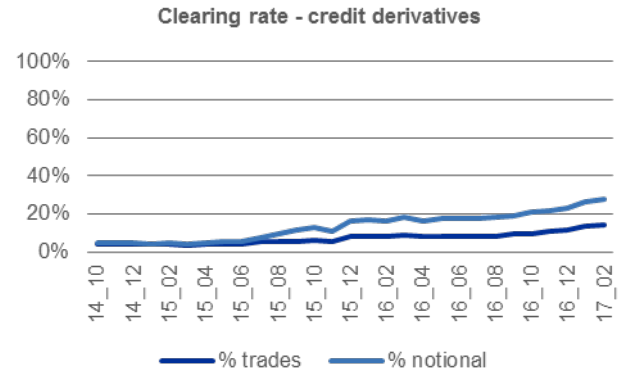
The euro area OTC credit derivatives market

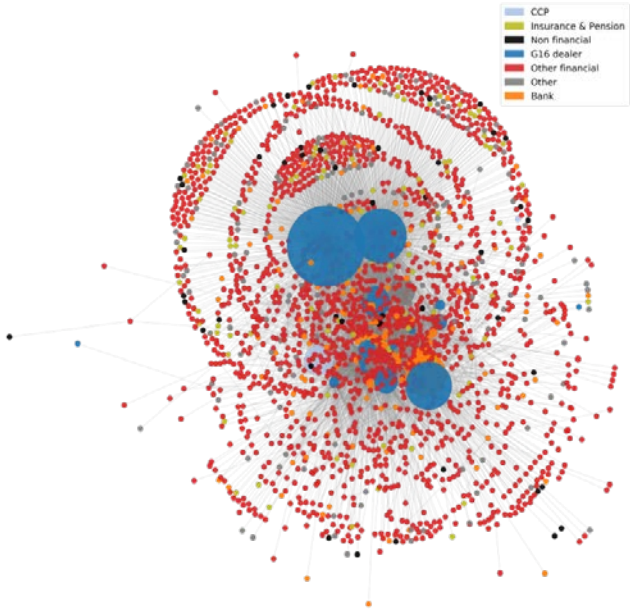
Main characteristics

- Smaller market, with a **total notional outstanding of c. €7 trillion** (March 2017), half of global BIS aggregate (caveat: BIS only considers CDS);
- Slightly decreasing in size since 2016;
- **Top product** type is swaps (95%);
- Increasing importance of **Index products** (20% of total trades but 60% of total notional);
- Sovereign (40%), non-financials (30%) and banks (10%) **top underlying securities issuers' sectors**;
- **Increasing clearing rates** (c.20% of trades and 40% of notional outstanding), both for index and single-name products.

Sub-market (single-name CDS) network visualisation

- **G16 dealers and banks at the core**;
- **Higher density** (each node trades with more other nodes);
- Lower impact of clearing obligation.





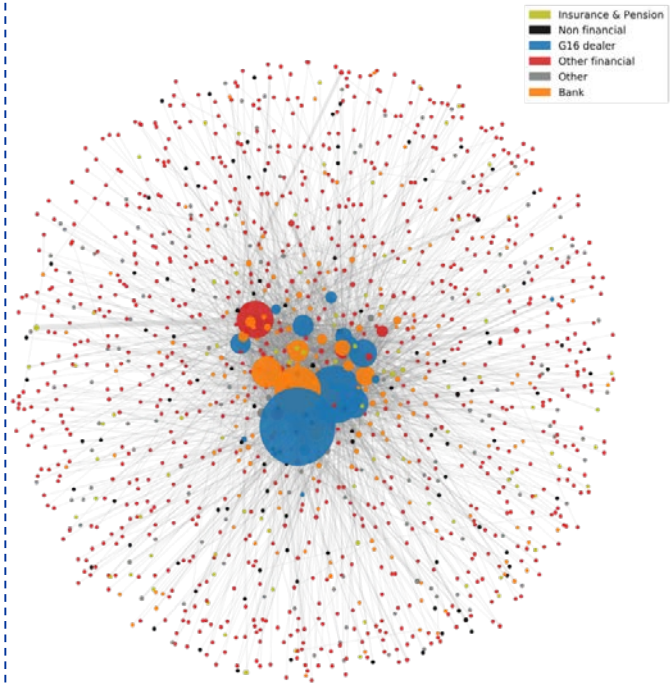
The euro area OTC currency derivatives market

Main characteristics

- Market in expansion, with a **total notional outstanding of c. €20 trillion** (March 2017), c.25% of global BIS aggregate;
- **Top product types** are forwards (80%) and options (15%);
- **Top currency pairs** are EUR/USD (37%) and USD/JPY (10%);
- Slightly higher number of contracts but lower total notional outstanding compared to interest derivatives points to a more dynamic market, with short-term contracts to cover specific currency risks;

Sub-market (EUR/USD forwards) network visualisation

- More **diverse structure**: G16 dealers, banks and other financial institution at the core;
- **Higher participation of non-financial counterparties**;
- Sparse network.



A dynamic view over the sub-markets' structure (1)

- We build an **undirected network** of the three sub-markets considered above (EURIBOR 6M IRS, single-name CDS and EUR/USD forwards) and compute the following measures **between January 2016 and March 2017**:

Measure	Definition	Meaning
Size	The number of nodes in the network.	How many counterparties?
Volume	The number of links between nodes in the network.	How many outstanding trades among counterparties?
Degree	The number of links connected to a node.	How many other counterparties does each counterparty trade with?
Strength	The sum of weights of all links connected to a node.	What is the aggregate outstanding notional of all trades each counterparty is involved in?
Density	The fraction of present connections to possible connections.	How interconnected are counterparties among themselves?

A dynamic view over the sub-markets' structure (2)

	1 EURIBOR 6M IRS	2 Single-name CDS	3 EUR/USD forwards
Size	High but decreasing	Lower than IRS and slightly decreasing	Very high and increasing
Volume	High but decreasing	Lower than IRS and slightly decreasing	Very high and increasing
Average degree	Low and stable	Higher and slightly decreasing; CCPs increasing	Low and stable
Average strength	Increasing, driven by CCPs; high values for G16 too	Slightly decreasing, with the exception of CCPs	Very low and slightly increasing
Density	Low and slightly increasing	Higher than IRS and stable	Low and stable

1. **Slight increase in density and strength** (especially for CCPs) resulting from the clearing obligation; **G16 remain the core** of the network.

2. **Denser network**, with **CCPs acquiring increasing importance** (although clearing obligation only applies to Index products).

3. **Sparse and expanding network**, with the largest number of participants and the highest volume; **G16 and banks playing an increasingly important role**.

Conclusions

- EMIR data are a **powerful tool to monitor OTC derivative markets dynamics**, but still subject to a number of caveats.
- EMIR **data quality challenges** is a result of:
  1. Intrinsic complexity of OTC derivatives markets and products (*we can't do anything about it*);
  2. Incompleteness of regulatory standards and insufficient reporting standardisation (*we can do a lot*).
- **A lot has been done** and the conclusion of the work of UPI/UTI, as well as the entry into force of the new ITS/RTS will bring **further improvements**.
- **Investment in resources** and infrastructure, **better coordination among authorities** as well as more **opportunities for exchange of views** and experience among users will increase the knowledge in the area and **favour a broader use of the data**.