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<u>Market Law and Regulation</u>

Scope and functioning of Central Counterparties (CCPs) in the context of the European Market Infrastructure Regulation in OTC markets: synergies vs. systemic risks

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To my mom and dad.

Abstract

Over-the-counter (OTC) markets have long been considered "dark markets" as they lack transparency in the products being traded, in the market participants and, consequently, in the price discovery process, generating a complex web of mutual interdependence among counterparties. After the 2008 financial crisis, the G20 leaders committed to reform the OTC sector. The main purpose of EMIR is to enhance the OTCD market transparency and reduce systemic risk making all eligible OTCDs contracts subject either to mandatory central clearing through a Central Counterparty (CCP) (Art. 4) or to suitable risk mitigation techniques (Art. 11(3), while all relevant data on outstanding OTCDs and ETDs must be reported to a Trade Repository (TRs)(Art. 9).

In this context, the dissertation investigates the scope and functioning of central counterparties in OTC derivatives markets, with particular focus on *systemic risk*. After providing a general overview on the over-the-counter derivatives markets, it summarises the main features and objectives of EMIR, its current implementation status and future perspectives, including a brief comparison with the USA Dodd Frank Act. Then, functions and characteristics of TRs and CCPs are examined in some details.

Systemic risk is the result of a failure of the market in assessing assets prices and can be seen as a potential negative externality cumulated in the system (a "bubble") that, subject to an unexpected event, may erupt into a crisis, causing the disruption and eventually the collapse of the system, through multiplicative "domino effects", due to financial contagion propagating through interconnectedness. Biased market prices become an incentive to freely ride the system and so to furtherly feed price, moral hazard and systemic risk anomalous trends, inflating the bubble. OTC derivatives, often a tool for speculation, play a critical role in price biasing. The OTCDs trade distribution is right-skewed (with a long right tail), and hence strongly asymmetric, signaling a highly concentrated structure. Mature OTCDs markets and, more generally, financial systems can be represented by scale-free networks. According to network analysis, a system is represented by its *underlying network*, whose nodes are the system elements and connections their interactions. The probability distribution of the variable node degree, the small world character, and the clustering character describe the structure of the network and its connectivity properties (sensitivity to shocks). When connections cannot be considered statistically equiprobable, the network has biases and shows some level of stratification, clustering and concentration, so that individual nodes are not any longer all alike. *Scale-free networks* –typical of many complex information systems– generate from a process of growth and preferential attachment and are characterized by a power law node degree probability distribution, heavily asymmetric, decreasing for increasing node degrees, with a long right tail. There are few *hubs* (giant nodes), with a very high number of connections in comparison to all other nodes, which shape the properties of the network. They have incentives to select and bias information to feed their business and, in doing so, they increase over and over their market power, becoming a primary source of endogenous bias of prices and therefore of systemic risk. In a scale-free network system it will suffice that just one or two hubs default to make the whole financial system collapse. This possibility leads directly to the syndrome commonly known as too-big-to-fail. In a scale-free network system *EMIR OTCDs market scenario*, hubs are subject to CCPs clearing and have become clearing members (CMs) of CCPs. Moral hazard associated to the hubs (now CMs) is minimized, while systemic risk is concentrated in the CCPs. Since networks can be mathematically represented through matrices and these allow for quantitative methodologies, network analysis permits calculations of the financial requirements for CCPs and CMs. There exists no capitalization threshold below which the system may collapse. The stability of the scale-free network financial system depends solely on CCPs.

The dissertation is completed with the possible impact of distributed ledger technologies (DLTs) in the securities markets' post-trading landscape (clearing and settlement of transactions). This revolutionary technology could speed the processing of transactions and facilitate information reporting, while significantly reducing expenses and enhancing security. In this setting, the major role played by CCPs in OTC markets could be potentially overcome.

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Introduction

Over-the-counter (OTC) markets have long been considered "dark markets" as they lack transparency in the products being traded, in the market participants and, consequently, in the price discovery process, generating a complex web of mutual interdependence among counterparties. The 2008 financial crisis highlighted the major shortcomings of the OTC sector, which put pressure on regulators to effectively address these issues. Following the 2009 Pittsburgh Summit, the G20 leaders committed to reform the OTC sector to foster financial stability, improve transparency in derivatives markets, mitigate counterparty and system risks, reduce the degree of interconnections among market participants and protect against market abuse. The outcome was the European Market Infrastructure Regulation (EMIR), which seeks to achieve the regulators' objectives by mandating all standardised OTC derivatives fulfilling some specific conditions to be centrally cleared through central counterparties (CCPs), i.e. financial market infrastructures that stand between counterparties to the contracts traded on one or more financial markets, becoming the buyer to every seller and the seller to every buyer. For any OTC derivative that is not clearing eligible, risk mitigation practices must be applied. Moreover, all structured finance products (both over-the-counter and exchange traded derivatives) must be reported to trade repositories (TRs), regardless of their clearing eligibility. *Trade repositories* are registries that centrally collect and maintain electronic databases on derivatives contracts traded OTC and through exchanges.

Lastly, EMIR outlines organisational business conduct and prudential standards for both TRs and CCPs, to ensure their sound and resilient operation.

The OTC sector is mostly characterised by few large market participants which negotiate considerable volumes of OTC derivative contracts. All the other players account for a minor share of the market. While these minor counterparties are not systemically significant, the default of one of the large counterparties can cause great distress to the financial system. This is the reason why the OTC derivatives market can be considered as a potential generator of *systemic risk*. More specifically, the bankruptcy of one large institution can provoke losses or even the default to other large financial institutions. This, in turn, can lead to more and more losses and defaults, eventually causing the collapse of the financial system. In this setting, central counterparties play an increasingly important role in Europe and are considered fundamental financial market infrastructures and key pillars of the European financial system. By interposing itself between an OTC transaction, the CCP effectively guarantees the obligations under the contract agreed by the two counterparties: if one counterparty defaults, the other is preserved thanks to the default management processes and internal resources of the CCP. Moreover, by centralising transactions, CCPs are able to simplify the complex web of mutual interdependencies, thereby reducing the overall level of exposures and making the trading network more transparent.

Therefore, CCPs can represent real assets for the financial markets. However, if not appropriately operated, CCPs' own functioning features imply potential risks for the stability of the system. In fact, the central role of a CCP in financial markets and its interconnectedness with other market participants are the main determinants of its systemic importance, which increase the risk of contagion in the event of financial distress. In extreme cases, the (very unlikely) default of a CCP could have a domino effect on financial markets, propagating to other markets and to other market participants, causing losses and liquidity shortages across the financial system, and, in very severe situations, leading to the default of one or several banks, CCPs and other financial entities. This defines the CCPs' *too-interconnected-to-fail* nature. Therefore, measures to protect the CCPs from default are absolutely the most important ones, since the whole vulnerability of the financial system is now concentrated in the CCPs. If they default, the system defaults. However, in spite of their robustness, CCPs will not work properly if they cannot rely on complete and adequate information on the OTC derivatives transactions. So, the supporting functions of trade repositories are also essential to establish an acceptable low level of risk.

The purpose of this dissertation is to investigate the scope and functioning of central counterparties in OTC markets, with particular focus on *systemic risk*, in the context of the European Markets Infrastructure Regulation (EMIR). More specifically, *Chapter 1* provides a general overview on the over-the-counter derivatives markets, with a detailed analysis of the standardised structured finance products that are subject to central clearing, namely credit default swaps, interest rate swaps and non-deliverable FX forward agreements. *Chapter 2* summarises the main features and objectives of EMIR, the current implementation status of the Regulation and an insight on what to expect in the near future. Moreover, it displays a brief introduction to the American equivalent of EMIR, the Dodd Frank Act and a comparison between the EU regime vs. the US regime. In *Chapter 3*, the reporting system arising from the function of trade repositories will be introduced and explained in all its main aspects. *Chapter 4* explains the clearing system, namely CCPs operational framework, the key benefits and major risks associated with central clearing, as well as the main rules that ensure the soundness and reliability of this financial market infrastructure. Taking forward a suggestion of the European Commission, *Chapter 5* proposes an introduction to a possible qualitative and quantitative network analysis of systemic risk in OTC markets based on Network Theory. It also draws some considerations on the potentialities that network analysis offers to regulators. Lastly, *Chapter 6* outlines the possible impact of distributed ledger technologies (DLTs) in the securities markets' post-trading landscape (clearing and settlement of transactions). In fact, this revolutionary technology (which is currently only applied to crypto-currencies) could speed the processing of transactions and could facilitate information reporting on the counterparties to the transactions and on the securities being traded, while significantly reducing expenses and enhancing security. In this setting, the major role played by CCPs in OTC markets could be potentially overcome.

I. The over-the-counter (OTC) derivatives market

Over-the-counter (OTC) markets have long been considered “dark markets” as they lack transparency in the products being traded, in the market participants and, consequently, in the price discovery process. Following the 2008 financial crisis, the G20 leaders committed to reform the OTC sector to foster financial stability. The main instruments devised to achieve their objectives are central counterparties (CCPs) and trade repositories (TRs). CCPs centralise standardised OTCD transactions becoming the buyer to every seller and the seller to every buyer. TRs are registries which store data on all derivative contracts for public disclosing. Together, CCPs and TRs mitigate counterparty risk, reduce the complex web of interdependencies between market participants and foster transparency in the OTC sector. This overall design was translated into detailed rules, giving birth to a new piece of legislation at the European level, namely the European Markets Infrastructure Regulation (EMIR).

1. Exchange Traded Derivatives (ETDs) and OTC derivatives

A *derivative* is a structured finance product which derives its value from an underlying asset or a basket of assets[1] (e.g. equities, commodities, FOREX, interest rates, etc.). The main objective of derivatives is to reallocate risk among the market participants involved in the contract. Derivative contracts can be used for hedging (protection against risk) or for speculation (pursue of economic returns from price changes). The extent of standardisation of derivative contracts may differ, “ranging from full standardisation of parameters, such as notional value or maturity, to bespoke contracts that are fully tailored to the specific needs of a particular user”[2].

There are two main categories of derivatives: exchange traded derivatives and over-the-counter derivatives.

Exchange traded derivatives (ETDs) are structured finance products that present a high degree of standardisation (in terms of specific delivery and settlement terms) and they are *anonymously* traded through trading venues, namely regulated markets. In this setting, a *regulated market* is defined as a market authorised under MiFID[3], or a Third-Country market considered as equivalent under MiFID. In other words, if counterparty A sells an ETD to counterparty B, the regulated market will act as the buyer to A and as

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[1] See definition https://www.thebalance.com/what-are-derivatives-3305833.

[2] See EMIR Amendment Impact Assessment Report, May 2017.

[3] Markets in Financial Instruments Directive, 2004.

the seller to B (i.e. clearing house). In fact, the booking (i.e. clearing and settlement) of ETDs is carried out by a *clearing house*, which becomes the counterparty to all trades. There are three main advantages arising from ETDs: (i) derivative contracts must have a high level of standardisation because the exchange is the counterparty to all market participants, (ii) market participants are not exposed to credit risk thanks to the market participants' anonymity and centralisation of transactions through the exchange and, (iii) operating through a regulated trading venue eases the price discovery process, increases transparency and enhances liquidity (Heckinger, 2013).

An *over-the-counter derivative* (OTCD) is a customised financial contract bilaterally traded between the market counterparties (private negotiation). In other words, an OTCD is a contract involving some level of standardisation which allows for it to be tailor-made to meet the counterparties' risk preferences. However, although this contract is very flexible, there are three main disadvantages: (i) the value to the buyer of the derivative contract will depend on the credit-worthiness of the OTCD seller (if the seller defaults, the contract becomes worthless), (ii) it is very difficult to transfer the OTCD to a third-party because of the customisation of the contract, and (iii) it is very challenging to infer the true market price of the OTCD due to the lack of transparency in the pricing process and to the difficulty in valuing ad-hoc single contracts uniformly on a large scale. In general, OTCDs are different from ETDs in many ways. First, the trading counterparties are free to set their own negotiation terms (reflecting their risk preferences). Second, derivatives trades are executed through dealers (and not through exchanges) which in turn trade among themselves. Lastly, bilateral trading entails direct counterparty credit risk, which must be managed by the counterparties involved in the transaction (Heckinger, 2013). EMIR defines OTC derivatives as all derivatives which are not executed on a regulated market.

These opposing peculiarities of the OTC market and exchanges mean that these two markets are complementary by supplying a trading platform to satisfy different business needs (Nystedt, 2004). In fact, ETD markets enjoy a greater price transparency than OTC markets and carry smaller counterparty risk due to the daily centralisation of trades through clearing houses; whereas OTC markets' flexibility allows for a better fulfilment of trades that do not have a large volume or have special requirements. In this setting, OTC markets act as incubators for new financial instruments (Chui, 2012). Moreover, Hull (2010) believes that OTC derivatives markets were created to allow end-users to handle their risk exposures more effectively than is achievable with ETDs thanks to the advantage of OTCD markets, which enable to meet the specific needs of a counterparty.

2. *The OTC derivatives: potential source of systemic risk and instruments for speculation*

The OTC sector is characterised by private negotiations between multiple counterparties with limited public disclosure of information. The bilateral nature of these transactions generates a complex web of mutual interdependence. Paired with lack of transparency, this produces a situation in which it is challenging for both market participants and regulators to thoroughly understand the real nature and levels of the risk to which market participants are exposed (European Commission, 2009). This causes uncertainty to grow in case of market distress and, consequently, impairs financial stability (as highlighted by the 2008 financial crisis).

In particular, OTC markets are mostly characterised by few large market participants which negotiate considerable volumes of OTC derivative contracts. All the other players account for a minor share of the market. While these minor counterparties are not systemically significant, the default of one of the large counterparties can cause great distress to the financial system. This is the reason why the OTCD market can be considered as a potential generator of systemic risk. More specifically, the bankruptcy of one large institution can provoke losses or even the default to other large financial institutions. This, in turn, can lead to more and more losses and defaults, eventually causing the collapse of the financial system.

As stated above, derivatives are structured finance products whose original purpose is that of trading and redistributing risks generated in the real economy and are, therefore, significant tools for economic entities to transfer risk. Originally, derivatives were introduced to insure against risk. However, these financial instruments have increasingly been negotiated with the purpose of making a profit (speculation or arbitrage). *Speculation* refers to a type of investment activity in which the market participants make a bet on the direction of the price fluctuations of an underlying asset (not directly owned by the investor) through an agreement with another counterparty. In fact, financial institutions can take significant risks through OTCDs transactions. In the last three decades, derivative products have been linked with several credit distresses. In the 90s, P&G Corporation lost more than USD 100 million in equity swaps. By the end of 1994, Orange County went on default after losing USD 1.6 billion caused by a wrong

bet on interest rates. In 1995, Barings went bankruptcy when one of its traders lost USD 1.4 billion in negotiating equity index derivatives. In 2001, Enron Corporation collapsed. Enron's derivatives operations were mostly based on the prices of oil, gas and electricity, which were instruments traded through highly unregulated markets with no disclosure obligation. Also many large financial entities such as Bear Stearns, Merrill Lynch and AIG have engaged in highly risky speculative activities in the first ten years of the 21st century. The case of AIG was particularly severe. The company was selling CDSs as a protection against the potential losses on the securitised financial instruments generated from subprime mortgages, i.e. mortgage-backed securities (MBSs) and collateralised debt obligations (CDOs). With the beginning of the 2008 financial crisis the company was downgraded below AA. As a consequence, AIG needed to repay many of its counterparties but was not able to do so. AIG avoided to go on default thanks to the US government, which injected USD 85 billion funds. Other colossal institutions have not had the same luck as AIG, such as Lehman Brothers, which went on default in 2008 becoming one of the biggest financial cracks in history.
These events highlighted the importance to strengthen regulations in derivatives negotiations and improve financial stability.

3. Need for transparency in OTC derivatives markets

OTC markets are often referred to as opaque markets, as they are not able to publicly report trading information. In the 2008 Great Recession, dark trading hampered the price discovery process, and, as a result, deterred market participants from negotiating. The deficiency of transactions lowered market liquidity, which challenged even more the price discovery and caused round-two of liquidity deterioration (Zhong, 2012). When trading in OTC markets, it is crucial to gather the best *trade quote* through searching and negotiating with possibly fragmented liquidity suppliers. However, the availability of such trade data, known as *pre-trade transparency*, is very constrained to market participants in OTC markets. As a result, the price discovery process can be potentially burdensome to investors (Duffie, 2012). Transparency is always a relevant factor to consider when engaging into market transactions. To enhance lit markets, *pre-trade* and *post-trade transparency* would be necessary (Chen, 2014). *Pre-trade transparency* refers to the public disclosure of the trading information ex-ante the settlement of the transaction (such as trade interest and quotations), whereas *post-trade* *transparency* refers to the public disclosure of the trade data ex-post the settlement of the transaction (such as prices and volumes).

The collapse of Lehman Brothers, the almost default of Bear Sterns and the bail-out of AIG showed such functional weaknesses in the structure of the OTCD market. Such shortcomings involved (i) amplification of large counterparty exposure among market participants which were not adequately risk managed, (ii) risk of contagion generated by the high interconnectedness among market participants, and (iii) lack of transparency on the total market participants credit risk exposures, which led to a loss of confidence and of liquidity in times of market distress. The Great Recession put the OTCD market at the centre of regulatory scrutiny.

Since the OTCD market is global in nature, the Group of 20 decided to cooperate and commit to address the weaknesses of such market and to increase financial stability, improve market transparency in the derivatives market, mitigate systemic risk and protect against market abuse. In the 2009 Pittsburgh Summit, the international leaders conceived five commitments to restructure the OTC derivatives market:

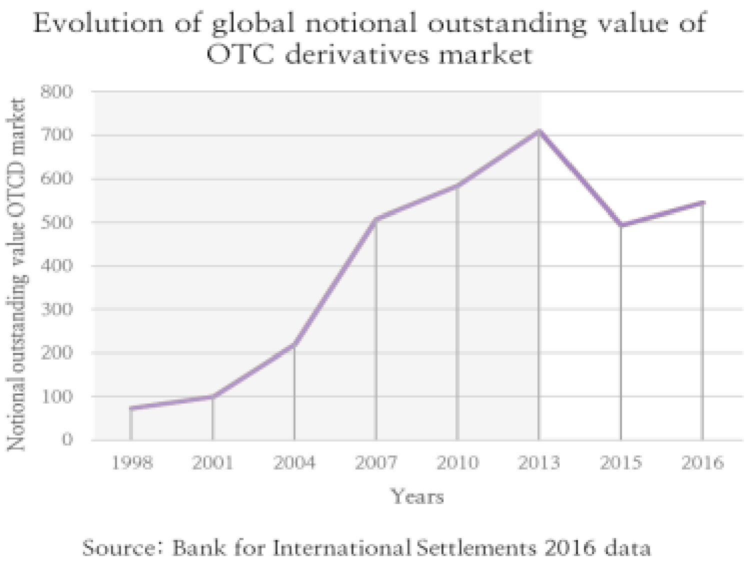
- Standardised OTC derivatives should be centrally cleared;
- Non-centrally cleared derivatives should be subject to higher capital requirements;
- Non-centrally cleared derivatives should be subject to minimum standards for margin requirements;
- OTC derivatives trade information should be reported to trade repositories;
- Standardised OTC derivatives should be traded on exchanges or electronic trading platforms, where appropriate.

Moreover, the Financial Stability Board (FSB) measured that the 2008 financial crisis generated a loss in global output of nearly 25% of global GDP, in comparison to the pre-crisis levels. Therefore, the benefits of lowering the probability of future financial crises, to which the reforms on OTCD markets are believed to contribute, are possibly very significant. Since OTCD markets are global, it is crucial to have productive international collaboration and, where suitable, coordination to accomplish enforcement and supervisory requirements, minimise the risk of regulatory arbitrage, and thoroughly and consistently implement the G20’s commitments.

At the European level, the European Markets Infrastructure Regulation (EMIR) enforced the G20's engagement to enhance OTCD market stability. Analogous actions were implemented over the G20 jurisdictions (such as in some Asian countries) and in the US through the Dodd Frank Wall Street Reform and the Consumer Protection Act (dated July 2010).

4. *Empirical data on OTC derivatives market*

After the declining trend observed since 2013, the notional outstanding value[4] of OTC derivatives has recently started to increase, growing from USD 493 trillions in 2015 to USD 544 trillions in 2016, although remaining under the peak of USD 710 trillion reached by the end of 2013. This trend reversal can be seen from Figure 1 below.



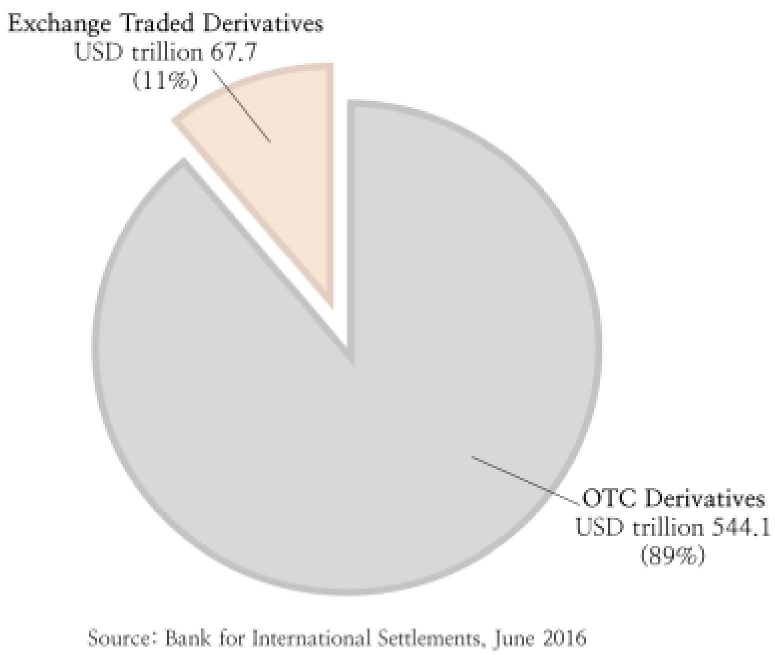
<u>Figure 1</u> – Evolution of the global outstanding notional value of the OTC derivatives market over the period 1998-2016 (with special focus from 2013 to 2016).

Moreover, also the gross market value of OTC derivatives, i.e. the cost of replacing all outstanding derivative contracts at the current market prices (BIS, 2016), which was following a decreasing path since 2007, started increasing after 2013. More specifically, it raised from USD 14.5 trillions in 2015 to USD 20.7 trillions in 2016 (Figure 2).

[4] Total amount of a financial instrument's underlying asset at its spot price.

<u>Figure 2</u> – Evolution of the global gross market value of the OTC derivatives market over the period 2001-2016.

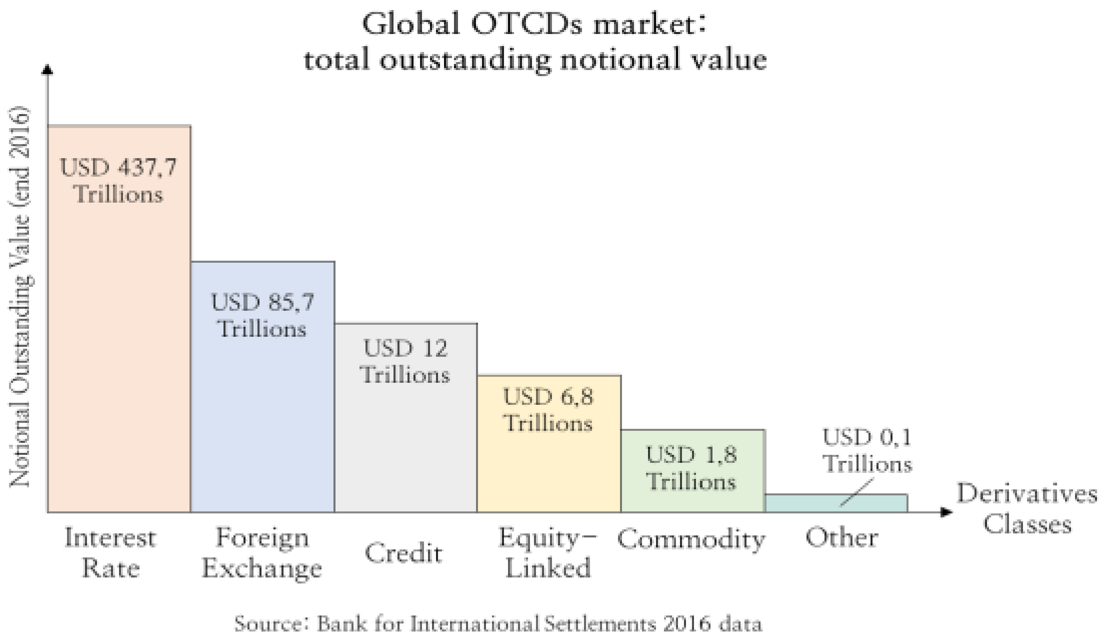
The volume of OTCD activity is in hundreds of trillions. As stated above, by the end of June 2016, the global notional outstanding value of OTCD added up to USD 544 trillion, that is, 89% of the total value of the derivatives market (Figure 3). OTC derivative contracts have therefore a significant impact on the real economy and on the financial system.



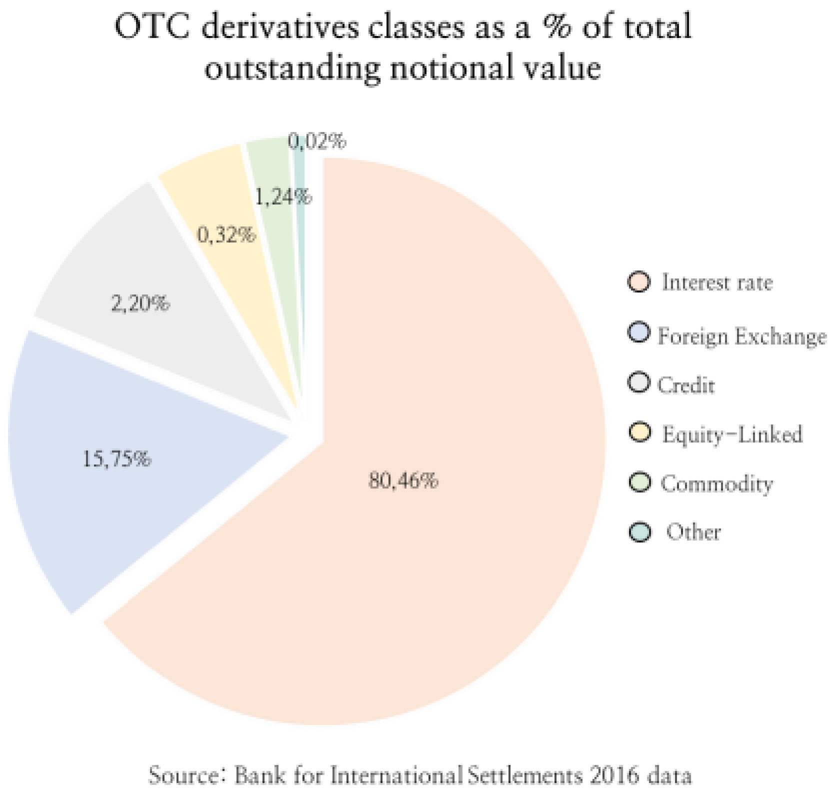
<u>Figure 3</u> – OTCDs and ETDs share of overall derivatives market.

Despite helping market counterparties manage their risks, enhancing risk pricing and promoting liquidity, thus playing a relevant role in the economy and benefiting financial markets, derivatives also carry some risks. The 2008 financial crisis displayed such risks, when important shortcomings in the OTC derivatives market came to light. During the fueling of the housing bubble, investments in OTCDs increased drastically. The Bank for International Settlements (BIS) estimated that the value of all outstanding OTCD contracts amounted to USD 683.7 trillions by the end of June 2008, which corresponds to a 15% increase with respect to that of December 2007.

In general, the five major classes of OTC derivative contracts are equity, commodity, credit, interest rate and currency (FOREX). Figure 4 shows the notional value for each class of derivatives, while the pie chart in Figure 5 represents the notional value of each asset class as a percentage of the total outstanding notional value of the OTC derivatives market.



<u>Figure 4</u> – Notional value of each class of derivatives (end-June 2016).



<u>Figure 5</u> - Notional value of each asset class as a % of the total outstanding notional value of the OTC derivatives market.

As can be seen from Figure 4 and Figure 5, the derivative contracts that are mostly traded are on interest rate (80,46%), which are the simplest and cheapest to standardise (Deloitte, 2014), and on foreign exchange (15,75%). The remaining derivatives contracts, credit (2.20%), equity-linked (0.32%), commodity (1,24%) and other (0.02%) only account for a small portion of the OTCD markets. This may be due to the fact that these types of contracts are more difficult to standardise, especially equity-linked derivatives, which carry the most expensive standardisation process.

5. "Standardised" OTC derivatives and "non-standardised" derivatives

In 2010, the Committee of European Securities Regulator (CESR) published in a Consultation Paper the concept of standardisation. *Standardisation* has three main dimensions: (i) standardisation of the legal terms of the contracts, i.e. legal uniformity (such as applicable law and dispute resolution mechanisms), (ii) process uniformity and automation (straight-through processing matching, confirmation, settlement and event handling) and, (iii) standardisation of the economic terms of the contracts, i.e. product uniformity (such as the maturity of the contract and payment structure).

Standardisation can be very useful. Trading under a structure of broadly accepted, standard contractual conditions promotes legal certainty and reduces legal risk. In addition, standardisation fosters operational efficiency, by enabling the automation of the mechanism of trading and post-trading value chain (European Commission, 2009). Standardisation could also mitigate counterparty credit risk, as it allows for a greater use of CCP clearing services or exchange trading and facilitates the reporting and sharing of information for regulatory purposes. Overall, standardisation seeks to deliver efficient, safe and healthy derivatives markets.

It is important to keep in mind, as stated by the Nordic Association of Securities, that a sufficient or high degree of standardisation is not a synonymous for clearing-eligibility. Rather, it is a necessary but not sufficient condition. In fact, to become clearing eligible, among other things, (i) an OTC derivative product must display a sufficient/high degree of standardisation, (ii) it must be traded by specific market participants, and (iii) the volume of the transaction must exceed certain clearing thresholds. These issues will be addressed in more detail in the following chapters.

However, it is very unlikely that all OTC derivatives contracts become standardised. There are two main reasons for this: (i) some structured finance products are far too complex to meet the basic standard requirements and restructuring such contracts would be too costly and, (ii) OTC derivatives' function to protect against risk may be hampered by excessive standardisation, as specific risk profiles could not be fully hedged (Hull, 2010).

The OTC derivatives classes which present a sufficient degree of standardisation and which could be clearing eligible (under EMIR) are credit, interest and foreign exchange derivatives. More specifically, credit default swaps (CDSs), interest rate swaps (IRSs) and non-deliverable FX forward agreements.

5.1. OTC credit derivatives and credit default swaps (CDSs)

A *credit derivative* is a type of structured finance product in which the default or credit risk (i.e. the risk that the loan will not be repaid) is sold by the lender of the loan to a counterparty.

A *credit default swap* (CDS) is the most popular type of OTC credit derivative and may be related to municipal bonds, emerging market bonds, corporate bonds and mortgage-backed securities (MBS).

More specifically, it is a type of *swap contract* structured to transfer the credit exposure of fixed-income financial instruments between two or more counterparties (Augustin et al., 2016). In a CDS, there are three parties to the agreement: (i) the lender, who is the CDS buyer, (ii) the issuer of the loan (borrower) and, (iii) the CDS seller. The swap's buyer (holder) makes streams of payments to the swap's seller until the maturity of the swap is reached. In exchange, if the debt issuer defaults, the swap's seller agrees to give the buyer the principal and all the interest payments that would have been paid from the time of the default to the maturity date of the CDS. Therefore, a CDS functions as an *insurance* against non-payment. In fact, by means of such swaps, the buyer can reduce the investment's risk by transferring all or part of such risk to an insurance company or other sellers of CDS, by paying a periodic fee (Anthropelos, 2010). In other words, it is a contract that insures against default events. Therefore, on the one hand, the buyer of a CDS is guaranteed with credit protection; on the other hand, the seller of the CDS ensures the credit worthiness of the debt financial instrument. If the debt issuer does not default, the CDS buyer will make losses equal to the fees payed to the CDS seller. However, if the buyer did not receive protection, he could lose as much as his entire investment. In this setting, it is clear that the more the buyer of a security (the lender) believes its issuer (the borrower) could default, the more attractive the CDS becomes but also the higher its cost will be. Therefore, the price of the CDS reflects the market assessment of the borrower's default probability.

Under the EMIR framework, ESMA has suggested central clearing for two types of credit derivatives, which are summarised in Table 1 below.

OTC credit derivatives classes

Type	Sub-type	Geographical zone	Reference index	Settlement Currency	Tenor+
Index CDS	Untranched index	Europe	iTraxx Europe Main	EUR	5 years
Index CDS	Untranched Index	Europe	iTraxx Europe Crossover	EUR	5 years

+ Tenor refers to the amount of time left for the repayment of a loan or until a financial contract expires

Source: ESMA, last update 11 July 2017

<u>Table 1</u> – OTC credit derivatives subject to central clearing under EMIR.

An *index CDS* is a type of credit derivative used for hedging against credit risk or to enter in a basket of credit entities. Contrary to OTC CDS, an index CDS is a fully standardised financial instrument and, consequently, offers a liquidity and a lower bid-ask spread advantage (Calice, 2012). Therefore, hedging a portfolio would be less expensive by means of index CDS (instead of opening several long positions om many individual CDSs to obtain an equivalent result). Moreover, these standardised derivatives are used as benchmarks by (i) investors owning bonds, who seek insurance against default and, (ii) by traders, who are willing to speculate on fluctuations in credit quality.

(i) Credit default swap risks

The CDS market is an OTC market where most transactions are carried out by large financial intermediaries. These market participants enter long and short insurance positions to get protection in case other large financial institutions default. Since the issuer of the CDS (usually banks) can default, the holder of the CDS faces *counterparty risk*. To get a concrete idea, assume that Bank A sells a CDS against Bank B (i.e. to provide insurance to a counterparty in the event B goes bankrupt). The price of the CDS will then reflect the single probability that Bank B goes on default and the joint probability that both Bank A and Bank B default. Therefore, the CDS buyer is faced with the possibility of not receiving the guaranteed payment from Bank A, if the default of Bank B causes the default of Bank A.

Therefore, counterparty risk can reduce considerably the CDS spread (i.e. the value of the insurance) if the risk that the two banks default simultaneously (joint default) is significant, for example during systemic risk episodes, such as crises (Oehmke and Zawadowski, 2016)[5]. In the extreme situation in which the default of the seller (in the previous example, Bank A) and the default of the reference entity (in the previous example, Bank B) are simultaneous, the buyer should receive a payment equal to the total notional value of the credit default swap (a very significant claim against the defaulted counterparty). Moreover, if the CDS buyer is at risk of not getting paid at the time the CDS contract is expected to pay off, the *ex-ante* notional value of the CDS decreases. Giglio (2016) furthers this argument adding that the CDS buyer could also face considerable losses even if there is no simultaneous default of the issuer and the seller of the contract. In fact, it may happen that the reference entity defaults ex-post the seller's default and vice versa. These two scenarios are referred to as double default cases. In general, the value of the insurance mostly depends on how much the buyer of

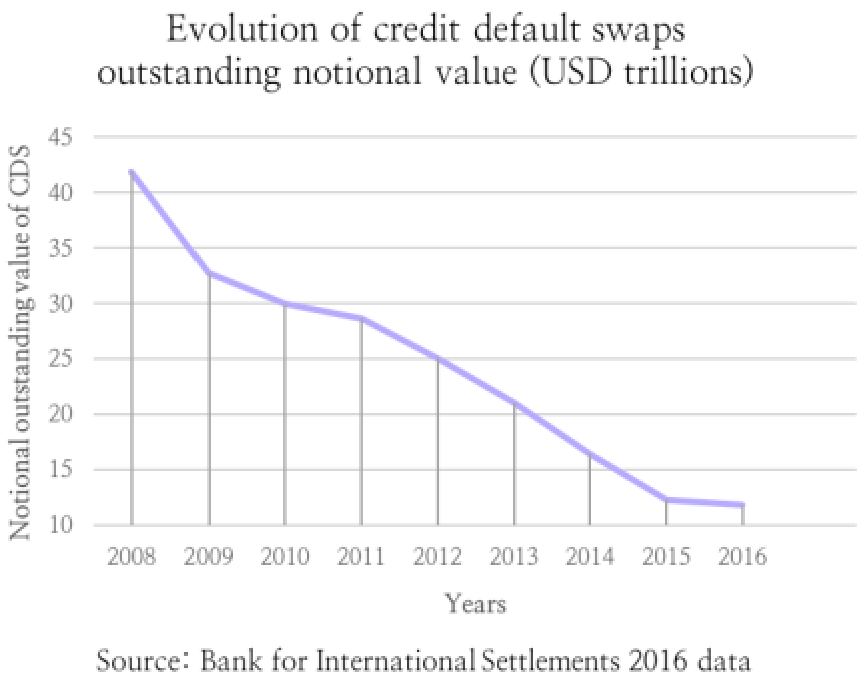
[5] If the probability of joint-default is high, the value of the CDS would drop, reflecting the lower possibility of being fully insured by the issuer of the CDS. In this setting, investors would not find such contracts appealing.

CDS expects to recover from the defaulting counterparty. Similar to other structured finance products, credit default swaps claims are secured by safe harbor provisions, which “exempt claimants from the automatic stay of the assets of the firms, so that the buyers can immediately seize any collateral that has been posted for them” (Weistroffer, 2009). Moreover, it is possible to net transactions with the same counterparty but across different classes of derivatives against each other. For all the outstanding positions that are left unmatched after the netting and after having posted collateral, “the buyer is an unsecured creditor in the bankruptcy process, and as such is exposed to potentially large losses” (Roe, 2011).

Concurrently, the price of bonds issued by banks is not influenced by counterparty risk, because this price represents only the probabilities of individual defaults. Therefore, the prices of bonds and credit default swaps written by financial institutions against other financial institutions incorporate information on individual and joint defaults of such institutions (Weistroffer, 2009).

(ii) Empirical data on CDSs

The credit default swap market has been rapidly decreasing in the last years. The notional outstanding value of the CDS market has increased from USD 5 trillions in 2004 to around USD 60 trillions in 2007, when it reached its peak. However, the 2008 global financial crisis started a trend reversal. In 2008, the notional outstanding value of CDS dropped down to around USD 40 trillions and since then, the path has always been decreasing. The most recent data from the Bank of International Settlements (BIS, 2016) show that the total outstanding value of CDS kept falling, from USD 12.3 trillions in 2015, to USD 11.8 trillions in the first half of 2016, to USD 9.9 trillions in the second half of 2016. The evolution of the CDS market can be seen in Figure 6, below.



<u>Figure 6</u> – Evolution of credit default swaps (CDS) outstanding notional value (USD trillions) over the period 2008-2016.

The fall in the total credit default swaps positions has been mostly due to the contraction of *intra-dealer* transactions[6]. In fact, the notional value of CDS contracts carried out between intra-dealers has fallen from USD 5.5 trillions in 2015 to USD 3.7 trillions in 2016. The notional value with other financial institutions has also decreased, from USD 0.9 trillions in 2015 to USD 0.6 trillions in 2016. At the same time, the notional value of centrally cleared CDS contracts was, on average, unchanged at USD 4.3 trillions. This downfall of the non-cleared sector is likely to have been mostly caused by higher margin requirements for non-centrally cleared derivatives (BIS, 2016).

5.2. OTC interest rate derivatives and interest rate swaps (IRSs)

An *interest rate derivative* is a financial product whose value depends on interest rates' fluctuations and are generally used for hedging purposes against interest rate risk or to adjust (increase or decrease) the risk profile of the holder of the financial instrument and it involves the exchange of cash flows at a specified date in the future.

Interest rate swaps (IRS) are a type of interest rate derivative and they account for the greatest share of the global OTCD market, around 80 to 90% based on the assessment

[6] Through trade compression activities carried out by central counterparties.

techniques used (ISDA Europe Conference Speech by ESMA's chair Steven Maijoor (2015/1417)).

In an IRS, there are two counterparties to the transaction: one counterparty which receives the stream of interest payments based on a floating rate[7] (floating leg) and pays a stream based on a fixed rate (fixed leg); the other counterparty receives the fixed leg and pays the floating leg.

On July 11th 2017, ESMA released the final regulatory technical standards in relation to the clearing requirement of IRSs. The classes of IRS that are subject to central clearing are (i) basis IRS, (ii) fixed-to-float IRS, (iii) forward rate agreements and, (iv) overnight index swaps.

Basis interest rate swaps. A Basis IRS is a type of interest rate swap for which settlement is in the form of periodic floating interest payments for both counterparties, based on interest rate benchmarks over a term to maturity. The interest rate payments are exchanged for a specified period based on a notional amount (ICAP, 2013).

OTC interest rate derivatives classes: basis swap classes

Type	Reference index	Settlement currency	Maturity	Settlement currency type	Notional type
Basis	EURIBOR	EUR	28days-50years	Single currency	Constant or variable
Basis	LIBOR	GBP	28days-50years	Single currency	Constant or variable
Basis	LIBOR	JPY	28days-30years	Single currency	Constant or variable
Basis	LIBOR	USD	28days-50years	Single currency	Constant or variable

Source: ESMA, last update 11 July 2017

<u>Table 2</u> – OTC interest rate derivatives: basis interest rates swaps

Fixed-to-float interest rate swaps. A fixed-for-floating swap is a beneficial bilateral contract through which one counterparty pays a fixed rate, while the other pays a floating rate over a term to maturity. Counterparties can benefit from a fixed-to-float IRS because they can swap each other's interest rates to match their interest rate preferences. Table 3 summarises the types of fixed-to-float IRSs that ESMA defines as clearing eligible.

[7] Such as the LIBOR rate.

OTC interest rate derivatives classes: fixed-to-float interest rate swaps

Type	Reference index	Settlement currency	Maturity	Settlement currency type	Notional type
Fixed-to-float	EURIBOR	EUR	28days-50years	Single currency	Constant or variable
Fixed-to-float	LIBOR	GBP	28days-50years	Single currency	Constant or variable
Fixed-to-float	LIBOR	JPY	28days-30years	Single currency	Constant or variable
Fixed-to-float	LIBOR	USD	28days-50years	Single currency	Constant or variable
Fixed-to-float	NIBOR⁕	NOK	28days-10years	Single currency	Constant or variable
Fixed-to-float	WIBOR✦	PLN	28days-10years	Single currency	Constant or variable
Fixed-to-float	STIBOR‡	SEK	28days-15years	Single currency	Constant or variable

⁕ Norwegian Interbank Offered Rate ✦ Warsaw Interbank Offered Rate ‡ Stockholm Interbank Offered Rate

Source: ESMA, last update 11 July 2017

<u>Table 3</u> – OTC interest rate derivatives: fixed-to-float interest rate swaps

Forward rate agreements (FRAs). A forward rate agreement (FRA) refers to an over-the-counter bilateral contract that assesses the interest rate (or foreign exchange rate) to be paid or received on a duty starting at a future start date and the interest rate payments are exchanged based on a notional amount. Moreover, the FRA determines the rates to be used along with the termination date and the notional value. FRAs are cash settled with the payment based on the net difference between the interest rate and the reference rate in the binding agreement (Fleming, 2012). Table 4 summarises the type of FRAs subject to central clearing.

OTC interest rate derivatives classes: forward rate agreements

Type	Reference index	Settlement currency	Maturity	Settlement currency type	Notional type
FRA	EURIBOR	EUR	3days-3years	Single currency	Constant or variable
FRA	LIBOR	GBP	3days-3years	Single currency	Constant or variable
FRA	LIBOR	USD	3days-3years	Single currency	Constant or variable
FRA	NIBOR⁕	NOK	3days-2years	Single currency	Constant or variable
FRA	WIBOR✦	PLN	3days-2years	Single currency	Constant or variable
FRA	STIBOR‡	SEK	3days-3years	Single currency	Constant or variable

⁕ Norwegian Interbank Offered Rate ✦ Warsaw Interbank Offered Rate ‡ Stockholm Interbank Offered Rate

Source: ESMA, last update 11 July 2017

<u>Table 4</u> – OTC interest rate derivatives: forward rate agreements

Overnight index swaps (OISs). An OIS is a type IRS which involves the overnight rate being exchanged for a fixed interest rate. An overnight index swap makes use of an overnight rate index, (for example, the FedFunds), as the underlying rate for its floating leg, while the fixed leg would be based on a set rate (Whittall, 2010). Table 5 summarises the type of OISs subject to central clearing.

OTC interest rate derivatives classes: overnight index swap classes

Type	Reference index	Settlement currency	Maturity	Settlement currency type	Notional type
OIS	EONIA	EUR	7days–3years	Single currency	Constant or variable
OIS	FedFunds	USD	7days–3years	Single currency	Constant or variable
OIS	SONIA	GBP	7days–3years	Single currency	Constant or variable

❖ EONIA (Euro Overnight Index Average) is the reference rate computed as a weighted average of all overnight unsecured lending transactions in the interbank market, undertaken in the EU.
★ FedFunds is the interest rate at which a depository institution lends funds maintained at the Federal Reserve to another depository institution overnight.
◉ SONIA is the Sterling Overnight Index Average. It reflects bank and building societies' overnight funding rates in the sterling unsecured market.

Source: ESMA, last update 11 July 2017

Table 5 – OTC interest rate derivatives: overnight index swap classes

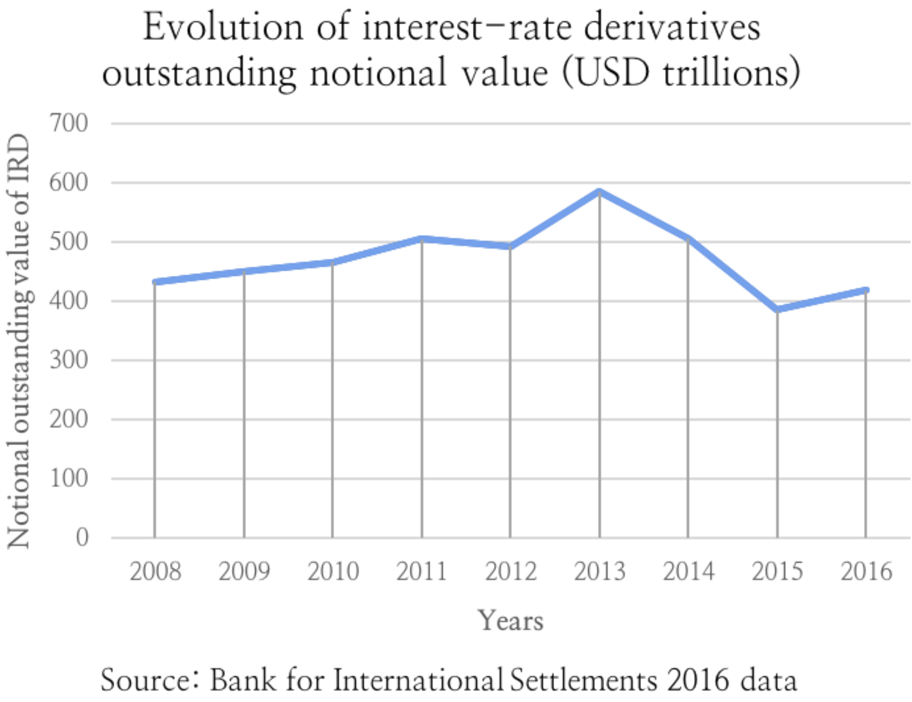
(i) Interest rate swap risks

There are two major types of risks linked to interest rates swaps: (i) interest rate risk and (ii) counterparty risk. *Interest rate risk* involves both counterparties and it is important to manage it because fluctuations may be unpredictable. The fixed leg's holder is exposed to an increase in the variable interest rate, therefore facing a loss in interest that she would otherwise have received. The floating leg's holder is exposed to a decrease in the variable interest rate, which would cause a loss in the variable cash flow stream payments made by the fixed leg holder. *Counterparty risk* refers to the risk that one of the counterparties engaged in the swap agreement will not be able to fulfil its obligations, thereby going on default. For example, the default of the variable leg holder will cause credit exposure (to fluctuations in interest rate) to the fixed leg holder, which is exactly the type of risk that the fixed leg's holder is willing to mitigate.

The default of counterparties in swap agreements was one of the main causes of the 2008 financial crisis. In the U.S., the government has tried to increase transparency and diminish systemic risks in swap transactions by implementing the Dodd-Frank Act (i.e. the American equivalent of EMIR), which imposes the trading of most swaps on ad-hoc "swap execution facilities" (opposite to OTC) and it also mandates public disclosure of swap trade data.

(ii) Empirical data on interest rate derivatives and IRSs

The notional outstanding value of interest-rate derivatives has followed an increasing trend until 2013. From 2013 to 2015 it decreased quite significantly, and since 2015 it started increasing again (as can be seen from Figure 7 below).



<u>Figure 7</u> – Evolution of interest-rate derivatives outstanding notional value (USD trillions) over the period 2008-2016.

Outstanding notional value of interest rate derivatives experienced a large drop in the first-half of 2015, triggered by the fall in euro-denominated interest rate derivatives, from EUR 138 trillion in 2014 to EUR 113 trillion in 2015. *Trade compression*[8] was the main reason for this decline. Wooldridge (2016) defines trade compression as "a process through which the number of outstanding OTC derivative (and therefore, the notional outstanding value) contracts is lowered, while maintaining the same economic exposure". In fact, the total value of compressed contracts kept increasing in the first half of 2015, principally influencing IRS cleared through CCPs. In the second-half of 2015, the outstanding notional value of interest-rate derivatives has started to increase, mainly due to the growth in yen and USD denominated agreements: from 2015 to 2016, the notional value of the yen contracts increased from USD 39 trillions to USD 50 trillions, whereas the notional value of USD agreements went from USD 139 trillions to USD 149 trillions.

There is evidence that interest rate derivatives transactions are progressively shifting from the intra-dealer sector towards CCPs. Intra-dealer transactions volume has reached

[8] Compression is a process for tearing up trades that allows economically redundant derivative trades to be terminated early without changing each participant's net position.
[TriOptima, www.trioptima.com/resourcecenter/statistics/triReduce.html]

its maximum in 2008 at USD 189 trillion, and since then has been decreasing on a steady pace. In 2015, the outstanding value of intra-dealer transactions dropped down to USD 61 trillion.

5.3. OTC foreign exchange (FX) derivatives and non-deliverable FX forward agreements

The primary purpose of the foreign exchange market is to help international trade and investment, by allowing trading entities to convert one currency to another currency (Kotzé, 2011).

Foreign exchange derivatives (FX derivatives) are financial instruments whose return is based on the foreign exchange rates of two or more currencies. They involve the purchase or sale of a specified amount of currency at a future date, with the exchange rate set when the contract begins. These products are mainly used for currency speculation and arbitrage or for hedging FX risk. The main types of FX derivatives are forward contracts, futures contracts and options.

FX non-deliverable forwards (NDFs) are defined by Nera (2013) as follows. FX NDFs are non-deliverable forward foreign exchange contracts which are like normal forward foreign exchange contracts but do not require physical delivery of the designated currencies at the maturity. Instead, the NDF specifies (i) an exchange (forward) rate against a convertible currency, usually USD, (ii) a notional amount of the non-convertible currency and (iii) a settlement date. On the settlement date, the spot market exchange rate is compared to the forward rate and the contract is *net-settled* in the convertible currency based on the notional amount. The spot rate is assessed through an agreement at the beginning of the contract and varies by currency and jurisdiction. NDFs are mainly OTC derivatives. Since March 2012, NDFs are subject to the central clearing obligation. Under EMIR, the definition of FX derivatives is unclear. More specifically, there is no clear line distinguishing between a FX spot transaction and a FX forward. Regulators expect this issue to be addressed under MiFID II. In 2014, the European Commission argued that there was a general agreement to classify a spot FX trade as a trade with an average settlement timeframe of 2 working days or ending on a standard delivery date.

(i) Foreign exchange risk

FX risk (also known as currency or exchange rate risk) refers to the risk that the value of an investment changes (possibly decreases) due to the fluctuations in currency exchange rates. It also refers to the risk faced by investors that must close a (long or short) position in a foreign currency at a loss, caused by an unfavorable movement in FX rates. Currency risk, among others, affects investors engaging in international transactions. For example, if an investment requires currency conversion, any fluctuations in the currency exchange rate will lead to a change in value (increase or decrease) when the investment is concluded and converted back into the initial currency.

There are four main exposures types: (i) transaction exposure, (ii) economic exposure, (iii) translation exposure and (iv) contingent exposure.

Transaction exposure refers to currency risk that arises when an entity has receivables/payables positions whose values may be directly influenced by FX rates.

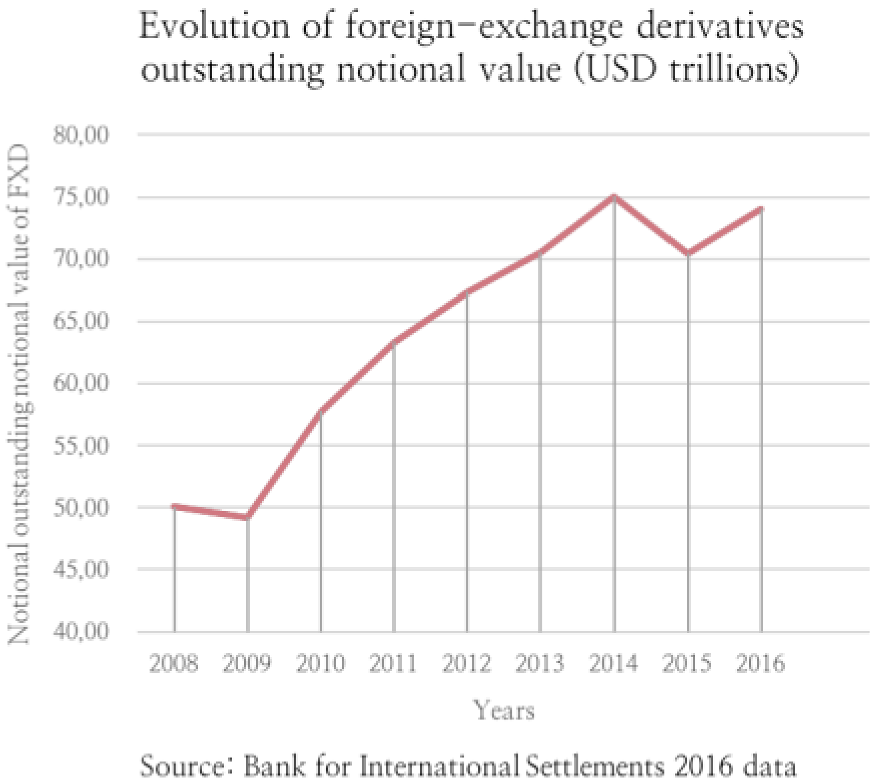
An entity faces currency risk due to *economic exposure* (or forecast risk) if its market value is affected by unpredictable changes in FX rates. Moreover, such fluctuations could have an impact on a firm's position with respect to its competitors and its future cash flow streams. Economic exposure may be offset or mitigated through arbitrage and outsourcing.

All corporates deliver financial statements (for reporting purposes). Commonly, there is the need to translate such reports from one currency (domestic) to another (foreign). These translations could be faced with FX risks, since there could be fluctuations in FX rates when the conversion from one currency to another is done. Even if *translation exposure* could not affect a firm's cash flows, it may alter the comprehensive firm data, which in turn, directly influences its stock price.

Corporates face *contingent exposures* when they "bid for foreign projects, negotiate contracts directly with foreign firms, or have direct foreign investments" (Radatz, 2014). In the case of a foreign negotiation, currency rates will fluctuate from the beginning of the transaction to its settlement. For example, a firm may be on hold for the acceptance of a bid. As it waits, it faces contingent exposure, given that FX rates may change and the firm will not be able to acknowledge the value of their (domestic) currency with respect to the foreign one until the bid is accepted.

(ii) Empirical data on FX derivatives

Since 2008, the notional value of outstanding foreign exchange derivatives has had, on average, an increasing trend. However, in the period 2014-2015 there has been a 6.7% decrease, from USD 75 trillions to USD 70 trillions. After 2015, the notional amount of outstanding FX derivatives grew from USD 70 trillions to USD 74 trillions in 2016. The evolution of FX derivatives market can be seen in Figure 8 below.



<u>Figure 8</u> – Evolution of foreign-exchange derivatives outstanding notional value (USD trillions) over the period 2008-2016.

Contrary to the interest rate derivatives market, where there has been a shift from intra-dealer contracts to CCPs central clearing, in the foreign exchange derivatives market intra-dealer transactions continue to represent the largest share of outstanding positions (compared to positions with other financial institutions, such as CCPs). In fact, in 2016, the notional amount of outstanding foreign exchange contracts with dealers amounted to USD 32 trillions, compared to USD 33 trillions with all other financial institutions. On average, intra-dealer positions account for 43% of the overall FX contracts positions. Among FX instruments, intra-dealer currency swaps transactions and options represent 55% and 48% of notional value, respectively.

6. *OTC FX derivatives increase in importance*

Interest rate derivatives keep dominating the OTCD market, whose notional outstanding value in 2016 amounted at almost USD 438 trillions (more than 80% of the total OTCD market). However, their value has decreased: in 2013 they totalled USD 581 trillions (around 83% of the total OTCD market). One of the main drivers of the decline in notional value seems to be *trade compression*, whose aim is to remove repetitive contracts. Moving towards central counterparties (CCPs) in the last years has helped the compression process. Foreign Exchange (FX) derivatives constitute the second biggest component of the OTCD market. Contrary to interest-rate derivatives, the notional outstanding value of FX derivatives kept increasing, skyrocketing at a pick of USD 86 trillions in 2016. As a percentage of the total OTCD market value, FX derivatives increased from 13% in 2013 to 16% in 2016 (in notional outstanding value). For what concerns credit derivatives, their notional value in 2007 was comparable to that of FX derivatives, but since then, it has been continuously decreasing (from USD 51 trillions in 2007, USD 25 trillions in 2013, to USD 12 trillions in 2016). As a percentage of the total notional outstanding value of the OTCD market, their value went from 10% to 2%. The narrowest OTCD market segments is the one related to equity and commodity contracts (in 2016 their notional outstanding value was USD 6.8 trillions and USD 1.8 trillions, respectively).

7. *Most interest rate derivatives are centrally cleared*

Clearing services are a fundamental element for conducting reforms in OTCD markets to reduce systemic risks. Central clearing is very active in OTC interest rate contracts, but is lacking behind in other OTC areas. In 2016, 75% of all outstanding interest-rate derivative contracts were booked against CCPs[9].

In the interest-rate derivatives class, 91% of forward rate agreements and 80% of interest rate swaps (IRS) were booked against CCPs in 2016. Concerning interest-rate options, the CCPs' share is almost zero. The relevance of CCPs does not really change among the major currencies. For example, in 2016, 76% of the Swedish IRS were subject to CCPs intervention, compared to 86% for Canadian and Japanese IRS and

[9] This share refers to the outstanding positions of reporting dealers and not the share of trades cleared through CCPs; as a share of outstanding positions, contracts with CCPs are counted twice, whereas as a share of trades each contract would be counted once [BIS (2016). "OTC derivatives statistics at end-June 2016". *Monetary and Economic Department*].

83% for US IRS. Despite full data on central clearing are only accessible from the end of June 2016, "the historical counterparty distribution of OTC derivatives, can be used to approximate the pace of the shift in activity towards CCPs in recent years"(BIS, 2016). Originally, CCPs were classified equivalently with all other financial institutions, accounting for most of the positions stated with this collection of counterparties (except dealers). The portion of interest rate derivative contracts conducted with financial institutions (except dealers) went from 61% of total notional values outstanding in 2010 to 75% in 2013 and 86% in 2016. In parallel, intra-dealer transactions have experienced a decrease in importance, from 30% to 12% in the past years (declining from USD 163 trillions in 2007 to USD 50 trillions in 2016). This diverging paths show the switch from intra-dealer contracts to CCPs.

The services provided by CCPs are becoming increasingly important for credit derivative contracts. In fact, the share of outstanding credit default swaps (CDS) centralised by CCPs has grown significantly over the past years: from 10% in 2010 to 37% in 2016. Moreover, there is a greater portion of CCPs dealing with multi-name products (the issuer is exposed to the default risk of more than one credit or name) than with single-name products (the issuer is exposed to the default risk of just one credit or name): 47% and 29%, respectively. The reason for these figures is that multi-name products (for example, CDS indices) are likely to have a more standardised structure compared to that of single-name products, becoming therefore more suitable for central clearing.

For other OTC derivatives classes, central clearing was almost imperceptible: in 2016, less than 2% of outstanding OTC FX derivatives were cleared. Similar numbers describe OTC equity derivatives. This discrepancy partially shows the differences in regulations that apply to different derivatives classes. As stated at the beginning of section 1.5., the main standardised OTC derivatives classes that regulators require to be centrally cleared are interest rate swaps (IRS), credit default swaps (CDS) and non-deliverable FX forward agreements. In addition, relevant authorities are beginning to request greater capital and margin for OTC derivatives which are not eligible for central clearing, which incentivises to move towards CCPs transaction centralisation. Overall, 62% of the total notional outstanding value of OTC derivatives contracts reported by dealers was centrally cleared (BIS, 2016).

II. European Markets Infrastructure Regulation (EMIR)

Regulation (EU) No 648/2012 of the European Parliament and of the Council of 4 July 2012 on OTC derivatives, central counterparties and trade repositories has been implemented on 16 August 2012. EMIR directly applies to the Member States (MSs) of the European Economic Area (EEA), namely the EU Member States (28, 27 with Brexit) plus Iceland, Liechtenstein and Norway. The Regulation and the delegated acts related to it are directly applicable to the MSs of the EEA and therefore do not require the implementation of the legislation nationally.

1. EMIR implications on Brexit[10]

If the UK stayed in the European Economic Area (EEA) but left the EU, the clearing and margin requirements would still apply to UK derivatives market participants under EMIR.

In the White Paper of the British Government (released in 2017) entitled *The United Kingdom's exit from and new partnership with the European Union* it was explicitly declared that the UK will no longer be a member of the Single Market, after the formal exit from the EU.

Therefore, it is improbable that the UK will remain part of the EEA and it is therefore likely that it will become a "Third Country" under the EMIR framework. As a result, the Regulation will not apply to the UK anymore, unless differently stated by the UK law. However, since the UK is one of the G20 members and one of the members of the Basel Committee on Banking Supervision (BCBS), it is very probable that it will translate EMIR Regulation "and its related secondary legislation into domestic legislation" (Ashurst, 2017). If this was the case, then the requirements that are currently applicable to UK derivatives would still be valid (although there would be the need of several amendments to conform EMIR to the UK law).

In any case, the Regulation will be still implemented to any counterparty based in the EEA trading with a UK counterparty.

2. Purpose and objectives of EMIR

The main purpose of EMIR is to enhance the OTCD market transparency and reduce systemic risk, thus helping the European Union, cooperating with the European

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[10] See Ashurst (2017) www.ashurst.com on EMIR Portal Home

Securities and Markets Authority (ESMA), to have a clearer overview on the volume, market participants and any potential market abuse. EMIR also seeks to lower the number of market counterparties involved in OTCD trades and to mitigate the operational risk carried by market participants.

To achieve its objectives, EMIR requires that all eligible[11] OTC derivatives contracts must be subject to mandatory central clearing through an authorised Central Clearing Counterparty (CCP); derivatives which cannot be centrally cleared must be subject to suitable risk mitigation techniques; and that all the relevant information on outstanding OTCDs and ETDs must be reported to a registered Trade Repository (TRs).

Therefore, EMIR (Article 10) sets regulatory requirements on derivative contracts and on EU financial and nonfinancial counterparties.

The derivatives classes that are subject to EMIR are summarised in the Markets in Financial Instruments Directive (MiFID I - Annex I, Section C (4) - (10)) or under Article 2(5) of EMIR and have been thoroughly explained in Chapter 1, Section 1.5. Moreover, the regulation also applies to listed derivatives, i.e. Exchange Traded Derivatives (ETDs). The most popular ETDs are futures and options.

Financial Counterparties (FCs) are EU-regulated entities, such as banks, investment firms (authorised under MiFID 2004), authorised insurance undertakings (authorised in accordance with Directive 2009/138/EC, Solvency II), assurance and reinsurance undertakings (under Solvency II), undertakings for collective investment in transferable securities (UCITS, authorised under UCITS Directive), occupational retirement funds (authorised under Directive 2003/41/EC, Occupational Pension Funds Directive), and alternative investment funds (AIFs) managed by AIFs managers (authorised or registered in accordance with Alternative Investment Fund Managers Directive). *Nonfinancial Counterparties* (NFC) are all other EU-entities which engage in OTC derivative transactions not defined as FCs. There are currently two main categories of NFCs: the NFCs which engage in large transaction volumes of derivatives contracts (for purposes other than hedging), and the NFCs which trade derivatives to a smaller extent or for hedging purposes. NFCs fall in one of the two categories based on whether their transaction volumes exceed a pre-established clearing threshold. Generally, a NFC exceeding the clearing threshold is considered NFC+, whereas a NFC falling below the clearing threshold is considered NFC-. More specifically, under EMIR, if the average

[11] ESMA is charged with the task of deciding which classes of derivatives must be subject to the central clearing obligation.

rolling position of the NFC is greater than the clearing threshold over any 30-day span, the NFC is considered an NFC+ and will then be subject to the clearing obligation, whereas if the NFC's average rolling position is less than the clearing threshold, the NFC is considered NFC- and will not be required to clear its OTC derivative contracts.
Currently, the clearing thresholds (EMIR Article 10(3)) are:

a. EUR 1 billion in gross notional value for OTC credit derivative contracts;
b. EUR 1 billion in gross notional value for OTC equity derivative contracts;
c. EUR 3 billion in gross notional value for OTC interest rate derivative contracts;
d. EUR 3 billion in gross notional value for OTC foreign exchange derivative contracts; and
e. EUR 3 billion in gross notional value for OTC commodity derivative contracts and other OTC derivative contracts not provided for under points (a) to (d).

In March 2013, the *NFC notification* has been implemented, namely that NFC+s must notify ESMA and their EU MS competent authority when they exceed the clearing threshold.

Moreover, as detailed in Lucantoni's commentary of EMIR (2017), there is a second filter based on a *hedging test* aiming to exclude from the calculation all risk-hedging activities. Under Article 10 of Commission Delegated Regulation (EU) No 149/2013 (which supplements EMIR), an OTCD transaction should be objectively measurable as reducing risks directly relating to the commercial activity or treasury financing activity of the NFC or of that group, when, by itself or in combination with other derivative contracts, directly or through closely correlated instruments, it meets one of the following criteria: a) it covers the risks arising from the potential change in the value of assets, services, inputs, products, commodities or liabilities that the NFC or its group owns, produces, manufactures, processes, provides, purchases, merchandises, leases, sells or incurs or reasonably anticipates owning, producing, manufacturing, processing, providing, purchasing, merchandising, leasing, selling or incurring in the normal course of its business; (b) it covers the risks arising from the potential indirect impact on the value of assets, services, inputs, products, commodities or liabilities referred to under paragraph a), resulting from fluctuation of interest rates, inflation rates, foreign exchange rates or credit risk; c) it qualifies as a hedging contract pursuant to International Financial Reporting Standards (IFRS).

However, as Lucantoni (2017) discusses, the Commission proposed (under the proposal of EMIR review) to narrow the scope of the clearing obligation for NFCs since they involve a lower degree of interconnection than FCs and they are also often active in only one class of OTC derivative. The author continues saying that their activity entails less systemic risk to the financial system than the activity of FCs. The proposal is that NFCs should be subject to the clearing obligation only with regard to the asset class or asset classes that exceed the clearing threshold, while retaining their requirement to exchange collateral when any of the clearing thresholds is exceeded.

The regulatory requirements set by EMIR on both financial and nonfinancial counterparties and on derivative contracts can be catalogued into three main types:

(i) Clearing obligation (under Article 4 of EMIR) – certain standardised OTC derivatives are subject to compulsory central clearing through a central counterparty (CCP); clearing exemptions can be applied to NFC-s and to OTC derivatives which are defined by ESMA as non-clearing eligible.

(ii) Risk mitigation techniques for non-cleared OTC derivatives – the OTC derivatives which are not eligible for central clearing must be subject to risk mitigation techniques (timely confirmation, portfolio reconciliation and compression, contract valuation and dispute resolution);

(iii) Reporting obligation (under Article 9 of EMIR) – all outstanding OTC derivatives contracts and ETDs must be reported to one of the authorised trade repositories (TRs).

Currently, there are two approaches in the EMIR rulebook to establish which OTC derivatives classes must be subject to the central clearing requirement: the bottom-up procedure (industry-driven) and the top-down procedure (ESMA-driven)[12].

According to the *bottom-up approach* (under Article 5(1) and (2) of EMIR), the identification of the derivatives classes that will be subject to the clearing obligation will depend on the derivatives which are already being centrally cleared by central counterparties (CCPs). The CCPs must receive authorisation by the relevant competent authorities, which in turn must notify ESMA on the OTCD derivatives classes that will be centrally cleared (Articles 13 and 14 of EMIR). The *top-down approach* (under Article 5(3) of EMIR), instead, involves the own initiative of the European Markets and Securities Authority (ESMA) to select the classes that should be centrally cleared but for which central counterparties have not yet been authorised to clear. After a CCP

[12] See www.esma.europa.eu/regulation/post-trading/otc-derivatives-and-clearing-obligation

clearing class is authorised, ESMA has six months to deliver a draft of regulatory technical standards (RTS) in which it specifies all the details relevant for that asset class and which must be endorsed by the Commission (Article 11(15) of EMIR).

2.1. Exemptions from the clearing obligation

There are specific circumstances in which it possible to be exempted from the central clearing requirement. This section provides a brief overview on the exemptions allowed under EMIR.

Commercial hedging exemption for non-financial counterparties (NFCs). Under Article 10(2) of EMIR, NFCs entering into transactions for hedging purposes or treasury activities which are "objectively measureable as reducing risks directly in relation to the commercial activity of the group or treasury financing activity of the NFC or of that group" will not be considered when determining the clearing thresholds for NFCs. This exemption includes OTC derivatives that (i) help reducing the risks generated from the variations in assets value, (ii) cover indirect risks and, (iii) are defined as hedging contracts pursuant to the International Financial Reporting Standards (IFRS) principles on hedge accounting. On this matter, in 2015 ESMA released a report suggesting that the relevant authorities could change how the hedging exemption influences the definition of NFC+/NFC- by measuring the aggregate positions regardless of their hedging or non-hedging nature.

Intragroup exemption. Under Article 3 of EMIR, market participants can request an intragroup[13] exemption if (i) both counterparties are fully consolidated and are governed by centralised risk and regulatory procedures and if (ii) the market participant is a non-EU counterparty and the EU Commission has approved the equivalence of obligations in that non-EU country.

However, some disclosure requirements will still be applicable and if certain conditions are met, the exemption covers also margin requirements.

Pension schemes. Under Article 89(2) of EMIR, pension schemes (PSs) could be exempted from the clearing requirements and could obtain this exclusion from their competent authority if such PSs have difficulties in meeting the margin requirements

[13] In relation to a NFC, an intragroup transaction is an OTC derivatives contract entered into with another counterparty which is part of the same group, as defined under Article 3(1).

and if they comply with Article 2(10)(c) or (d)[14]. ESMA has released a list[15] of the PSs exempted from the clearing obligation (which was last updated in April 2016).

Supranational bodies. Under Article 1(5)(a), institutions such as the European Central Bank (ECB), national European Union public debt management entities, specified multilateral development banks and certain guaranteed public entities are exempted from the clearing requirement.

2.2. *Trade execution (MiFID II)*

The trading requirement under MiFID II states that all derivatives transactions which are considered sufficiently liquid and which are required to be centrally cleared under EMIR must be traded through a regulated market (RM), a Multilateral Trading Facility (MTF), an organised trading facility (OTF) or through a third-country (i.e. non-EU) trading venue. Under MiFID, these trading platforms are defined as follows.

A *regulated market* is a multilateral system operated and/or managed by a market operator, which brings together or facilitates the bringing together of multiple third-party buying and selling interests in financial instruments – in the system and in accordance with its non-discretionary rules – in a way that results in a contract, in respect of the financial instruments admitted to trading under its rules and/or systems, and which is authorised and functions regularly in accordance with MiFID.

A *multilateral trading facility* is a multilateral system, operated by an investment firm or a market operator, which brings together multiple third-party buying and selling interests in financial instruments – in the system and in accordance with non-discretionary rules – in a way that results in a contract in accordance with MiFID.

An *organised trading facility* is a multilateral system which is not a regulated market or an MTF and in which multiple third-party buying and selling interests in bonds, structured finance products, emission allowances or derivatives are able to interact in the system in a way that results in a contract in accordance with MiFID.

This obligation is expected to be applicable to both FCs and NFC+s.

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[14] Art. 10(c) refers to occupational retirement provision businesses of life insurance undertakings (covered by Directive (2002/83/EC) provided that all assets and liabilities corresponding to the business are ring-fenced, managed and organised separately from the other activities of the insurance undertaking (without any transfer possibility). Art. 10(d) refers to any authorised and supervised entities, or arrangements operating on a national basis, provided that: (i) they are recognised under national law and, (ii) their primary purpose is to provide retirement benefits.

[15] https://www.esma.europa.eu/sites/default/files/library/list_of_exempted_pension_schemes.pdf

2.3. Derivatives clearing organisations – Central Counterparties (CCPs)

A central counterparty interposes itself between the buyer and the seller of a trade, becoming the buyer to every seller and the seller to every buyer.

Under EMIR, Articles 14-50 deal with CCPs. Central counterparties must seek authorisation by the relevant national competent authority and must adhere to organisation, prudential, conduct of business and minimum capital requirements.

CCPs not belonging to the European Economic Area (EEA) must seek authorisation from ESMA to be able to perform clearing activities in the EEA and they must adhere to equivalent supervision and enforcement frameworks in the non-EEA country in question. Currently, the only foreign CCPs that are recognised by the EU Commission and that can, therefore, seek authorisation under EMIR are those from Australia, Hong Kong, Singapore and Japan.

CCPs are subject to several requirements, including:

- Specific and in-depth organisational requirements, relating to the composition and structure of the board and senior management plans and internal supervisory structures (i.e. risk, compliance, internal audit and technology management);
- Thorough and prescriptive Business Continuity Planning/Disaster Recovery requirements (for example, an obligation for the CCP to grant recovery of the core functions within 3 hours);
- In-depth financial resource and liquidity requirements. In particular, CCPs must have a base capital of EUR 7.5 million, as well as risk based capital (derived from the Capital Requirements Directive, CRD);
- CCPs must give the possibility to clearing members to segregate client accounts with the CCP itself either at an overall or individual level;
- Detailed requirements on how to deal with the default of one or more clearing members, including (i) minimum size of default fund and (ii) a duty for CCPs to use their own specific resources before seeking additional resources from the non-defaulting members.

As of today, there are 17 registered and authorised CCPs in the EU and 28 non-EU CCPs recognised by the EU Commission (under EMIR).

Further details on CCPs and central clearing services will be provided in the dedicated Chapter 4.

2.4. Trade reporting and trade repositories (TRs)

Article 9 under EMIR is dedicated to trade reporting, which came into force only on February 2014. European Union derivative contracts, including both OTC derivatives and ETDs independently from their clearing obligation, must be reported to an authorised trade repository (or, if not available, it must be directly reported to ESMA) by the next working day at the latest.

Market participants trading in OTCD markets are required to provide all the necessary details on OTC derivatives transactions. They must include any modifications and amendments and must avoid duplication of information. Counterparties must maintain a record of any OTC derivative trade they engage into for at least five years following the settlement of the contract (Article 9(2) under EMIR).

Moreover, TRs have to be registered and supervised by ESMA and must fulfil some operational requirements. Currently, there are seven TRs that have been authorised in the EU.

MiFID II will impose the disclosure of *pre-trade* information and of *post-trade* information and will expand the current pre- and post- trade transparency obligations outlined in MiFID I to include also equity-linked instruments, bonds and derivatives. In addition, MiFID II will also require more details and clarity on the data and format of trade reports by implementing standardised disclosure documents. As stated in MiFID II, the cost of information will decrease by requiring “trading venues to unbundle pre-trade from post-trade data”.

Further discussions on trade repositories and trade reporting will be developed in Chapter 3.

2.5. Risk mitigation techniques for un-cleared OTC derivative contracts

Article 11(3) of EMIR requires FCs and NFC+s to implement risk management practices margin requirements for OTC derivatives which are not eligible for central clearing.

These requirements are based on the collection of initial and variation margins[16], and are:

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[16] *Initial Margin* is a form of collateral which should (at least partially) cover potential future losses during the time interval between (i) the liquidation of positions following the default of its counterparty or (ii) the hedging of that exposure. *Variation Margin* is the collateral collected by a counterparty to cover potential losses arising from market fluctuations [Definition from *Delegated Regulation (EU) 2016/2251*].

- *Timely confirmation* of un-cleared derivative transactions – In force since March 2015, this technique requires each counterparty to an un-cleared OTC derivative to confirm transactions as soon as possible.
- *Mark-to-market* – From March 2015, FCs and NFC+s are required to mark-to-market[17] on a daily basis and report this information to trade repositories daily.
- *Portfolio reconciliation and portfolio compression* – Since September 2015, counterparties must reach an agreement on the portfolio reconciliation terms, which must include the reconciliation of the most important trade terms and any available mark-to-market valuation. The portfolio reconciliation performance's frequency depends on whether the trading counterparty is a FC, an NFC+ or an NFC- and it is also based on the number of outstanding OTCD contracts between the market participants. In fact, this technique applies to counterparties having more than 500 OTC derivative contracts outstanding against each other.
- *Dispute resolution* – Applicable since September 2013, this technique requires counterparties to have agreed mechanisms dealing with identification, recording and supervision of disputes relating to the recognition and valuation of a trade and any exchange of collateral. It requires disputes to be resolved in a timely way and specifies that counterparties must have specific resolution mechanisms for disputes which are not settled within 5 business days.

The afore mentioned risk mitigation techniques have two main benefits:

(1) *Systemic risk reduction* – central clearing is appropriate only for standardised derivatives. However, there are many derivatives which are not standard and cannot therefore be centrally cleared. Such derivatives carry the same risk that affected the 2008 financial crisis. Margin requirements help reducing systemic risk by granting collateral to cover the losses generated by the default of one counterparty. "Margin requirements can also have broader macro-prudential benefits, by reducing the financial system's vulnerability to potentially destabilising pro-cyclicality and limiting the build-up of uncollateralised exposures within the financial system" (IOSCO, 2013).

(2) *Central clearing promotion* – central clearing is compulsory for most standardised derivatives. However, clearing services have a cost, partly because

[17] Assess the value of the assets taking into account the daily fluctuations of such value, therefore using the most recent market price.

CCPs demand margins from the clearing members. The higher margin requirements on non-cleared OTCDs reflect the higher risk linked to such derivatives and thus, promote central clearing services.

2.6. Margin requirements for un-cleared OTC derivatives trades

The margin requirements for un-cleared OTC derivatives transactions fall under Article 11(3) of EMIR, which necessitates FCs and NFC+s to be subject to initial margins (IMs) and variation margins (VMs) when dealing with OTC derivatives not eligible for central clearing.

On March 2015, the Basel Committee on Banking Supervision (BCBS) and the International Organisation of Securities (IOSCO)[18] suggested, among other things, that IM obligations should be gradually introduced over a four-year period, starting from September 1st 2016 and beginning with the most significant market participants in the following way:

1. From September 1st 2016, if both counterparties have or belong to groups, each having a total average notional amount of un-cleared derivatives for the months March, April and May 2016 ≥ EUR 3 trillion;
2. From September 1st 2017, if both counterparties have or belong to groups, each having a total average notional amount of un-cleared derivatives for the months March, April and May 2017 ≥ EUR 2.25 trillion;
3. From September 1st 2018, if both counterparties have or belong to groups, each having a total average notional amount of un-cleared derivatives for the months March, April and May 2018 ≥ EUR 1.5 trillion;
4. From September 1st 2019, if both counterparties have or belong to groups, each having a total average notional amount of un-cleared derivatives for the months March, April and May 2019 ≥ EUR 0.75 trillion;
5. From September 1st 2020, if both counterparties have or belong to groups, each having a total average notional amount of un-cleared derivatives for the months March, April and May 2020 ≥ EUR 8 billion;

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[18] On March 2015, the Basel Committee on Banking Supervision (BCBS) and the International Organization of Securities Commissions (IOSCO) released revisions to their joint report (published on 2 September, 2013) on common international standards. The main change was to postpone the implementation date of the margin requirements by 9 months, to 1 September, 2016. On 10 June, 2015 the ESAs (ESMA, EBA, EIAOPA) launched a second consultation (following the first consultation in April 2014) on the draft regulatory technical standards which provide more detail on the margin requirements for OTC derivatives that are not cleared by a CCP.

After 2020, the IM requirements will be applicable to derivative trades non-eligible for central clearing if both counterparties have or belong to a group each having an average notional amount of un-cleared derivatives ≥ EUR 8 billion. A minimum transfer of EUR 500,000 is required.

If FCs and NFC+s are dealing with NFC-s or if the total initial margin between the counterparties is ≤ EUR 50 million, then there is no need to exchange IM and VM.

Moreover, market participants are also required to exchange VMs on a daily basis in respect of new contracts entered:

1. From September 1st 2016, if both counterparties have or belong to groups, each having a total average notional amount of un-cleared derivatives for the months March, April and May 2016 ≥ EUR 3 trillion;
2. From March 1st 2017, for all the remaining counterparties.

In addition, the collateral eligible to be posted could be in the form of (i) cash, (ii) allocated gold, (iii) debt securities issued by government bodies, multilateral development banks, credit institutions or investment firms, (iv) corporate bonds, (v) the most senior tranche of a securitisation; and (vi) equities.

2.7. Extraterritorial provisions (Articles 4 and 11 of EMIR)

Extraterritorial provisions are dealt with under Articles 4(2) and 11 of EMIR and state that the requirement to clear OTCD transactions is implementable when one or both counterparties (FC or NFC+) are not EU-counterparties that would be subject to central clearing if they were located in the EU and if the transaction has a "direct, substantial and foreseeable effect" in the EU or "where the obligation is necessary or appropriate to prevent the evasion of any provisions of EMIR".

As of today, a non-EU market participant (such as a firm) that operates with EU counterparties in OTCD contracts may be requested to seek authorisation under MiFID. The proposed amendments to MiFID explain that a non-EU counterparty willing to perform services/activities to retail and professional counterparties could be required to establish a branch in the EU and to gather authorisation from the competent authority charged with the supervision and regulation of the area where such branch is to be located.

3. *Evolution and effectiveness of EMIR implementation over the period 2012-present*

As previously mentioned, the EU regime addressing the shortcomings in the OTC derivatives market entered into force in 2012. However, on March 2013, certain provisions in EMIR necessitated the European Securities and Markets Authority (ESMA) to develop draft technical standards and several obligations (timely confirmation, mark-to-market, and the NFC notification requirements). Further risk mitigation techniques (portfolio reconciliation, portfolio compression and dispute resolution) were implemented on September 2013. The obligation on trade reporting started on February 2014.

In addition, on January 2015, in collaboration with the European Banking Authority (EBA) and the European Insurance and Occupational Authority (EIOPA), ESMA released a second set of draft technical standards, this time relating to the margin rules for un-cleared OTCD contracts.

The first clearing obligation (as outlined by EMIR) started on June 2016.

Even if EMIR has already been enforced, some of its definitions are linked to the ones outlined in MiFID I and, as a result, the current developments in MiFID II will have a considerable effect on derivatives. Regulators wanted to implement most of the measures under MiFID II by January 2017. However, the EU Commission has suggested to postpone the endorsement by one year, until January 2018. The MiFID II regulatory framework consists of a European Directive (MiFID II) and a regulation, the Markets in Financial Instruments Regulation (MiFIR)[19].

As of 2017, the EMIR reforms have not yet been completely implemented. However, relevant authorities can increasingly notice the positive impact of such reforms and the progress that is being made to achieve the G20s objectives. In what follows, each objective will be treated in more detail.

a. *Mitigating systemic risk*

There is a significant progress towards the mitigation of systemic risk, including the risk generating from the interconnectedness of financial institutions in OTCD markets. Greater central clearing activity performed by central counterparties (CCPs) is a crucial aspect of the reforms that is helping to mitigate systemic risk. In fact, increasing the use

[19] The final texts of the MiFID II Directive and MiFIR were published in the Official Journal of the EU on 12 June, 2014.

of CCPs is starting to lower counterparty credit risks in the financial system by substituting complex and opaque networks between counterparties trading in OTC markets with lit and transparent connections between CCPs and the associated clearing members (backed by strong resilience and risk management). More specifically, relevant authorities have observed that there are considerably higher activities of central clearing, mostly in OTC interest rate derivatives and credit derivatives, and to a lower extent in FX and equity-linked derivatives. The notional outstanding value of OTC interest rate derivatives that are subject to central clearing has globally risen from 24% in 2008 to 61% in 2016, while the central clearing for new OTC interest rate derivatives amounts to 87% in the US and 62% in the EU (IOSCO, 2016).

Moreover, mostly thanks to the Principles for Financial Market Infrastructures (PFMI), there has been progress in the CCPs' resilience concerning their governance, risk management structure and the capital requirements they must fulfil to manage a potential clearing member's default. At the same time, further achievements are being reached on the design of recovery and resolution plans for CCPs to avoid that "CCPs become the new concentrated source of too-big-to-fail risk" (BlackRock, 2014).

Lastly, relevant authorities have observed a remarkable increase in the levels of collateral requirements for OTCD exposures compared to the ones in force before the 2008 financial crisis. Evidence shows that the level of collateral for structured finance products increased from USD 0.67 trillions in 2006 to around USD 2 trillions in 2016.

b. Improving OTC derivatives market transparency

The reporting requirements on OTC derivatives trades have enhanced the post-trade transparency in OTCD markets to the relevant authorities and other entities that are allowed to access to trade repositories databases. Moreover, such trading information is increasingly used by the authorised entities primarily to control for systemic risk. However, there are still relevant challenges that must be overcome before the relevant authorities can thoroughly and efficiently access, aggregate and study the data stored in trade repositories (TRs). Such challenges include the removal of legal barriers that hampers the domestic and cross-border access to TRs trading data and the harmonisation of TRs elements. It is crucial that the FSB members tackle these obstacles in an efficient and prompt way. Moreover, there is evidence that market transparency has improved in jurisdictions where the trade repositories, trading platforms, central counterparties and other relevant authorities disclose to the public OTC derivatives trading data.

c. Protection against market abuse

Protection against market abuse can be enhanced by implementing reforms that encourage OTC derivatives trading on exchanges or electronic platforms and by requiring the provision of trade repositories' data to relevant market authorities. Several authorities have already declared to be using TRs data for market supervision, even if this is still in its initial phase. More work would be necessary to determine if there has been a decrease in market abuse. Moreover, significant challenges and costs have been spotted. Research is being carried out internationally in order to analyse, and if suitable, address these problems. This involves (i) the improvement of the resilience, recovery and resolution plans for CCPs, (ii) the harmonisation of TRs data elements and improve data quality and, (iii) eliminate legal barriers that hamper the reporting and accessibility of TRs data.

4. Progress in the implementation of EMIR

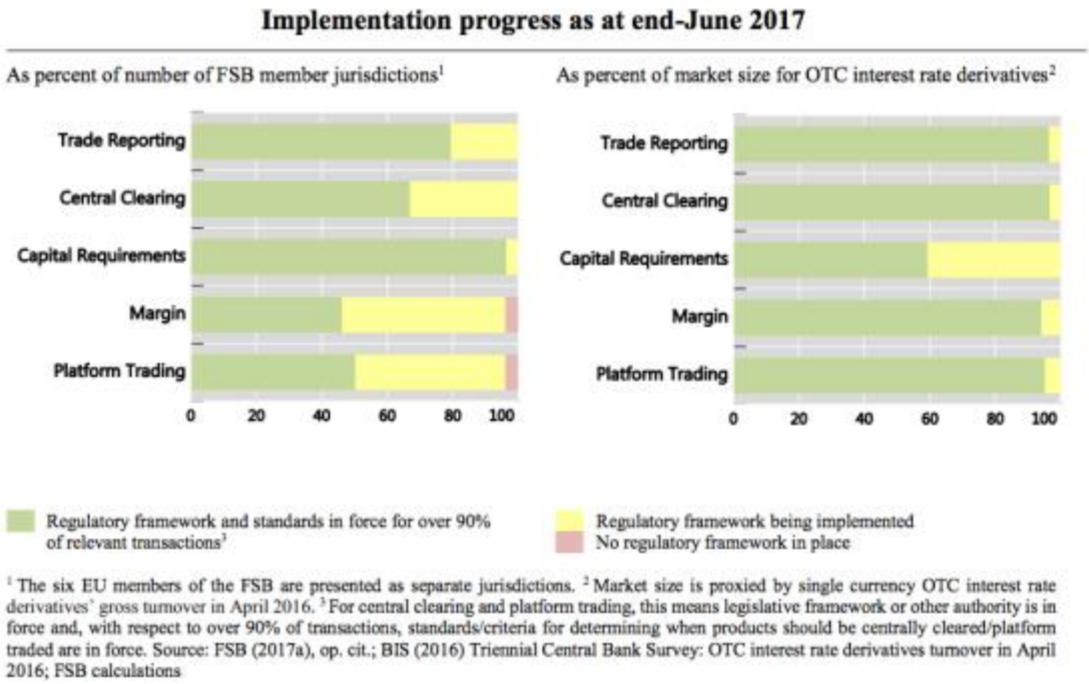
Comprehensively, despite progress is being made towards reforming the OTC derivatives market, there are still certain implementation gaps that must be filled.

Implementation of these reforms has taken longer than expected. This delay was caused by the volume and the complexity in the regulation of this previously unregulated market. The challenges have, among other things, involved the establishment of new financial market infrastructures (FMIs), such as new TRs and also the upgrade of some existing CCPs to adapt to new standards. As of 2017:

- central clearing frameworks have been, or are being, implemented;
- interim higher capital requirements for non-centrally cleared derivatives are mostly in force;
- margin requirements for non-centrally cleared derivatives have begun to be implemented (even if recent international deadlines have been missed by several jurisdictions and others have transactional arrangements to allow more time for market participants to adjust to the new requirements);
- comprehensive trade reporting requirements for OTC derivatives are mostly in force; and

- platform trading frameworks are relatively undeveloped in most jurisdictions.

The implementation of reforms has tended to be most rapid in the biggest OTCD markets, especially in the interest rate derivatives market (as shown in Figure 9 below).



<u>Figure 9</u> – EMIR implementation progress as of end-June 2017 for FSB jurisdictions (on the left-hand side) and for OTC interest rate derivatives market (on the right-hand side) – Source: FSB (2017).

Overall, authorities are still facing several implementation challenges, which are currently being addressed at international level. Moreover, given the global nature of OTCD markets, relevant authorities are also addressing (if deemed suitable) the impact of cross-border reforms. For example, in some cases geographical market fragmentation may occur when reforms are heterogeneously implemented across different jurisdictions and over different timespans.

5. Looking forward

It is difficult to estimate the long-term economic results generating from the OTCD markets reforms because (i) it is complex in analytical terms and, (ii) it can only be thoroughly assessed over a greater timespan, particularly if the implementation is still ongoing. Therefore, this cannot be considered a final estimate on the efficiency of such reforms. In fact, as more and more data becomes available over time and the data quality increases, the relevant authorised entities will be able to make a final assessment on the impact of EMIR. Additional research will be required in the following years to estimate the progress towards the accomplishment of the G20s commitments and to better quantify the extent to which the goals of mitigating systemic risk, increasing market transparency and protecting against market abuse are being met.

Margin and capital requirements for un-cleared OTC derivatives and central clearing mandates help promoting central clearing for standardised OTC structured finance products and to guarantee suitable systemic protections when dealing with non-standardised (i.e. non-centrally cleared) OTC derivatives. Relevant authorities recognise the necessity to analyse whether the adequate incentives to promote central clearing have been implemented for those eligible derivatives, but not for those non-standardised financial instruments that could increase the risks to central counterparties and should therefore remain un-cleared. For these matters, over the period 2017-2018, a Derivatives Assessment Team (DAT), assembled by the OTC Derivatives Coordination Group, will carry out an inspection of central clearing's incentives "for central clearing arising from the interaction of margin requirements for derivatives and several other requirements including the leverage ratio and liquidity coverage ratio, to update and expand the analysis in the study on these subjects conducted in 2014" (FSB, 2017).

Moreover, on the 29th of September 2017, ESMA delivered its final draft of regulatory technical standards introducing the compulsory trading of structured finance products under MiFIR[20], under which it outlines the specific aspects for IRS and CDS on-venue trading. MiFIR's trading requirement will place OTC transactions of liquid financial instruments onto regulated platforms, promoting transparency in the OTC sector which, in turn, will improve information relating to prices, liquidity and risks, thereby supporting market integration. Applying some aspects of MiFID II, MiFIR specifies how to establish which derivative products should be moved to regulated venues. This requirement will only be applicable to structured finance products that (i) display an adequate degree of liquidity and (ii) are accessible for trading on at least one regulated platform. In this setting, ESMA has selected the following derivatives to be subject to such obligation:

- Fixed-to-float IRS denominated in EUR;
- Fixed-to-float IRS denominated in USD;

[20] Markets in Financial Instruments Regulation.

- Fixed-to-float IRS denominated in GBP; and
- Index CDS – iTraxx Europe Main and iTraxx Europe Crossover.

The MiFIR's requirement for derivatives trading is strictly connected to the clearing requirement under EMIR. In fact, when a class of OTCDs is subject to central clearing under the EMIR framework, ESMA has to establish if such financial instruments should be compulsorily moved to a regulated market, multilateral trading facility, organised trading facility or an equivalent non-EU trading platform. On the 29th of September 2017 the RTS draft of ESMA have been forwarded to the European Commission for its authorisation. The EC communicated to ESMA that it is willing to implement this trading requirement on the same start date of MiFID II, namely on the 3rd of January 2018.

6. *The Dodd-Frank Wall Street Reform and Consumer Protection Act: the Dodd-Frank Act*

The primary objective of the Dodd-Frank Act is to restructure and reform the regulations governing the financial system to bring back confidence that was lacking following the 2008 Great Recession and to avoid another crisis from occurring. A core component of this piece of legislation addresses the shortcomings of the OTC derivatives market. Swaps and derivative financial instruments are treated under Title VII of the Dodd-Frank Act. The main goals of Title VII are the following:

- Minimise systemic risk of derivatives trading;
- Create transparency in derivatives markets;
- Prohibit entities holding customer deposits from engaging in speculative derivatives activity.

Title VII seeks to enhance market transparency, efficiency and competition by implementing a regulatory framework on OTC derivatives market based on central clearing, trading, margin, reporting and recordkeeping requirements. These requirements can be applied on a swap-by-swap basis or based on the type of counterparty entering the swap transaction. However, swap data reporting is mandatory for all swaps.

Such regulatory framework of OTC derivatives (usually referred to as swaps) is divided into (i) type of swap and (ii) type of swap-trading entities.

6.1. Types of swaps under Title VII

The market for swap derivative instruments had already been regulated prior to the implementation of the Act because the main market participants of such market are large banks, which are heavily governed by prudential bank regulators. Therefore, these regulators have included derivatives based transactions in their prudential requirements for bank regulation (including margin posting and capital rules). These rules have been expanded by US prudential bank regulators under Title VII. In addition, Title VII has brought in a new regulatory framework for swaps and derivatives under the administration of the *Commodity Futures Trading Commission* (CFTC) and *Securities and Exchange Commission* (SEC). The CFTC and SEC's rules are based on the type of swaps, which can be (i) non-security-based swaps or (ii) security-based swaps (defined in the Dodd-Frank Section 721(a)).

Non-security-based swaps are simple swaps which are usually regulated by the CFTC with some input from the SEC (where appropriate) and from the bank regulators. These are: interest rate swaps, FX swaps (which are exempt from the central clearing and platform trading requirements under the Act), CDS, agricultural and commodity swaps, all options, metal and energy swaps, and any combination of these, as long as this combination does not qualify as a security-based swap.

Security-based swaps are defined under the Securities Exchange Act of 1934 Section 3(a)(68)(A)) as an agreement, contract or transaction that is a swap based on (i) an index that is a narrow-based index, including any interest therein or on the value thereof; (ii) a single security or loan, including any interest therein or on the value thereof; or (iii) the occurrence, non-occurrence or extent of occurrence, or of an event relating to a single issuer of a security or the issuers of securities in a narrow based security index, provided that such event directly affects the financial statements, financial condition, or financial obligation of the issuer. They are usually regulated by the SEC with some input from the CFTC and from bank regulators. These include: swap based on a single security or loan, narrow-based security indices, swaps based on the occurrence or non-occurrence of certain events.

The derivatives excluded from the Title VII Swaps Regulation are equity options, commodity futures and physically settled forwards.

6.2. Types of Swap-Trading Entities under Title VII (Dodd-Frank Section 761).

The type of entities trading swaps that are subject to Title VII are (i) banks and bank holding companies, (ii) swap dealers (SDs) and security-based swap dealers (SBSDs), (iii) major swap participants (MSPs) and major security-based swap participants, (iv) non-financial commercial end-users and (v) commodity pool operators (CPOs) and commodity trading advisors (CTAs).

A *swap dealer* trades non-security-based swaps and is defined as an entity that enters in USD 3 billion notional swap transactions annually, subject to a starting threshold of USD 8 billion; it is overseen by the CFTC (which covers 95% of the derivatives market). A *security-based swap dealer* enters security-based-swap activity, controlled by the SEC (which covers 5% of the derivatives market). The threshold calculations are more complex and will not be further investigated for the purposes of study in this dissertation.

A *major swap participant* trades significant volumes of non-security-based swaps for any of the principal swap categories (determined by CFTC), except the positions for hedging purposes and whose outstanding positions generate considerable counterparty risk which could threat the financial stability of the US financial system (also if the MSP is highly leveraged). A *major security-based swap participant* trades security-based swaps and they are defined as entities that hold substantial positions[21] in any of the non-security based swaps or security-based swaps categories.

Non-financial commercial end users are exempt from the swap clearing and exchange-trading requirements if they are following hedging purposes, whereas they are subject to Title VII if they are willing to enter speculative investments. Only non-financial entities can benefit from the exemption.

Commodity pool operators (CPOs) and commodity trading advisors (CTAs) were not introduced with the Dodd-Frank Act. However, Title VII broadened the definition of commodity pool to integrate entities that work as pooled investment vehicles and control commodity trading accounts that hold swap positions. A CPO is a single entity

[21] Substantial position is defined as: (i) daily average uncollateralized exposure over the most recent calendar quarter of $1 billion in the applicable category of swaps ($3 billion for rate swaps) or $1 billion in security-based CDS or in non-security-based CDS; or (ii) daily average uncollateralized exposure over the most recent calendar quarter plus potential future exposure of $2 billion in the applicable category of swaps ($6 billion for rate swaps), security-based CDS or non-security-based CDS.

or an organisation which manages commodity pool funds[22]. A CTA is a single entity or organisation which provides advisory services on the purchase or sale of futures contracts, options on futures or forex contracts.

6.3. Swap data reporting and recordkeeping requirements (Dodd-Frank Section 727 and Commodity Exchange Act (7 USC 2(a)(13)).

One of the main objectives of the Dodd-Frank Act is to ease transparency in OTC derivatives market, which has historically been considered an opaque market. To achieve this goal, regulators have issued several rules regarding swap data reporting outlined in Title VII of the Act. Even entities that are exempt from central clearing and exchange trading are subject to the reporting requirements. Therefore, all financial and non-financial counterparties entering swap trades must fulfil the reporting rules. The CFTC has the authorisation to require real-time public disclosure for cleared and un-cleared swap contracts. More specifically, the main swap data must be reported "as soon as technologically practicable after execution" and reporting must occur on a continuous basis to ensure that all the relevant swap information is up-to-date. Moreover, each swap contract must be registered by using a *unique swap identifier* and each market participant must be recognised by a single *legal entity identifier*[23]. The reporting must be made to one of the authorised swap data repositories (SDR) and in the event no SDR is available for reporting, swap transactions must be directly reported to the CFTC. In addition, several swap participants are mandated to have records of their swaps transactions for at least five years after the swap contract is settled.

The reporting of swap data and recordkeeping regulations include:

- Final Swap Data Reporting (SDR) and record keeping rules, which mandates the reporting of all CFTC swap contracts.
- Real-time CFTC public data reporting rules, which requires real-time reporting to the public.
- Historical swap data reporting and recordkeeping rules, which involves the reporting and recordkeeping on CFTC historical swap data.

[22] A commodity pool is made of funds provided by several entities/individuals which are put together for (i) trading futures contracts, options on futures or forex contracts and (ii) investing in another commodity pool.

[23] A Legal Entity Identifier is a 20-digit alphanumeric code which allows to uniquely identify each entity trading in financial markets.

- Large-trader commodity reporting, asks for large-trader position data for physical commodity swaps to be reported.
- Recordkeeping rules for swap dealers and MSPs.
- Regulation on data reporting for SBS dealers.

6.4. Swap central clearing and exchange trading under Title VII (Dodd-Frank Section 723(a)(3) and Commodity Exchange Act (77 USC 2(h)(1)).

Following the 2009 G20 commitment, Title VII of the Act requires that all standardised swap derivatives should be globally centrally cleared and traded on exchanges no later than end-2012. This deadline was missed not only by US regulators, but also by all other international regulators. Compulsory central clearing for specified classes of IRS and CDS entered into force in March 2013.

Under Title VII rules, a large portion of the OTC swaps market, especially credit default swaps and interest rate swaps, must be traded on registered exchanges and must be centrally cleared by central counterparties (i.e. clearing houses). In particular, IRS that must be centrally cleared are (i) fixed-for-floating swaps, basis swaps and forward rate agreements that are specified in US dollar, Euro and British pound. To be eligible for the clearing obligation, the swaps must be referencing specific floating rate indexes and must have a maturity date fulfilling certain requirements. The four swap classes that qualify for central clearing represent more than 80% of the IRS market[24]. Swaps that are deemed eligible to be centrally cleared must be submitted to an authorised clearinghouse, which can be of two types: Derivatives Clearing Organisation (DCO) for non-security-based swaps and clearing agencies for security-based swaps. A DCO is a derivatives CCP registered with the CFTC which is charged with the clearing of non-security based swaps (in particular, CDS and IRS); whereas, clearing agencies are derivatives CCPs registered with the SEC charged with the clearing of securities-based swaps.

Under Title VII, the purpose of central clearing is to mitigate counterparty risk and to increase market transparency. Market participants engaging in non-cleared trades will be then subject to higher margin, collateral and capital requirements.

There are certain exemptions from the requirements on compulsory clearing and exchange trading, including (i) the commercial end-user exemption, (ii) the foreign

[24] Swaps with optionality, multiple currency swaps and swaps with conditional notional amounts are not subject to mandatory clearing.

exchange swap exemption and (iii) exemptions for certain physically settled commodity options.

Moreover, Title VII of the Act requires that all swaps which are classified as eligible for central clearing must be traded on (i) swap execution facilities (SEFs) and (ii) designated contract markets (DCMs).

Swap execution facilities refer to independent open-access trading platforms which have been created under Title VII. Such platforms grant market participants to trade non-security-based swaps with one another directly. SEFs, which are overseen by the CFTC, were introduced by regulators to (a) try to reduce the function of large financial institutions as gatekeepers and to increase the role of derivatives exchanges (such as DCMs) for the purpose of swap trading, (b) decrease the cost of accessing derivatives transactions and (c) foster transparency in swap markets.

Designated Contract Markets are traditional derivatives exchanges regulated by the CFTC through which standardised derivatives contracts are traded. Although Title VII of the act does not implement regulations on DCMs, it requires that certain OTC derivatives (such as IRS), which were previously bilaterally traded, must also be executed on such exchanges. Contrary to SEFs, which allow open entrance to market participants, DCMs can only be accessed if the counterparty enters a swap contract with a member of the Futures Commission Merchant (FCM).

6.5. Exemptions from the clearing obligation

There are several exemptions to which counterparties can apply for under the Dodd-Frank Act. These exclusions are briefly summarised below.

Commercial end-user exception. This exemption can be applied to counterparties which are classified as non-financial entities making use of SB swaps for hedging[25] purposes or for the mitigation of commercial risk (15 USC 78c- 1(3C)(g)(1)).

The clearing obligation is not applicable to CFTC swaps if one of the counterparties involved in the transaction is (i) a non-financial entity[26], (ii) is using the swap contract

[25] A swap is used to hedge or mitigate commercial risk if: (a) the swap is economically appropriate to the reduction of the person's risks in the conduct and management of a commercial enterprise; and (b) the risks arise from changes in values of assets and liabilities, including changes related to movements of interest rates and foreign exchange rates.

[26] For a counterparty to be classified as a nonfinancial entity, the following needs to be considered: (a) the CEA defines a financial entity as a swap dealer, a security-based swap dealer, an MSP, a major security-based swap participant, a commodity pool, a private fund, certain types of benefit plans under ERISA, or a person predominantly engaged in activities that are in the business of banking or in activities that are financial in nature as defined in section 4(k) of the Bank Holding Company Act of 1956; (b) to be

for hedging purposes or to mitigate counterparty risk and, (iii) reports to the CFTC how it meets in general its financial duties associated with un-cleared swaps.

Treasury affiliates (CFTC Letter No. 13-22). Swap contracts carried out by eligible treasury affiliates can be excluded from the clearing requirement if (i) a non-financial counterparty is the direct owner of the treasury affiliate and is not indirectly owned by a financial counterparty, (ii) the final parent of the affiliate is a non-financial entity, and "the majority of the ultimate parent's wholly and majority-owned affiliates qualify for the end-user exception", (iii) treasury affiliates engage into exempted swaps transactions for hedging and risk mitigation purposes.

Inter-affiliate exception (17 CFR Part 50). The clearing obligation does not apply to swap agreements between affiliates if (i) affiliates share a common ownership (one counterparty is the major direct/indirect owner in the other counterparty or a third party is the direct/indirect major owner in both affiliate counterparties), (ii) an annual disclosure on how the individual affiliates fulfil their financial duties related to un-cleared swaps is provided and (iii) external swaps of affiliates have to be either cleared in the US (or through a comparable domestic regulation) or be excluded from clearing under the Dodd-Frank Act (or a comparable regulation).

FX exclusion. The FX swaps have been excluded from the classification of "swap" in November 2012 by the US Secretary of the Treasury. As a result, FX swaps and FX derivatives which are physically settled are exempted from the clearing obligation.

6.6. Risk mitigation techniques of un-cleared derivatives (17 CFR Part 23)

Risk mitigation techniques are implemented when one or more market participants are swap dealers or major swap participants. Such techniques are summarized below.

- Timely confirmations of un-cleared off-facility swap transactions, which requires each swap dealer and MPS entering a swap operation to confirm transactions as soon as technologically possible;
- Mark-to-market: Swap dealers or MSPs are to inform their counterparties that they (the counterparties) are entitled to request and obtain the daily mark-to-market for cleared swaps from the relevant clearing structures. In case of un-

predominantly engaged in financial activities, the entity generally must either devote 85% or more of its assets to or derive 85% or more of its revenues from financial activities; (c) the list of financial activities in section 4(k) is broad and includes activities such as insurance underwriting and agency, securities brokerage, investment advisory activities, and financial data processing; and (d) small ($10 billion or less in total assets) depository institutions, credit unions and farm credit system institutions are also eligible for the commercial end-user exception.

cleared swaps, instead, it will be the swap dealer or the MSP to be in charge of making available the daily mark (i.e., the mid-market mark) to its counterparties. Amounts for profit, credit reserve, hedging, funding, liquidity, or any other costs or adjustments will not be included in the mid-market mark of the swap. The daily mark will be released to the counterparties during the swap term at the day close of business or at a different time as agreed in writing.

- Portfolio reconciliation, which is a technique that can be applied when both counterparties are (i) swap dealers and/or MPSs and, (ii) non-swap dealers and non-MSPs. For swap transactions in which both counterparties are swap dealers and/or MSPs, portfolio compression must be implemented at least (a) each business day for each portfolio with ≥ 500 swaps; (b) weekly for each portfolio with >50 swaps but <500 swaps on any business day during the week and, (c) quarterly for each portfolio with ≤50 swaps during the calendar quarter. Moreover, each counterparty has the obligation and must have policies to resolve immediately any inconsistency in "a material term of a swap identified as part of a portfolio reconciliation". For swap transactions in which both counterparties are non-swap dealers and non-MSPs portfolio reconciliation must be made at least (a) quarterly for each portfolio with >100 swaps at any time during calendar quarter and (b) annually for each portfolio having ≤100 swaps at any time during calendar year. In addition, every non-swap dealer and non-MSP must dispose of written procedures to resolve any inconsistencies in "the material terms or valuation of each swap identified as part of a portfolio reconciliation".
- Portfolio compression for un-cleared swaps, in which every swap dealer and MSP must have procedures to: (a) timely conclude every entirely offsetting swap contract with another swap dealer/MSP, (b) carry out portfolio compression exercises on a periodic basis with other swap dealers/MSPs and, (c) engage in multilateral portfolio compression exercises with other swap dealers/MSPs. Moreover, any swap dealer/MSP must have procedures for ending completely offsetting swap contracts with non-swap dealers and non-MSPs.

6.7. The Volcker Rule and the Pushout Rule[27]

The *Volcker Rule*, taking its name from the former Federal Reserve Chairman Paul Volcker, is a US regulation that seeks to prevent banks from engaging in some types of speculative activities, such as proprietary trading of securities, derivatives and commodity futures and options carried out with their own accounts, with the specification that these investments are not beneficial for the clients of the banks. That is, banks are not allowed to carry out these types of activities with their own resources to stimulate their returns. The main objective of the Volcker Rule is to dissuade banks from engaging in investments considered too risky.

The *Prohibition Against Federal Government Bailouts of Swap Entities*[28] (also known as Pushout Rule or Lincoln Rule) was proposed by Senator Blanche Lincoln. The primary version of the Pushout Rule impeded banks which were much involved in the swap markets to benefit from different types of Federal intervention (such as Federal deposit insurance or any credit channel). Following several discussions, the range of implementation of such rule has been considerably tightened. In fact, the final version of the Lincoln Rule does not allow only depositary institutions that constitute swap entities[29] to receive Federal assistance.

6.8. Extraterritorial provisions

The Dodd-Frank Act includes two provisions on extraterritoriality: (i) section 722 controlling the extraterritoriality of swap rules and, (ii) section 772 controlling the extraterritoriality of security-based swap rules. These two sections on extraterritoriality determine that Title VII cannot be implemented to swap operations carried out outside the US territory unless such operations infringe anti-evasion rules applied by the CFTC or the SEC. Moreover, section 722 enables the implementation of swap rules to operations that "have a direct and significant connection with activities in, or effect on, commerce of the United States". In addition, non-US swap dealers may be requested to register with the CFtC or the SEC.

[27] American Bankers Association, 2017.

[28] American Bankers Association, 2017.

[29] Containing also certain significant exclusions for qualifying insured depositary institutions which do not enter in the category of swap entities.

7. *A comparison of the European Market Infrastructure Regulation (EMIR) and the Dodd-Frank Act Title VII (Title VII).*

As mentioned in section 2.2., following the 2009 Pittsburgh Summit, the G20 leaders set up several commitments to regulate previously unregulated OTC derivatives markets (fostering transparency and credit and operational risk mitigation). In the European Union, the EU Commission implemented two new different pieces of legislation setting out the rules on OTC derivatives central clearing and platform trading:

(i) The *European Market Infrastructure Regulation* (EMIR), which governs the requirements on central clearing through central counterparties and on OTC derivatives data reporting. This regulation was adopted by the European Parliament in 2012 and was applied from the 1st of January 2013.

(ii) The *Markets in Financial Instruments Directive II* (MiFID II), which is the review of MiFID I (2004) and, among other reforms, specifies that all OTC derivatives transactions should be carried out on trading venues. The European Commission proposed MiFID II in October 2011 and is expected to be applied in 2018.

At the same time, in the United States, *Title VII of the U.S. Dodd-Frank Wall Street Reform* and *Consumer Protection Act*, i.e. the Dodd-Frank Act, outlines rules mandating OTC derivatives to be cleared through central counterparties and to be traded on trading platforms. The Dodd-Frank Act was signed into law by former President Barack Obama, in July 2010.

In general, the new EU and US pieces of legislation implemented the following requirements:

- 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 and ETDs should be reported to trade repositories;
- non-centrally cleared contracts should be subject to higher capital requirements;
- registration, financial and risk management requirements for clearing organisations.

As a consequence, several initiatives have been taking place globally to reform the over-the-counter sector. These efforts may have a significant extraterritorial impact. For market participants engaging in global trading transactions, it may happen that difficulties in "compliance and choice-of-law questions will arise as the new global regulatory landscape for OTC derivatives evolves" (Sidley, 2012). It is also important to keep in mind that other pillars of the global financial system (such as Hong Kong) have set rules to reform the OTCD market; however, these are out of the scope of this research dissertation and will, therefore, not be developed further.

7.1. Comparison between the European Market Infrastructure Regulation and the Dodd-Frank Act

For many aspects, the European Markets Infrastructure Regulation and the Dodd-Frank Act are very alike. However, these similarities may not be as strong to ensure global harmonisation in the financial system (Quaglia, 2012). The European Union and the United States are the principal actors in OTC derivatives trading. Therefore, implementing similar regulatory requirements would be very important to help preventing *gold-plating*, i.e. the risk of regulatory arbitrage (Vinals, 2013).

The core principles of EMIR and of the Dodd-Frank Act seek to achieve the same end-result, namely financial stability. This is a consequence of the strong commitment shown by the EU and the US following the G20 2009 Summit in Pittsburgh to reform OTC derivatives market and therefore, to eliminate regulatory arbitrage.

It is important to notice that, since both regulations are still a work in progress, it is currently not possible to provide an in-depth comparison between the two pieces of legislation. In what follows, the main similarities and differences between EMIR and the Dodd-Frank Act are summarised.

7.2. Similarities and differences between EMIR and the Dodd-Frank Act

The European Union and United States legislations both require central clearing and reporting of a wide class of OTC derivatives and give regulators the discretion to decide in what circumstances the clearing obligation must be applied.

Some experts argue that the EMIR is less onerous for end-users. In the United States, the clearing requirement is applicable to any counterparty that enters a transaction with an eligible contract, with a minute exemption for non-financial counterparties trading for hedging purposes. In the European Union, the obligation of central clearing is only applicable to financial and non-financial counterparties whose transactions (except some hedges) exceed certain pre-defined thresholds (as previously mentioned in Section 2.2.). Moreover, both regulations impose a wide obligation on market participants to report all derivatives transactions to authorised/registered trade repositories and to maintain the records of their trades.

Both EMIR and the Dodd-Frank Act mandate margin requirements for un-cleared derivatives trades, which envisage the collection of capital to be used in the event of default from one of the counterparties.

Both regulations entail registration and business conduct rules for dealers (bilateral trading). The US regulation widens registration, conduct of business, margins, capital and other risk mitigation requirements to the major swap participants, whereas the EU regulation (under MiFID) implements risk mitigation techniques (such as timely confirmation, reconciliation, compression and dispute resolution) to all financial and non-financial market participants and duties to carry out daily valuations and exchange of collateral to all entities whose transactions exceed the clearing thresholds.

Moreover, the two regimes foster cross-border clearing by granting the recognition/exemption of non-domestic central counterparties. However, as supported by ISDA, they are not as flexible when dealing with the cross-border provision of trade repositories activities, "with the US requiring compliance with full US requirements and the EU making recognition of non-EU repositories conditional on conclusion of a treaty".

The US regulatory framework mandates the trading of OTC derivatives eligible for central clearing through swap execution facilities or designated contract markets, real-time post trade transparency for cleared derivatives transactions and position limits. In the EU regulatory framework, these arguments are separately dealt with as part of MiFID II.

EMIR does not include an equivalent to the US *push-out rule* (limiting banks' derivatives trading activities) or to the *Volcker rule* (limiting proprietary trading transactions of banks or the provisions letting regulators to restrain bank ownership of CCPs).

Contrary to the Dodd-Frank Act, EMIR includes exemptions from clearing and other risk mitigation techniques for intra-group transactions. However, the CFTC (US regime) has introduced regulations excluding operations between affiliates from the clearing obligation (where both affiliates are financial entities).

One of the main differences between the two legislations relates to the extra-territorial implementation of their rules. More specifically, the CFTC has implemented guidance that "would impose the US swap dealer requirements on non-US persons that engage in more than de minimis swap dealing activities with US persons, but non-US persons may be able to comply with certain swap dealer requirements through compliance with home-country rules" (Harvard Law School, 2014). Instead, EMIR outlines rules on some transactions between EU and non-EU counterparties (and between non-EU counterparties) as well as a broad provision that considers a trade to have met the clearing, reporting and risk mitigation requirements where at least one of the entities is located in a non-EU area that the European Commission has deemed to have an equivalent regulatory framework which is implemented in a fair and non-distortive way.

Table 6 below summarises the main similarities and differences between the European Markets Infrastructure Regulation and the Dodd-Frank Act.

	Clearing obligation applies to eligible OTC transactions	Reporting obligation applies to OTC transactions	Margin requirements apply to un-cleared OTC transactions	Capital requirements apply to un-cleared OTC transactions	Authorisation/registration and business conduct requirements apply
OTC derivatives dealers	EU: Yes ✦ US: Yes +	EU: Yes US: Yes	EU: Yes ✦ US: Yes ✱	EU: Yes ✦ US: Yes	EU: Yes (under MiFID) US: Yes
Other financial counterparties/entities	EU: Yes ✦ US: Yes +	EU: Yes US: Yes	EU: Yes ✦ US: Yes (if MPS or if counterparty a dealer/MPS✱)	EU: Yes ✦ US: No (unless MPS)	EU: No (except for existing sectoral rules) US: No (unless MPS but bank activities limited by pushout rule)
Non-financial counterparties/entities	EU: No (except NFCs whose positions exceed clearing threshold✦) US: Yes (but NFCs may qualify for exemption for transactions hedging commercial risk+)	EU: Yes US: Yes	EU: Yes (if own positions exceed clearing threshold✦) US: Yes (if MSP or if counterparty a dealer/MPS + possible exemptions for end-users✱)	EU: No US: No unless MPS	EU: No US: No unless MPS

+ Under the Dodd-Frank Act, derivatives subject to central clearing must also be traded through a SEF or DCM, unless one of the counterparties is a NFC which opts for the clearing exemption, and compulsory real-time public reporting will apply to all cleared trades whether or not subject to the clearing obligation. The Dodd-Frank Act also mandates the establishment of position limits for OTC derivatives. In the EU, trading and transparency topics are separately address under MiFID.
✦ Under EMIR, the clearing requirement applies to transactions between FCs, NFCs whose positions (excluding certain hedges) exceed a specified clearing threshold and certain non-EU counterparties. EMIR requires FCs and NFCs over the clearing threshold (and some non-EU counterparties) to have policies for the exchange of collateral and to carry out daily valuations of transactions, but additional risk mitigation rules apply to all FCs and NFCs. EMIR also requires FCs to hold appropriate capital for uncollateralised risk.
✱ The Dodd-Frank Act requires regulators to impose margin requirements on dealers and MSPs for their un-cleared transactions, without an express exemption for cases where the counterparty to the un-cleared transaction is an un-user (although US legislators have indicated that margin requirements should not apply to end-users).

Source: Harvard Law School

<u>Table 6</u> – Main differences and similarities between EMIR and the Dodd-Frank Act

III. *Trade repositories (TRs): the reporting system*

The 2008 financial crisis highlighted a severe lack of transparency in the over-the-counter sector and the need to correct this market inefficiency. Over the past several years there has been a coordinated effort by public and private sector entities to improve the post-trade infrastructure for the OTC derivatives market (IOSCO, 2010). One of the results of this commitment was the instalment of *trade repositories* (TRs), following the 2009 G20 meeting. TRs are registries that centrally collect and maintain electronic databases of the records of derivative contracts traded over-the-counter (ESMA, 2017). Their primary function is to enhance *market transparency* by providing good quality data to the relevant public and private market participants and by ensuring timeliness and appropriateness of the disclosed information. Passacantando (2012) adds that TRs also mitigate systemic risk and help assessing financial stability. Moreover, TRs protect investors in the event of a crisis (Strate, 2013) and detect and prevent market abuse (IOSCO, 2013). Heitfield (2014) argues that they also perform the task of conducting market surveillance and enforcement, supervising market participants and conducting resolution activities.

If the access to a TR is not possible, OTC derivatives transaction data must be stored "by individual counterparties and possibly other institutions providing services to market participants (e.g. prime brokers, CCPs, trading platforms and custodians), often registered using proprietary systems in various formats" (Passacantando, 2012). It follows that, one of the significant advantages of a TR is that it encourages *standardisation* of trade data and ensures quality of and access to OTC derivatives post-trade information (IOSCO, 2013). Nevertheless, information recorded by TRs cannot be considered equivalent to the data registered by individual counterparties. It is therefore fundamental that market participants keep recording their own transaction data and compare it with their counterparties or TRs in a consistent and periodic manner (IOSCO, 2011).

Moreover, as stated in the Consultative Report published by the Bank of International Settlements (BIS, 2011), a well-structured trade repository can help and enhance the ability of a central counterparty to centralise OTCD transactions in a safe and efficient way, particularly if the CCP is directly relying on the information held by a TR to perform its clearing services. TRs can also promote market transparency for the financial instruments and market segments which are not yet receiving the benefits from central clearing. In the European Economic Area (EEA), OTC derivatives trades reporting is mandatory for all OTCD contracts (both eligible and non-eligible for CCPs' clearing) as well as for ETDs.

1. Reporting Obligation (Art. 9 under EMIR)

1.1. Who should report under EMIR?

Under EMIR, both counterparties to the trade are subject to the reporting obligation (*double-sided reporting*), i.e. the buying counterparty and the selling counterparty must provide one of the registered TRs with the relevant information on the OTC derivative contracts transaction. This duty applies to both financial[30] and nonfinancial[31] market participants. The only exception concerns single individuals who, however, mostly trade with financial counterparties, which are then required to report such transactions. EMIR also outlines duties and requirements concerning nonfinancial counterparties, hence amplifying the scope of the regulation.

1.2. Which classes of derivatives fall under the reporting obligation under EMIR?

Under EMIR, both OTC derivatives and exchange traded derivatives (ETDs) are subject to the reporting obligation, whether or not being clearing-eligible. Under Article (2)(7) of EMIR, an *OTC derivatives contract* is defined as a derivative contract the execution of which does not take place on a regulated market or on a third country market considered as equivalent to a regulated market. On the other hand, ETDs are standardised derivative contracts that trade on regulated markets that are more liquid and do not carry default risk. The asset classes of derivatives that fall under EMIR are detailed in Annex I, Section C.4-C.10 of MiFID (2004) and are listed below.

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[30] "Financial counterparty" means an investment firm authorised in accordance with Directive 2004/39/EC , a credit institution authorised in accordance with Directive 2006/48/EC, an insurance undertaking authorised in accordance with Directive 73/239/EEC, an assurance undertaking authorised in accordance with Directive 2002/83/EC, a reinsurance undertaking authorised in accordance with 2005/68/EC , a UCITS and, where relevant, its management company, authorised in accordance with Directive 2009/65/EC, an institution for occupational retirement provision within the meaning of Article 6(a) of Directive 2003/41/EC and an alternative investment fund managed by AIFMs authorised or registered in accordance with Directive 2011/61/EU (EMIR, Article (2)(8)).

[31] "Nonfinancial counterparty" means an undertaking established in the Union other than the entities classified as financial counterparties (EMIR, Article (2)(9)).

(i) Options, futures, swaps, forward rate agreements and any other derivative contracts relating to securities, currencies, interest rates or yields, or other derivatives instruments, financial indices or financial measures which may be settled physically or in cash;

(ii) Options, futures, swaps, forward rate agreements and any other derivative contracts relating to commodities that must be settled in cash or may be settled in cash at the option of one of the parties (otherwise than by reason of a default or other termination event);

(iii) Options, futures, swaps, and any other derivative contract relating to commodities that can be physically settled provided that they are traded on a regulated market and/or an MTF;

(iv) Options, futures, swaps, forwards and any other derivative contracts relating to commodities, that can be physically settled not otherwise mentioned in C.6 and not being for commercial purposes, which have the characteristics of other derivative financial instruments, having regard to whether, inter alia, they are cleared and settled through recognised clearing houses or are subject to regular margin calls;

(v) Derivative instruments for the transfer of credit risk;

(vi) Financial contracts for differences.

(vii) Options, futures, swaps, forward rate agreements and any other derivative contracts relating to climatic variables, freight rates, emission allowances or inflation rates or other official economic statistics that must be settled in cash or may be settled in cash at the option of one of the parties (otherwise than by reason of a default or other termination event), as well as any other derivative contracts relating to assets, rights, obligations, indices and measures not otherwise mentioned in this Section, which have the characteristics of other derivative financial instruments, having regard to whether, inter alia, they are traded on a regulated market or an MTF, are cleared and settled through recognised clearing houses or are subject to regular margin calls.

Note that EMIR does not treat transferable securities, money-market instruments and units of collective investment undertakings.

1.3. Minimum details of the data to be reported to trade repositories

"The Commission Delegated Regulation (EU) No 148/2013 of 19 December 2012 supplementing Regulation (EU) No 648/2012 of the European Parliament and the Council on OTC derivatives, central counterparties and trade repositories with regard to regulatory technical standards on the minimum details of the data to be reported to trade repositories" sets the information that must be delivered to TRs.

1.4. To whom should be reported?

Given the global nature of OTC derivatives markets, there are some discussions on whether a single *global* trade repository would be more suitable to improve market efficiency and transparency rather than several *local* trade repositories. Passacantando (2012) believes that it is very challenging to answer this question in a definite way, since, as of today, the industry has got little experience and it would be premature for authorities to suggest an ad-hoc solution. The author argues that, on the one hand, a *global solution* would surely (i) unify and implement a common approach as a reporting standard and (ii) promote economies of scale and cost reduction in data reporting. On the other hand, a "de facto monopoly" may result in higher prices for users, though this risk can be mitigated if "the TR is owned and governed by the users".

On this issue, Passacantando observes that, in many jurisdictions, relevant authorities are promoting the instalment of *local* TRs for the following reasons: (i) local TRs are easier to monitor, (ii) local small players can access them more comfortably, and (iii) operational risks would be lowered by a plurality of infrastructures, which could, for example, specialize in different product lines. The author recommends that authorities, given that they cannot promote the institution of a global monopoly, should keep in mind that data fragmentation or lack of access to trade information could hamper TRs to achieve their ultimate aims.

As stated by the European Commission and the European Central Bank, a position of neutrality on the issue is acceptable if and only if authorities: (i) are able to access with no restriction the data stored in TRs, (ii) implement common oversight frameworks, (iii) engage in strict cooperation to oversee TRs, and (iv) develop suitable processes for data aggregation.

Currently, in the European Economic Area (EEA), there is neither a global nor an extremely local solution. In fact, there are a total of seven trade repositories authorised and registered by ESMA.

Table 1 presents the list of such TRs and the relevant asset classes with which they deal.

Trade Repository	*Asset Class*
DTCC Derivatives Repository Ltd. (DDRL)	All asset classes
Krajowy Depozyt Papierów Wartosciowych S.A (KDPW)	All asset classes
Regis-TR S.A	All asset classes
UnaVista Limited	All asset classes
CME Trade Repository Ltd. (CME TR)	All asset classes
ICE Trade Vault Europe Ltd. (ICE TVEL)	Commodities, credit, equities, interest rates, FOREX
Bloomberg Trade Repository Limited	All asset classes

Source: ESMA list of registered trade repositories (last update 7 June 2017)

<u>Table 1</u> - List of trade repositories registered by ESMA

All the data concerning OTC derivatives contracts and exchange traded derivatives transactions must be disclosed to one of the registered trade repositories.

2. Key risks emerging from trade repositories' functioning (IOSCO, 2010)

There are several *risks* that trade repositories face which could lead to a negative downturn of the OTC sector, if not appropriately managed.

TRs are registries that centrally store OTC derivatives transaction data and may potentially specialise in specific derivatives asset classes, thereby becoming a "single source of information for ad-hoc segments in the OTC derivatives market". There are many risks that could hinder the "safe and efficient functioning of a TR", for example "deficiencies in *operational risk*[32] management and business continuity arrangements (operational reliability[33]), as well as data inaccuracy, loss and leakage (safeguarding of data)". Moreover, having access to transaction data in a timely and reliable manner gives a more accurate and deeper understanding of the OTC derivatives market and enables relevant authorities to supervise the market and its players. Therefore, TRs failing to report good quality data could cause great damage to the private and public market participants (hampering market transparency and data availability), undermining the main function of the TR.

[32] Operational risk is the risk of loss resulting from people, inadequate or failed internal processes and systems, or from external events" (def. from http://www.osfi-bsif.gc.ca/)

[33] The reliability of a system or software subsystem in its actual use environment. Operational reliability may differ considerably from reliability in the non-operational or test environment.

TRs are a fundamental pillar of the framework sustaining the OTCD markets, since data stored in a TR may be implemented as source of analysis by many market participants, such as relevant authorities and central counterparties. For this reason, consistent availability and adequacy of information registered in a TR is of crucial importance. Robust controls of operational risk and business continuity plans are key prerequisites for ensuring the ongoing availability of information which are commensurate with the ability of a TR's operations to grow larger (scalability). Moreover, a TR may be one of the hubs of a network connecting different entities (e.g. central counterparties, dealers, custodians, service providers, etc.). For this reason, it is crucial to designate and operate the TR in such a way that the probability of operational disruptions spreading to the linked entities is minimised.

Trade repositories must guarantee data protection by ensuring convenient quantitative and qualitative conditions which, consequently, increase the confidence that market participants have in TRs. In fact, post-trade derivatives information should be safeguarded "from loss, leakage, unauthorised access and other processing risks". Therefore, it is crucial for TRs to implement "information security and system integrity objectives to its own operations" to ensure data protection during the phases of transmission and disclosure. Moreover, the members of a TR and entities connected with the TR should have vigorous "operational capacity and internal controls, and this should be part of a TR's access and participation requirements". Since alternative sources OTC derivatives information are very restrained, the role of TRs to increase market transparency and to disclose data to the relevant authorities is very important. In fact, if TRs are not available, trade information is usually registered by single market participants. This modality of data storage hampers the relevant authorities and the public to gather a thorough image of the OTC derivatives market, since "quality, quantity and availability of data vary".

By providing timely and adequate data, trade repositories can truly (i) enhance the capacity of the relevant authorities and the public to sort out and assess lurking systemic risks originated from the OTC derivatives sector to the global financial system and (ii) significantly increase the capacity of the relevant authorities to supervise the risks associated with individual counterparties and market participants.

"Against this background, robust arrangements to ensure effective disclosure of TR data to both relevant authorities and the public are crucial".

3. *Authorities access to TRs data (IOSCO, 2013)*

Trade repositories are a new type of financial market infrastructure (FMI[34]) and have today a crucial role in supporting OTC derivatives markets. The activity of centralised collection, storage and disclosure of OTC derivatives trade information carried out by TRs (operating under effective risk controls) may significantly increase market transparency and, consequently, contribute to the stability of the financial system and to the prevention of market abuse. TRs perform also the fundamental function of standardising and normalising the records of OTC derivative contracts trades "across a critical mass of market participants and consequently allowing for otherwise unavailable systemic views of the OTCD markets".

Following the G20 consultation on OTC derivatives contracts trade information reporting, it has been decided that the relevant authorities must be able to gather all the data required to perform and fulfil their respective mandates. The faculty of having access to the data stored in TRs demonstrates that there has been an incredible evolution from the methods originally adopted by the relevant authorities to gather information on OTC derivative contracts. Traditionally, there was a *decentralised mechanism* to access trade data, i.e. entities would gather information directly from each other. Today, thanks to the instalment of TRs, there has been a shift to a more *centralised mechanism*, i.e. TRs collect and record OTC derivatives information, which, in turn, makes it easier for authorities to access data. It follows that increasing the use of TRs would help authorities to perform their tasks in a more efficient and effective manner.

Such centralised mechanism has taken root or is taking root in the legal and regulatory framework of an increasing number of authorised areas of competence. In this setting, it could happen that some authorised entities request trade data held by a TR relying on jurisdiction-specific legal rights (different from the ones regulating the TR). Regardless of the TR's location or regulatory framework, the access to such information must be granted. Moreover, it may be mandatory for the trade repository

[34] IOSCO, 2011: FMIs play a critical role in the financial system and the broader economy. The term FMI refers to systemically important payment systems, such as CCPs and TRs. These infrastructures facilitate the clearing, settlement, and recording of monetary and other financial transactions, such as payments, securities, and derivatives contracts (including derivatives contracts for commodities). While safe and efficient FMIs contribute to maintaining and promoting financial stability and economic growth, FMIs also concentrate risk. If not properly managed, FMIs can be sources of financial shocks, such as liquidity dislocations and credit losses, or a major channel through which these shocks are transmitted across domestic and international financial markets.

to adhere to such data requests as a requisite for the TR's acceptance/eligibility in the authority's jurisdiction to operate as a TR pursuing OTC derivative contracts data reporting conditions. Thus, a TR may be legally bounded to disclose the information sought by authorised entities performing a specific analysis.

Furthermore, the centralisation of OTC derivatives transaction information highlights the need to impose *confidentiality constraints* on the management of market participants' trade information, which legally restrain the use and disclosure of such data. In fact, trade repositories will often store information that usually requires confidentiality protection if such information is disclosed directly to an authorised entity with legal jurisdiction over the market participant or the transaction. Privacy issues gain relevance as the network of authorities willing to have access to TR data becomes bigger. It is therefore crucial to ensure control and security to overcome these confidentiality worries while granting the authorised entities the data they need to accomplish their mandates. In the absence of data protection, certain authorities may not be willing to allow market participants trading in their jurisdiction to release data to TRs established in different jurisdictions. This obstacle could cause authorities to demand the instalment of TRs in their area of competence. Effective data management is crucial to minimise confidentiality concerns and, consequently, to avoid the instalment of unnecessary TRs. In fact, increasing TRs focusing on the same OTC derivatives class could worsen the process of gathering information in an effective and efficient manner.

4. Data aggregation

The main purpose of *data aggregation*, in the EMIR framework, is to enable authorised entities to access TR data, which, consequently, would ease the accomplishment of the objectives set by such entities in their mandates. These include "assessing systemic risk, conducting market surveillance and enforcement, supervising market participants, conducting resolution activities, and increasing the transparency of OTC derivatives markets" (IOSCO, 2011). Therefore, data aggregation is fundamental to get an extensive view on the OTC derivatives market.

4.1. Trade repositories help assessing systemic risk (Heitfield, 2014)

There are many types of mandates that relevant authorities could perform. One of the most significant relates to the *assessment of systemic risk*. Authorities being responsible for assessing systemic risks are worried because such risk (i) could damage many investors and market participants and (ii) it could have a negative downturn to the entire financial system. Mandates connected to systemic risk can have a macro or a micro orientation. Macro-prudential supervisors could oversee systemic risks that may threat financial stability, arising from changes in the financial system, while, at the same time, taking into consideration macroeconomic trends. Micro-prudential supervisors may be legally bounded to analyse and acknowledge systemic risks that they find while carrying out the objectives of their mandates. Adequate organisation between macro and micro structural aspects is usually achieved, which, in turn, helps exchange and standardisation of data, "avoids the duplication of tasks and fully exploits the expertise of the authorities in their respective fields". To find possible conditions that generate systemic risk, authorised entities will have to gather information concerning (i) market participants, (ii) market characteristics and (iii) infrastructure of OTC derivatives market. Information stored in trade repositories should support determining if the default of market counterparties could propagate to other participants. Therefore, TRs could help relevant authorities analysing systemic risk by providing suitable data on "size, concentration, interconnectedness and structure with respect to institutions". The data that will be disclosed will depend on the specific authorities' mandates.

4.2. Opportunities and challenges in data aggregation (IOSCO, 2011)

National authorities are currently cooperating to implement a harmonised framework for the regulation and supervision of structured finance products traded in OTC markets. An increasing number of jurisdictions is now mandating to report OTC derivatives trade information to TRs and requires that authorised entities must be able to carry out legal entity and product aggregation "across and within TRs and asset classes". To achieve this objective, international cooperation is needed.

It is very challenging to increase authorities' capacity to aggregate OTC derivatives transaction information, for four main reasons. First, it is very hard to reach a uniform agreement on the techniques and tools to use for data aggregation. A harmonised approach could surely increase the possibility of achieving the objectives set by EMIR and would, at the same time, lower the potential regulatory arbitrage. Second, data aggregation among different trade repositories (from the same asset class or from different structured finance products) is difficult. A third challenge is represented by *temporal nature*, i.e. regulations on data reporting and on data aggregation are different across time and among jurisdictions. Lastly, it is very complex (technical) to aggregate trade information on the same type of financial product across several TRs.

Currently, international authorities are cooperating to find tools that will ease and improve data aggregation methods. The 2012 CPSS-IOSCO report on principles for financial market infrastructure suggests that "an FMI should use, or at a minimum, accommodate internationally accepted reference data standards for identifying financial instruments and counterparties".

4.3. Three main methods to carry out data aggregation

To gather a complete and rigorous perspective on structured finance products market, it is necessary some sort of data aggregation. Without data aggregation, it would be harder to achieve the goals set in EMIR Regulation. Despite having information of OTC derivatives transactions stored in several TRs (which entails data fragmentation), the current structure of trade repositories provides some tools to allow authorised entities to analyse the entire global OTC derivatives market in a more detailed manner.

Aggregating data held by TRs makes it easier for authorised entities to spot possible shortcomings in the OTC market and estimate systemic risk.

In 2014, the FSB released a study on potential solutions to create a mechanism for producing and sharing global aggregated data. One of the main considerations was that "it is critical for any aggregation option that the work on standardisation and harmonisation of important data elements be completed, including in particular through the global introduction of the Legal Entity Identifier (LEI)" (Aggregation Feasibility Study, 2014).

(a) Legal entity aggregation

This technique enables authorised entities to oversee and study possible systemic risks generating from structured finance products transactions, "attributable to a group of legal entities sharing common affiliation" (Reserve Bank of India, 2013). Such information can help authorities to estimate "concentration and contagion risk associated with a group and its counterparties" (IOSCO, 2012). For example, an authority could consider together a counterparty's OTC transaction with its collateral or guarantor and credit sources as well as with other entities under the relevant *master agreement*[35]. This technique of data aggregation produces a *report* on "OTC derivatives activity attributed to a group of related entities" and it can be conducted among relevant TRs to establish *group-level concentrations* on a global scale (European Central Bank, 2016). Consequently, authorities are able to submit "large exposures" (transactions) to a stronger valuation at the group level, which, in turn, could require supplementary investigation on the risk arising from the concentration of a group's sizable position and the potential propagation risk to other market participants if default occurs.

Authorised entities carrying out this technique of data aggregation would require further information in addition to that held by TRs.

When such aggregation occurs, relevant authorities should be in a condition to associate the counterparty to a specific transaction to the entity expected to take responsibility for it in case of default of the counterparty.

To conduct legal entity data aggregation, each legal entity must be identified with a *Legal Entity Identifier (LEI)*. A LEI is a standard, global and harmonised 20-digit *alphanumeric code* which makes it easier for relevant authorities to adequately identify OTC derivatives transactions to a single counterparty or group of counterparties (both financial and non-financial counterparties).

LEIs are used to deliver a detailed and standardised description of a specific legal entity engaging in financial transactions (not only OTCD transactions). More specifically, a LEI is a single data field containing the minimum reference information to identify the legal entity holding such code. Authorities can also have access to further data such as "on the hierarchical relationships and other affiliations of the entity, or on business units within an entity (such as a branch)", which can be then used to carry out different forms of data aggregation.

Moreover, the LEI system not only can be used as an aggregation instrument, but can also deliver important information on the interconnectedness among financial authorities relevant for financial policy making.

Prior to 2012, it was possible to identify a single entity by different names or codes. Consequently, an automated system could read these references as different firms. For example, if the investment bank Goldman Sachs could have been identified as

[35] Standard document generally implemented to control OTCDs trades, specifying basic terms to a structured finance product trade between two market participants (ISDA, 2017).

“Sachs”, “G. Sachs”, “Goldman S.” or “Goldman Sachs” a mechanic system would not have been able to classify all the trading data to the same legal entity and, therefore, data aggregation was extremely complex or even impossible.

In 2011, the group of 20 international leaders evidenced several shortcomings in the existing identification systems and proposed the implementation of a new and universal one. In response to such proposal, “the Financial Stability Board assembled a global set of financial regulators, international organisations and other experts to develop a set of principles and requirements necessary for a new identification system” (Kennickel, 2016). The result was the *Global Legal Entity Identifier System* (GLEIS): a new mechanism created to guarantee the best quality information globally available, improve transparency and safeguard the public interest which, by releasing LEIs, today delivers unique identification codes to market counterparties engaging in financial trades around the world. GLEIF oversees a web of partners (i.e. LEI issuing organisations) to ensure reliable services and adequate accessible data for a worldwide harmonised LEI.

After the 2008 financial crisis, the main objective of the G20, the FSB and several regulators around the globe was to increase transparency in the OTC derivatives market through the implementation of the LEI. This commitment has proven to be very successful. Currently, the legal entities which are primarily subject to the LEIs are those located in the U.S. and Europe, “where regulations require the use of LEIs to uniquely identify counterparties to transactions in regulatory reporting”. In such jurisdictions, public authorities use the LEI to assess risk, engage in corrective actions and, if necessary, enhance the quality of financial data and try to minimise market abuse.

There are two other data aggregation techniques that are worth to be mentioned: product aggregation and bilateral portfolio aggregation, which are briefly discussed below.

(b) Product aggregation (ESMA, 2017)

Product aggregation refers to collecting OTC derivatives “activity in one product with other OTC derivatives products sharing common risk factors”. These shared risk components might be observable in “historically price-correlated OTC derivatives”. Such technique could produce very important information for the relevant authorities to estimate speculative positions of a counterparty or a group of

counterparties and could be useful to supervise the level of exposure implied in a group of financial products.
In this setting, regulators have introduced the *Unique Product Identifier* (UPI), an identification code to uniquely tag accurately the derivative products being traded.

(c) Bilateral portfolio aggregation (ESMA, 2017)

Authorised entities could be willing to gather or be admitted to a *bilateral portfolio* view on two counterparties OTC derivatives relationship, which could be obtained approximately by using the data held by TRs. "A *gross* bilateral portfolio view would present the OTC activity between two counterparties across all asset classes and would therefore be representative of aggregate data attributed to both parties across all TRs". It would also be interesting to analyse a *net* bilateral portfolio, obtained by netting the positions between the two counterparties "and the exchange of collateral based on the netting and collateral agreements between the parties".
Moreover, *Unique Trade Identifiers* (UTIs) have been introduced to identify the transactions that take place in OTC derivatives market.

Overall, when a transaction is reported to a TR, regulators are willing to have (i) a LEI, to identify each counterparty (Article 3), (ii) an UTI, to get the identity of the specific transaction (Article 4) and (iii) an UPI, to get what has been exchanged (Article 4a), (Grody, 2014).
Professor Lucantoni (2017) adds that these Implementing Technical Standards will become applicable from Novermber 1st 2017 and relate to compulsory employment of LEIs, ad-hoc requirements for the reporting of swaps and exchange of collateral, criteria for the creation of UTIs and more broadly the explanation of data standards and formats. The Professor also states that the volume of variables to be reported for every trade is very large, including information on counterparties, details on the characteristics of the contract (for example, type of derivatives, underlying assets, prices and amount outstanding), information on the platform on which the derivative trade was carried out or centrally cleared, valuation and collateral and life-cycle events. Therefore, reporting under EMIR involves colossal amounts of information.

IV. Central Counterparties (CCPs): the clearing system

Another output resulting from the new regulatory framework to reform OTC derivatives markets is the central clearing of OTC derivatives. Central counterparties (CCPs) play an increasingly important role in Europe and are considered fundamental financial market infrastructures and key pillars of the European financial system.

Under Article 2(1) of EMIR, a *central clearing counterparty* (CCP) is defined as a financial market infrastructure that stands between counterparties to the contracts traded on one or more financial markets, becoming the buyer to every seller and the seller to every buyer. In the setting of EMIR, a CCP stands between OTC derivatives counterparties, insulating them from each other's default (Duffie and Zhu, 2011). As such, the CCP effectively guarantees the obligations under the contract agreed by the two (financial or nonfinancial) counterparties: if one counterparty defaults, the other is preserved thanks to the default management processes and internal resources of the CCP. Moreover, by centralising transactions, CCPs are able to simplify the complex web of interdependence that characterises the OTC derivatives market, thereby reducing the overall level of exposures and making the trading network more transparent.

The CCP runs a "matched book": every transaction entered in with one counterparty is always offset by an opposite transaction taken on with another counterparty (Rehlon, 2013). Therefore, CCPs do not bear *market risk*, i.e. losses that CCPs would suffer due to changes in market value of their outstanding positions. In this setting, central clearing provides (i) a ground for centralised risk management, through multilateral netting, collateralisation and loss mutualisation, (ii) efficient management of liquidity and (iii) data processing mechanisms, such as trade recording and reporting, which benefit the clearing members of the CCP. However, central clearing also carries some disadvantages, such as the risks in terms of credit concentration, liquidity, operational, and legal framework (Steigerwald, 2013).

CCP's activities are carried out on its own interest and for the collective benefit of its clearing members, by implementing risk management procedures and installing operational mechanisms to help the settlement of centralised trades. Moreover, CCPs perform a crucial role in the response to and resolution of possible defaults of its clearing members and other events that might impede their correct functioning. In fact, despite netting out market risk, CCPs are extremely exposed to *counterparty credit risk*, i.e. the risk that one of the counterparties is not able to meet its obligations with the

CCP. If this occurs, the CCP book is unmatched, and market risk becomes positive. This is why it is fundamental for the CCP to implement adequate and robust resolution techniques to defaulting members. The performance of such function by the CCPs contributes to the alignment of their incentives with the interests of their clearing members, who directly rely upon the CCP to carry out those transactions and who are subject to the default risk of a clearing member or other events that may prevent the CCP from settling such transactions.

By interposing itself between all transactions with its clearing members (to which it guarantees the settlement), CCPs are extremely interconnected with the market participants and financial markets (Wendt, 2015). Therefore, CCPs represent crucial hubs in the network. Their services or bankruptcy may have extremely high externalities on its clearing members and in the financial system, such as credit losses and liquidity shortages. For this reason, central banks and regulators usually treat CCPs as systemically significant institutions and subject these clearing providers to strict supervision. Their systemic significance made them *too-interconnected-to-fail*, implying that their default could cause disastrous consequences to the financial system and to the global economy and that governments would adopt any measure to avoid or save them from defaulting.

1. CCP clearing: actors involved

There are four main actors involved in central clearing: (i) the CCP, (ii) clearing members, (iii) clients and, (iv) indirect clients. Article 2 of EMIR defines these actors as follows.

A *central clearing counterparty* (CCP) is a legal person that interposes itself between the counterparties to the contracts traded on one or more financial markets, becoming the buyer to every seller and the seller to every buyer. Currently, there are 17 EU-based CCPs and 28 non-EU-based CCPs which are authorised to provide services and activities in the Union (Table 7). The national competent authorities of each Member State are in charge of providing the authorisation to firms (based in the EU) that want to offer CCP services. CCPs based outside the EU who want to offer clearing services within the EU need to be recognised by ESMA.

Name of CCP	*Country*	*Name of CCP*	*Country*
Nasdaq OMX Clearing AB	Sweden	CME Clearing Europe	United Kingdom
European CCP N.V.	Netherlands	CCP Austria	Austria
KDPW_CCP	Poland	LME Clear	United Kingdom
Eurex Clearing AG	Germany	BME Clearing	Spain
Cassa di Compensazione e Garanzia S.p.A	Italy	Athens Exchange Clearing House	Greece
LCH SA	France	ICE Clear Netherlands B.V.	Netherlands
European Commodity Clearing	Germany	OMIClear	Portugal
LCH Ltd	United Kingdom	ICE Clear Europe Limited	United Kingdom
Keler CCP	Hungary	**+ 28 non-EU CCPs recognised under EMIR**	

Source: ESMA list of authorised CCPs (last update 8 June 2017)

Table 7 – List of authorised CCPs to provide services in the European Union under EMIR

A *clearing member* (CM) is an undertaking which participates in a CCP and which is responsible for discharging the financial obligations arising from that participation (Article 2(14)). Clearing members can be of three types: (1) *a general clearing member* (GCM), that is a CM that clears its own trades, those of its clients and those of non-clearing members; (2) *direct clearing member* (DCM), that is a CM that clears its own trades and, (3) *non-clearing member* (NCM), that is a participant of a trading venue where the GCM trades but which does not have access to the CCP. Clearing members are *direct* members of the CCP. To become a CM, an entity must satisfy certain basic *admission requirements*, including (a) be established in a MS of the EU, Switzerland or Norway, (b) must receive authorisation from the relevant national competent authority, (c) must have a liable equity fund, EUR 30 million for GCMs and EUR 7.5 million for DCMs, (d) must contribute to the clearing fund with EUR 3 million for GCMs and EUR 0.5 million for DCMs, (e) minimum credit rating for the clearing member, (f) risk management capability, namely that the CM is able to independently assess the risks of its own portfolio and (g) operational capabilities, namely that the CM must show that it is capable of providing a fast response to information demands or demands to deposit more collateral from the CCP. Moreover, CMs must comply with the CCP's requirements, post initial margins and make transfers of variation margins (provides/receives) to/from clients/CCP. The CCP controls at least one time a year if its CMs still comply with these admission requirements.

A *client* is an undertaking with a contractual relationship with a clearing member of a CCP which enables that undertaking to clear its transactions with that CCP (Article

2(14)). Clients must provide initial margins to the CM and they provide/receive variation margins to/from CM.

An *indirect client* is a client of a client of a clearing member. They comply *indirectly* with the clearing obligation (Article 4(3) of EMIR) because they are not able to be direct members of the CCP. Indirect clients are seen as small financial counterparties (SFCs), such as mid-sized regional banks or commodity producers. For example, a SFC may not have enough liquidity to pay the CCP's fees, which usually range from EUR 95.000 to EUR 265.000 (a considerable fixed cost for small financial counterparties which, in general, have limited open positions in OTC derivatives). Therefore, as stated in ESMA Annual Report of 2016, indirect clearing services enable access to CCPs to a larger set of counterparties, therefore widening the scope of central clearing.

The hierarchical relationship that connects these entities is illustrated in Figure 10 below.

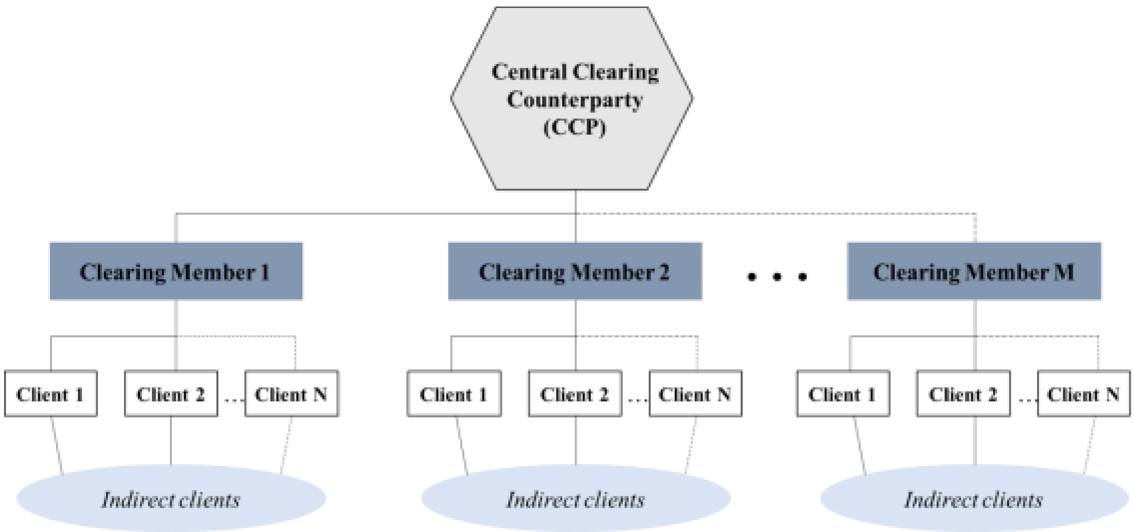


Figure 10 – Actors involved in central clearing

1.1. *Clearing, client clearing and indirect client clearing*

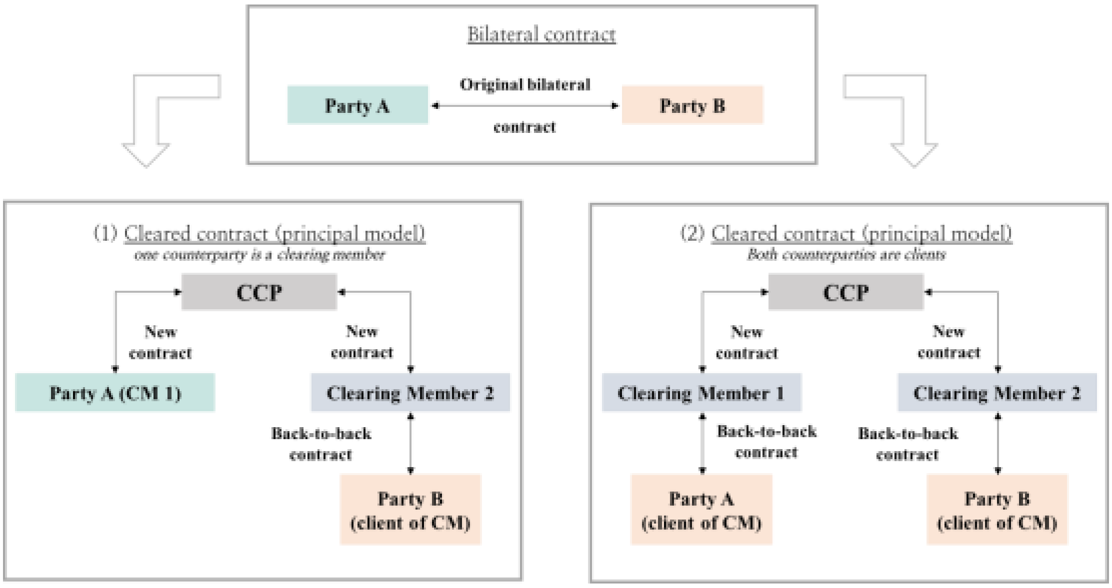
Broadly speaking, *clearing* is defined as the process of establishing positions, including the calculation of net obligations, and ensuring that financial instruments, cash, or both, are available to secure the exposures arising from those positions (Article 2(3) of EMIR).

As stated by Puleston (2014), central clearing of transactions through a CCP can only occur via a clearing member. CCPs impose strict requirements for an entity to classify as a CM, such as credit worthiness, operational sophistication, minimum trading activity in covered derivatives, contributions to the CCP’s default fund and participation in the default management process, which can result in expensive burdens. As a result, the costs and obligations required by CCPs from CMs are considerable and are, practically, reasonable only for market participants that have large positions in OTC derivatives markets. Therefore, most market participants willing to clear their OTCD trades will not seek to become a CM; instead, they are likely to enter in a transaction with one or several clearing members. In this setting, *client clearing* refers to a counterparty becoming a client of a clearing member to have access to a CCP to clear its OTCD positions.

There are two main client-clearing models: (i) the agency model and (ii) the principal model. The Linklaters Report of 2016 describes such models as follows.

The *agency model* (most widely used in the United States) requires the clearing member to act as the agent of the client, making the client and the CCP the two principals of the cleared trade. Moreover, the clearing member must be liable to the CCP for the client’s obligations. The *principal model* (most widely used in the European Union) requires the clearing member to have one contract as principal with the CCP and a matching *back-to-back contract* as principal with the client. A back-to-back contract is defined by ESMA as “the creation of a distinct legal contract between the clearing member and its client in addition to the legal contract that exists between the CCP and the clearing member. The back-to-back contract exists in order to pass the legal and economic effects of the cleared transaction onto the client”.

Even if the legal relations and the contractual structures that define the agency and the principal models are not alike, both models overall present the same rights and requirements for market participants. It is important to note that it is not necessary for a client to trade with a clearing member to obtain the clearing service. In fact, if both counterparties to a transaction are clients, they will be required to implement a clearing agreement with a CCP’s clearing member through which such counterparties agree to clear the OTCD transaction. Moreover, both clients will need to have access to an electronic platform which matches the trading data reported by both parties and delivers such data to the CCP charged with the clearing of such transaction (Linklaters, 2015). Figure 11 illustrates the typical scenario of a bilateral transaction that is centrally cleared, where (1) one counterparty is a clearing member and the other is a client and (2) both counterparties are clients.



<u>Figure 11</u> – Central clearing of a bilateral trade when (1) one counterparty is a CM and the other a client and (2) when both counterparties are clients (source: Linklaters).

Indirect clearing refers to the "chain of back-to-back contracts that exist between an indirect client, a client, a clearing member and a CCP" (Jones, 2014). EMIR requires indirect clearing to allow indirect clients to fulfil their OTC derivatives obligations through a CCP.

2. *Central counterparties (CCPs): key benefits of central clearing*

The European Commission explains that central counterparties (CCPs) have been introduced to (i) simplify the complex web of mutual interdependence and the network of credit exposures that characterise OTC derivatives markets, (ii) promote efficient management of liquidity and resources allocation, and (iii) increase transparency in OTC derivatives markets, so far known also as "dark" or "opaque" markets; thereby reducing systemic risk and promoting financial stability. This section explains the key benefits that CCPs perform in OTC derivatives markets, and how their well-functioning can guarantee a sound infrastructure to support secure financial activities.

2.1. Risk management procedures at CCPs

As the first defense measure, CCPs engage into transactions only with clearing members that have proven to be financially stable, with adequate competences and skills. For this reason, CCPs implement *admission criteria* based on competences and credit reliability, with the aim of building a sound basis of clearing members. The benefit of these requirements is transparency: all CCP's members know that they all fulfil such obligations (Schuil, 2013).

The primary step into counterparty risk mitigation is *novation*, the mechanism through which the initial bilateral contract is substituted with two equal and opposing contracts, one with the CCP and the buyer, and the other between the CCP and the seller. Thanks to novation, each counterparty has an outstanding position with the CCP, which is considered the most creditworthy and sound infrastructure in OTC derivatives markets (Rahman, 2015).

Second, CCPs can mitigate credit risk by "netting exposures across their members" (*multilateral netting)*, i.e. CCPs offset an amount due from a member on one transaction against an amount owed to that member on another, to reach a single, smaller net exposure (Rehlon, 2013). The following example will provide a simplified illustration of the multilateral netting and the efficiency of central clearing.

Example[36] *– Multilateral netting*

Figure 12 shows the following situation: according to contracts in being, Bank A should pay EUR 8 million to Bank C. Bank C will, in turn, have to pay EUR 10 million to Bank B, which has to make a payment of EUR 6 million to Bank A.

The gross exposures consequent to the described bilateral trades when they are not cleared centrally are represented in Figure 12 by arrows.

By interacting between each seller and each buyer, the CCP provides central clearing of bilateral transactions as Figure 13 illustrates.

In this way, gross exposures can be "netted", so that exposures in the event of default are drastically reduced, as shown in Figure 14. For example, exposure of Bank B reduces from EUR 10M, when trades are not cleared, down to a single net exposure of EUR 4M to the CCP when transactions are cleared.

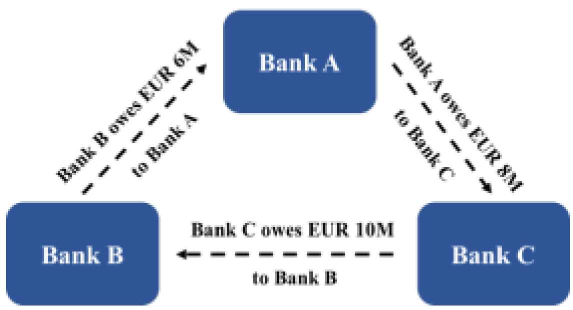
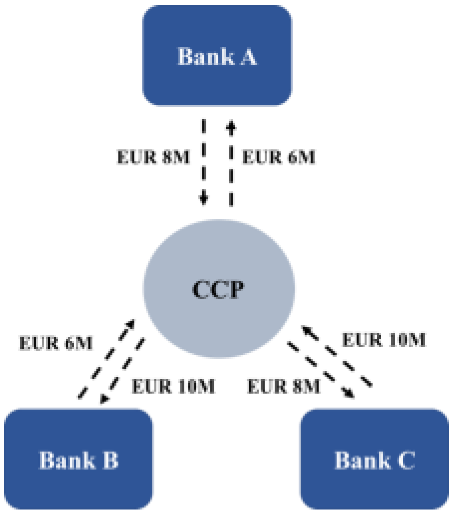


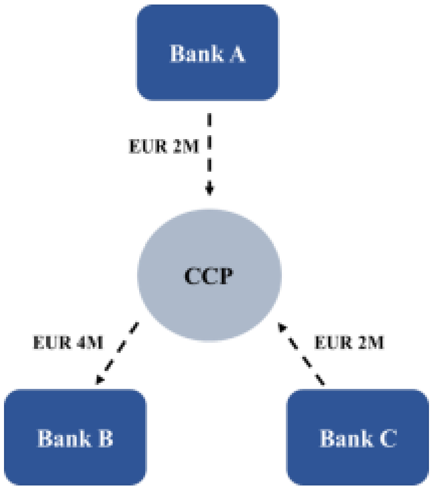
Figure 12 – Non-cleared bilateral trades

[36] Rehlon, A. (2013). "Central counterparties: what are they, why do they matter and how does the Bank supervise them?".

Mitigation against risk of default is achieved by the CCP detaining appropriate collateral (so called *initial margin*). Actually, the central counterparty compensates the various amounts due as a consequence of the bilateral contracts into a single, net amount due from or to each member, respectively, to or from the CCP itself. Back to the example, Bank A has an obligation for a gross payment of EUR 8M to Bank C but should receive EUR 6M from Bank B. After central clearing, Bank A has to make a single, net payment of EUR 2M to the CCP.
In order to prevent the mounting of big exposures, for some financial products, members' net payments are executed to or from the CCP day-by-day.



<u>Figure 13</u> – Bilateral trades centrally cleared through a CCP.



<u>Figure 14</u> – Bilateral trades centrally cleared through a CCP, gross exposures being netted out.

As anticipated in the example above, the third way to reduce counterparty risk is represented by the requirement for the clearing members of the CCP to post considerable amounts of margins (initial and variation margins) from its clearing members. Article 41 of EMIR, states that, to deal with its own risks due to potential counterparty default, a CCP must impose and collect margins to limit its credit exposure from its clearing members and that such margins must be sufficient to cover potential exposures that the CCP estimates will occur until the liquidation of the relevant positions. *Initial margins* are defined as margins posted to safeguard the CCP and its clearing members against the possible future exposures arising from the default of a clearing member from the last margin collection until the liquidation of positions

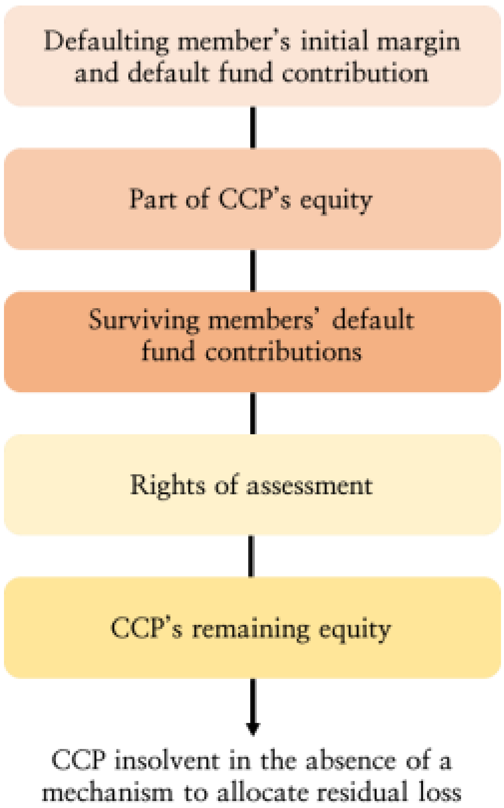
(EACH, 2016). *Variation margins* are defined as payments made necessary by the fluctuations in financial market prices and are used to prevent the accumulation of large losses over time. These margins must be posted by the CCP's members who are in a loss position. The process of collecting margins and collateral is also known as *collateralisation*. The collateral stored in the CCP is able to cushion the potential losses generated by a defaulting clearing member.

Lastly, CCPs are able to reduce and control for the risk of contagion by managing defaults in an orderly way (loss mutualisation). This mechanism is known as *default waterfall* and is explained in-depth below.

Loss mutualisation and default waterfall[37] - In its normal functioning, a CCP acts as a kind of compensation room, netting bilateral obligations into single payments. However, when one of the parties involved is not in the condition to honour its obligation and goes on default, there will be a mismatch in the resources available to the CCP, which will need to rely on appropriate provisions to be able to continue servicing the remaining members.

Such provisions consist in rules, arrangements and resources that allow the CCP to face in an orderly and efficient way the default of a member. For example, the CCP could try to find (even through an "auction" of the defaulter's positions among the surviving members) some new subjects willing to assume the positions of the defaulting member and this could bring back to a matching situation the CCP's book of contracts. In addition, CCPs may have access to own financial resources, those of the defaulting party, and other, non-defaulting members'. These funds are called the *CCP's default waterfall* (Article 45 under EMIR). Figure 15 shows the resources and the order in which they are employed, for a typical waterfall.

<u>Figure 15</u> - Default waterfall



The first resource of the default waterfall consists of the pre-set amount of *collateral* made available by the defaulting member as *initial margin*, according to the CCP's

[37] European Association of CCP Clearing Houses, 2016.

requirement for each party entering a transaction to post. In case of default, the collateral is the first asset to be used to cover obligations.

CCPs define the initial margin and, consequently, the value of collateral based on its estimate of the probability of default of the specific member and underlying transaction, and the anticipated losses to be covered.

If the initial margin is not sufficient, then the CCP will recur to the quote of the *default fund* –a fund fed by all members and administered by the CCP – to which the defaulting member has contributed. In case even this quote is not enough, the remaining losses are shared by all other members of the CCP. This is an important characteristic of the CCP's functioning.

To avoid that the CCP has an incentive to set too low initial margins and default fund contributions for entering members, the provision can be made that the CCP should use part of its own equity resources to cover exceeding losses before using the default fund contributions of non-defaulting members.

In those cases when all the mentioned pre-funded resources come out to be insufficient, non-defaulting members may be requested to cover the remaining obligations usually up to a certain pre-defined ceiling. This procedure is sometimes called *rights of assessment*.

When this procedure is not envisioned or possible, the CCP has to cover the residual losses with its own remaining equity. Should even this last resource result insufficient, the CCP itself would become insolvent and default.

In conclusion, central clearing of transactions has evident advantages over non-cleared transactions, because of the activities of reduction (netting and collateralisation), mutualisation and orderly distribution of losses by which it is characterised. Central clearing of transactions reduces the size of exposures at default, minimizes the need of liquidity in difficult market contingencies, and, consequently, abates uncertainty in the markets.

2.2. CCPs promote market liquidity

The European Commission stated that if a sufficient number and volume of derivatives classes is cleared, central counterparties are able to promote market liquidity, by allowing counterparties trading through the CCP to free capital for other activities. There are two main reasons for this.

The first reason is *payment netting*. As explained in Section 1.1.1., a CCP requires members whose positions have decreased in value due to market fluctuations to post variations margins. In addition, a CCP makes payments to the members whose positions have increased in value due to market fluctuations (ECB, 2013). This mechanism, through which variations margins are exchanged, allows the CCP to impose lower collateral requirements and, at the same time, maintain its value as an insurance against potential losses. The second reason is *multilateral netting* (see Section 1.1.1.). Indeed, by netting out transactions, a CCP not only reduces the risk exposure generating from gross positions, but also allows a reallocation of capital that can be used to carry out other activities. Ripatti (2004) adds that a CCP also allows for anonymous trading, resulting in benefits such as increased liquidity. *Anonymity* is ensured since the CCP becomes the counterparty to both the buyer and the seller which, in turn, remain anonymous to each other. Identity privacy reflects the fact that market participants need not to be interested in the creditworthiness of their counterparty, since the CCP guarantees the settlement of the transaction (Schuil, 2013).

2.3. *CCPs solve disruptive information problems and enhance transparency*

As explained by the European Commission, when a significant counterparty to a bilateral trade in OTC markets defaults, the other market participants are not able to immediately estimate the extent through which this failure will indirectly affect them. As a result, uncertainty increases, potentially destabilising financial markets. This uncertainty can be eliminated through the central clearing because (i) a CCP is considered the most sound and reliable counterparty in OTCD markets for several reasons, including its default management structure, which guarantees the safety of the non-defaulting parties and (ii) a CCP must disclose to market participants sufficient information for them to identify and evaluate accurately the risks and costs associated with using its services (BIS, 2016).

2.4. *CCPs increase operational efficiency and reduces costs*

Being the counterparty to all trades, a CCP imposes margin and collateral obligations, centralises the eligible transactions, marks-to-market outstanding positions and collects or distributes margins in automated ways, thereby lowering disputes and enhancing efficiency. Moreover, the centralisation of data flows and the standardisation of processes allow the CCP to take advantage from *economies of scale/scope*[38] when carrying out risk management procedures or in the performance of additional administrative services. In addition, as stated in Schuil's report (2013), through multilateral netting, which results in a smaller risk exposure, CCPs can significantly reduce costs. The author identifies the following three reasons. First, reduced exposures require lower collateral to be posted in the CCP from the clearing members. Second, multilateral netting drastically decreases the number of trades that have to be settled (sometimes even more than 90%), leading to substantial settlement expenses savings from the market participants. Third, CCPs promote efficiency in the risk management procedures of contracting participants. Moreover, the central role performed by CCPs helps the transacting parties to gather information on the risk profiles of their counterparties, that is, they no longer need to monitor their counterparties. Instead, they are only required to assess and oversee the credit reliability and risk exposures of the CCP. Since the CCP also seeks to mitigate operational risk, the risk management of a transacting counterparty is significantly simplified and therefore cheaper. For all these aspects, the implementation of a CCP results in important cost savings.

Table 8 summarises the key benefits from central clearing.

Benefits of central clearing
<u>Risk reduction through:</u> o Multilateral netting; o Improved risk management procedures (default waterfall framework); o Margin requirements;
<u>Operational efficiencies through:</u> o Reduced amount of settlement instructions; o Standardisation of processes (economies of scale/scope).
<u>Trading benefits in the form of:</u> o Anonymity of trading; o Increased liquidity availability.
<u>Transparency:</u> o Source of market information.

<u>Table 8</u> - Benefits emerging from central clearing

38 Economies of scale are factors that cause the average cost of producing something to fall as the volume of its output increases, whereas economies of scope are factors that make it cheaper to produce a range of products together than to produce each one of them on its own [Definition from the Economist, retrieved from: http://www.economist.com/node/12446567].

It is important to keep in mind that the presence of a central counterparty clearing individual positions has a twofold effect. As commented by Lucantoni (2017), on the one hand, a CCP averts the domino effect caused by the default of a single market participant, by mutualising losses among the other clearing members. On the other hand, however, it could discourage counterparty reliability monitoring. As a matter of fact, as a CCP is a legal person that interposes itself between the counterparties to the derivative contracts traded, becoming the buyer to every seller and the seller to every buyer, Lucantoni argues that this makes it impossible to make a distinction among the counterparties (and, therefore, to select them) based on solvency margins. There are two consequences to this, which are opposite compared to those envisaged by the legislator. She continues that this effects include (i) a significant increase in information asymmetry in centrally-cleared markets compared to bilaterally-cleared markets, where the financial counterparty is more motivated to assess (and, hence, price) counterparty risk, and (ii) that CCPs are assigned derivative contracts that are riskier to clear bilaterally.

Therefore, it is fundamental that the CCP manages its clearing members also from a solvency perspective, evaluating the contracts on a case-by-case basis and not only based on standardised requirements. In this setting, the role played by trade repositories becomes of crucial importance for the informative contribution they provide to CCPs. However, notwithstanding its major role in counterparty risk mitigation (which is extremely important), the primary function of a CCP is to counteract systemic risk, which generates from the size of its clearing members. This discussion will be furthered in Section 4.4.

3. *From a complex web of mutual interdependence to a simplified trading network*

The benefits from CCPs' central clearing are depicted (in a simplistic manner) in Figure 16. The *bilateral clearing network* (left-hand-side of Figure 10) displays the complex network of opaque bilateral connections that characterises trades that are not cleared by CCPs. Opaqueness refers to the fact that only the bilateral counterparties to each transaction have the direct information on their legal relationship. This means that other market participants are not able to gather a thorough vision on the credit and liquidity relationship upon which they indirectly depend.

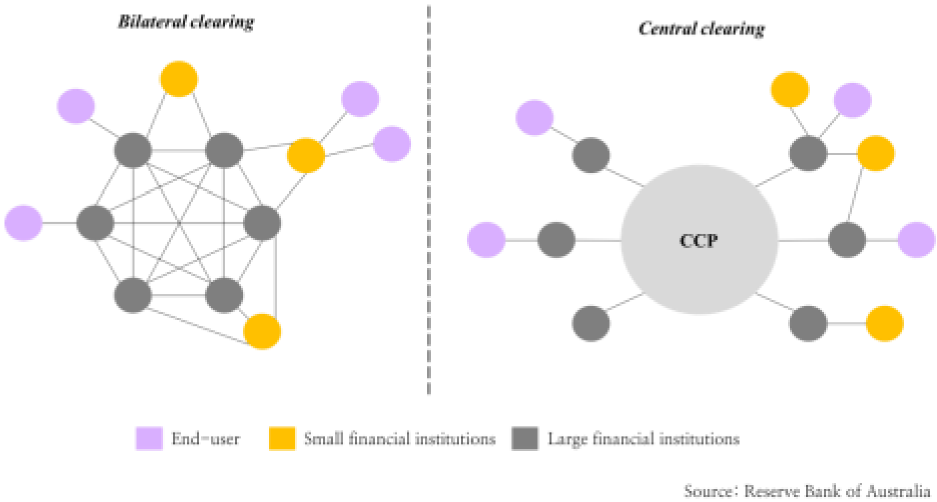


Figure 16 – From bilateral clearing to CCP central clearing

The interposition of a central counterparty (right-hand-side of Figure 16) allows for the substitution of several bilateral positions of the market counterparties with a single net exposure, which is granted by the robustness and soundness structure that characterises the CCP.

As explained by IOSCO (2012), currently there are two legal principles that allow for the interposition of CCPs as a central counterparty to every trade: (i) novation and (ii) open offer. Usually, novation is the most widely used process.

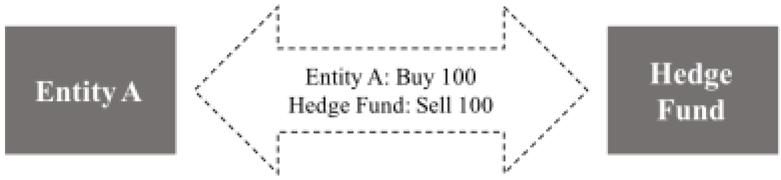
Novation indicates the process through which the original contract between two market participants is terminated and substituted with two new opposing contracts, one between the CCP and the buyer, and the other between the CCP and the seller. In an *open-offer system* a CCP automatically and immediately intervenes in a trade, when the two counterparties agree on the contractual terms.

Whether novation or open offer are implemented depends on the jurisdiction and the legal framework in which the CCP is established.

It is interesting to see how the interposition of a central counterparty influences the rights and obligations of the counterparties to a contract. The following example will first illustrate a normal bilateral transaction without central clearing, and then will show how the intervention of a CCP (with novation) changes the rules of the game.

Example[39] *– Bilateral trade vs. centralised trade through CCP interposition*

Suppose that two counterparties (say "Entity A" and "Hedge Fund", respectively) have engaged in a legally binding financial contract, where Entity A is the buyer and the Hedge Fund is the seller (Figure 17).



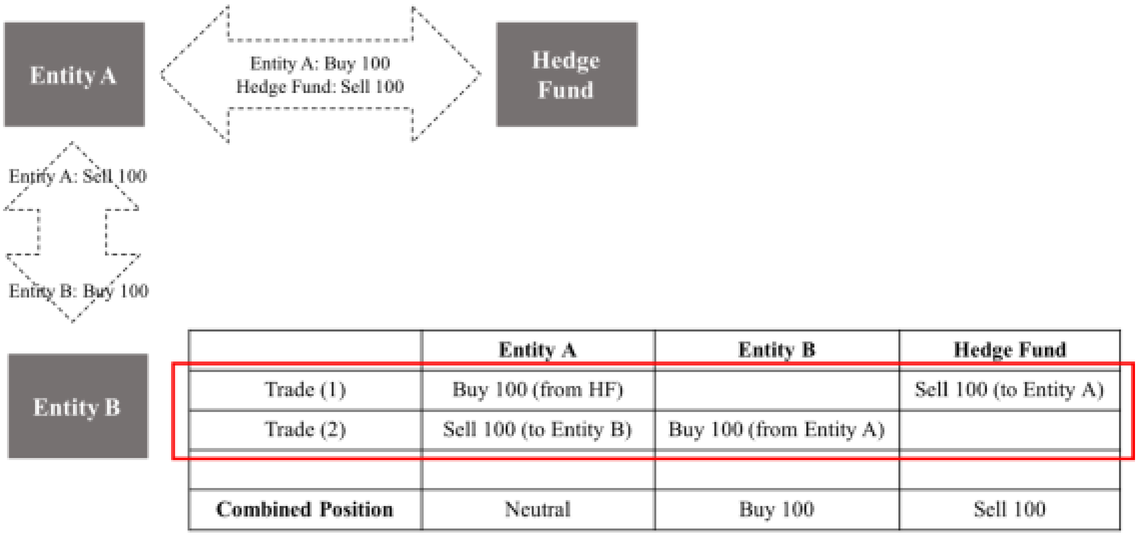
	Entity A	Entity B	Hedge Fund
Trade (1)	Buy 100 (from HF)		Sell 100 (to Entity A)
Combined Position	Buy 100		Sell 100

Source: Federal Reserve Bank of Chicago

Figure 17 – Base transaction (bilateral, non-cleared trade)

Suppose now that Entity A is willing to offset her position engaging in another legally binding contract with another counterparty, say Entity B. As a result, the risk exposure of Entity A is balanced, being it the buyer to the Hedge Fund and the seller to Entity B of the same underlying interest. This situation is illustrated in Figure 18.

[39] Book: *Understanding Derivatives: Markets and Infrastructure*, Chapter 2 (pages 14-23) – Robert S. Steigerwald, senior policy advisor, financial markets, Federal Reserve Bank of Chicago (2013).

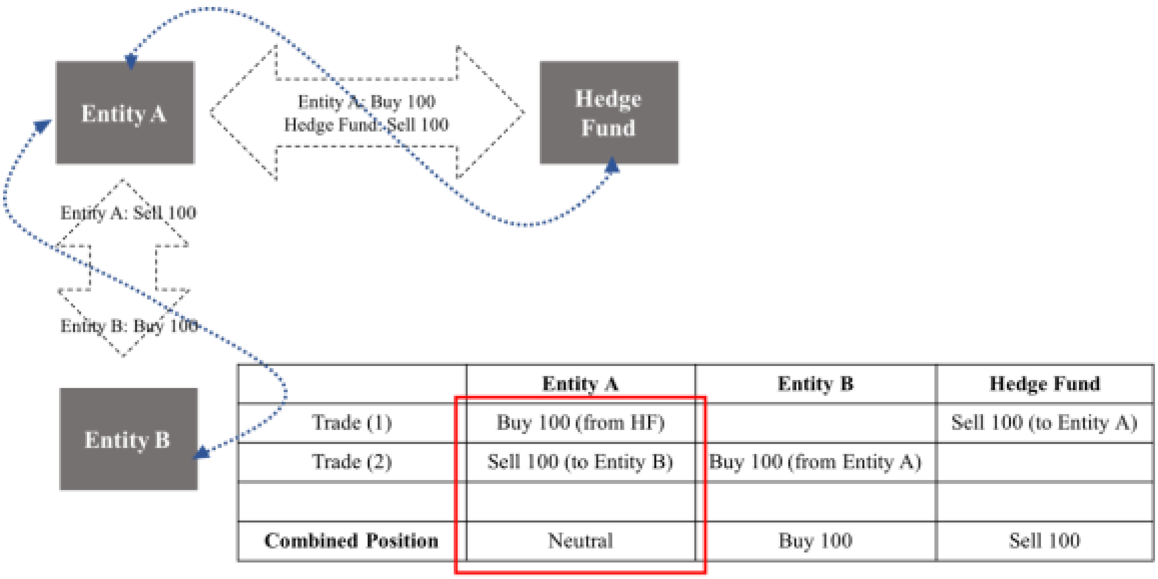


	Entity A	Entity B	Hedge Fund
Trade (1)	Buy 100 (from HF)		Sell 100 (to Entity A)
Trade (2)	Sell 100 (to Entity B)	Buy 100 (from Entity A)	
Combined Position	Neutral	Buy 100	Sell 100

Source: Federal Reserve Bank of Chicago

<u>Figure 18</u> – Additional transaction (bilateral, non-cleared trade)

Nevertheless, Entity A is now exposed to credit risk from both the Hedge Fund and Entity B and an implicit *credit chain* is generated from Entity A. Therefore, the counterparties that really matter in this sequence of trades are the Hedge Fund and Entity B, even if they are not directly connected. Since Entity A has separate binding agreements with both counterparties, it is exposed to the potential default of either party. Figure 19 depicts this stage of the transaction.



	Entity A	Entity B	Hedge Fund
Trade (1)	Buy 100 (from HF)		Sell 100 (to Entity A)
Trade (2)	Sell 100 (to Entity B)	Buy 100 (from Entity A)	
Combined Position	Neutral	Buy 100	Sell 100

Source: Federal Reserve Bank of Chicago

<u>Figure 19</u> – Implicit Credit Chain (bilateral, non-cleared trade)

Assume now that Entity B is not able or is not willing to fulfil its obligations to Entity A. Entity A's position, which was so far neutral, becomes unmatched (although Entity B has breached the contract, Entity A has still a long position with the Hedge Fund), as shown in Figure 20.

It is possible that Entity A had anticipated this eventuality and implemented some mitigation techniques to get protection against credit risk, for example by collecting collateral from both the Hedge Fund and Entity B (not knowing which of the two counterparties could have defaulted).

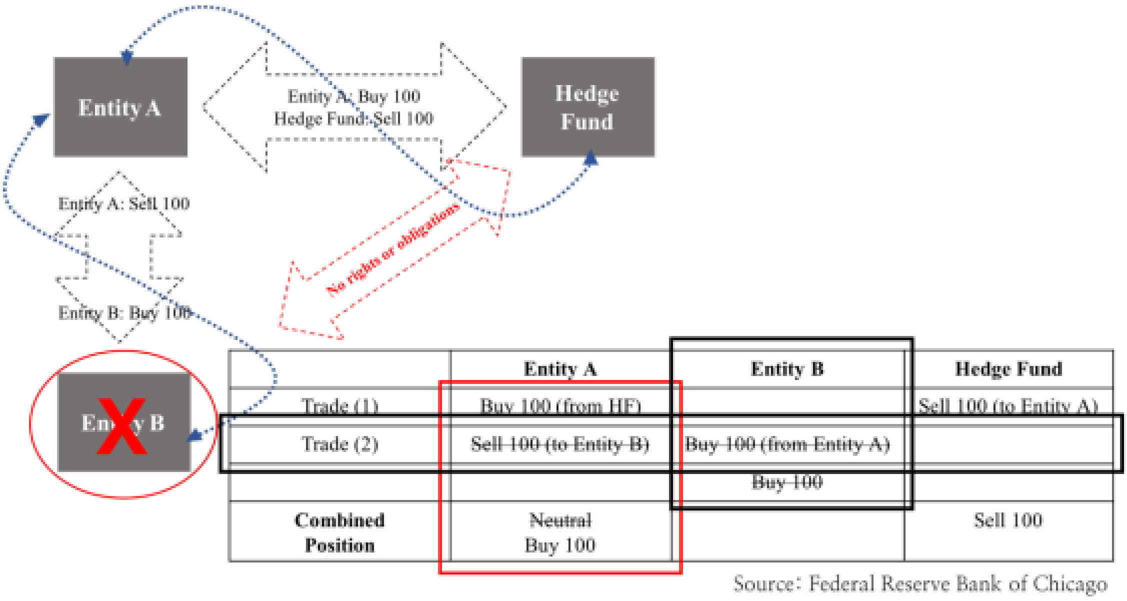
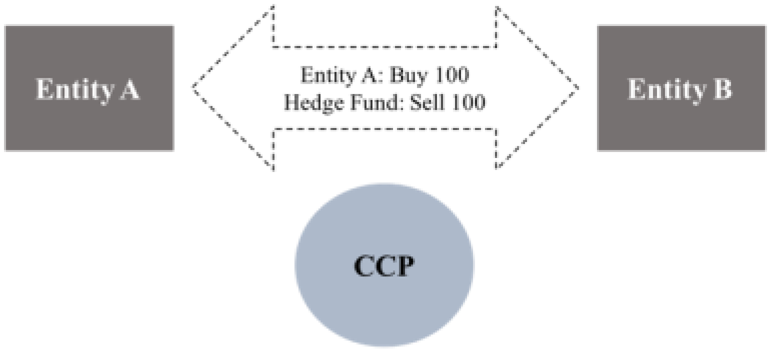


Figure 20 – **Consequence of Default (bilateral, non-cleared)**

Let's see now how the interposition of a CCP influences the credit risk dynamics generated from these trades, starting from the same initial bilateral agreement depicted in Figure 17, with Entity A being the buyer and Entity B being the seller. In this specific example, the novation mechanism is used for central clearing (Figure 21).



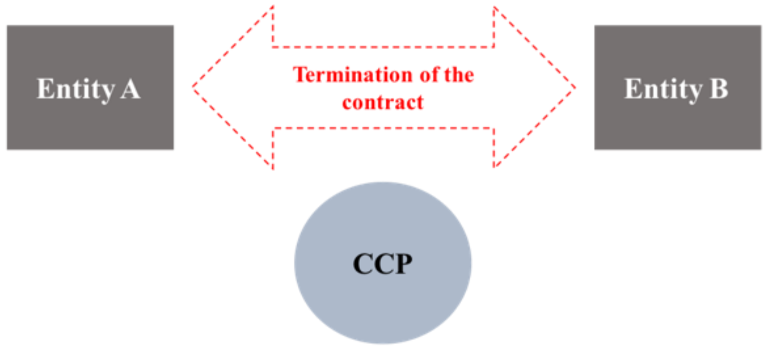
	Entity A	CCP	Entity B
Trade (1)	Buy 100 (from Entity B)		Sell 100 (to Entity A)
Combined Position	Buy 100		Sell 100

Source: Federal Reserve Bank of Chicago

Figure 21 – Base transaction (cleared trade)

Figures 22 and 23 will show the novation process of the binding agreement between Entity A and Entity B, having the CCP interposed as the common counterparty to Entity A and Entity B.

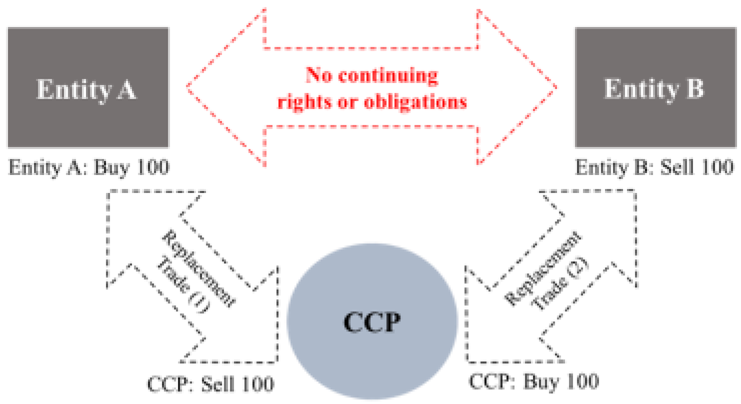
As previously anticipated, the first phase of the novation process is to terminate the contract between Entity A and Entity B (Figure 22), while simultaneously entering into two opposite binding contracts, one between the CCP and Entity A, and the other between the CCP and Entity B (Figure 23). The result is the breaking of the original contract between Entities A and B, substituted by two bilateral binding contracts that replicate the economic transactions initially agreed between Entity A and Entity B. The risk exposure of the CCP is balanced because it acts as a buyer to Entity A and as a seller to Entity B of the same underlying transaction.



	Entity A	CCP	Entity B
Trade (1)	~~Buy 100 (from Entity B)~~		~~Sell 100 (to Entity A)~~
Combined Position	~~Buy 100~~		~~Sell 100~~

Source: Federal Reserve Bank of Chicago

<u>Figure 22</u> – Novation: contract termination (cleared trade)



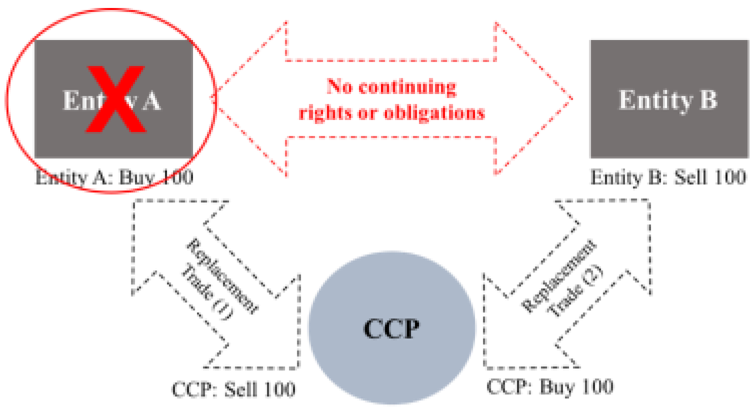
	Entity A	CCP	Entity B
Trade	~~Buy 100 (from Entity B)~~		~~Sell 100 (to Entity A)~~
Replacement Trade (1)	Buy 100 (from CCP)	Sell 100 (to Entity A)	
Replacement Trade (2)		Buy 100 (from Entity B)	Sell 100 (to CCP)
Combined Position	Buy 100	Offsetting (balanced)	Sell 100

Source: Federal Reserve Bank of Chicago

<u>Figure 23</u> – Novation: CCP interposition (cleared trade)

However, the CCP is exposed to credit risk arising from both A and B and an implicit *credit chain* develops through it. The CCP will explicitly take actions to manage this risk exposure, by requiring collateral, margins, and risk limits and by implementing other risk management procedures. By becoming the common counterparty to all trades subject to clearing, the CCP multilaterally nets open positions, which reduces the margin requirements. However, this does not imply that the credit default risk, to which the CCP is exposed, is mitigated.

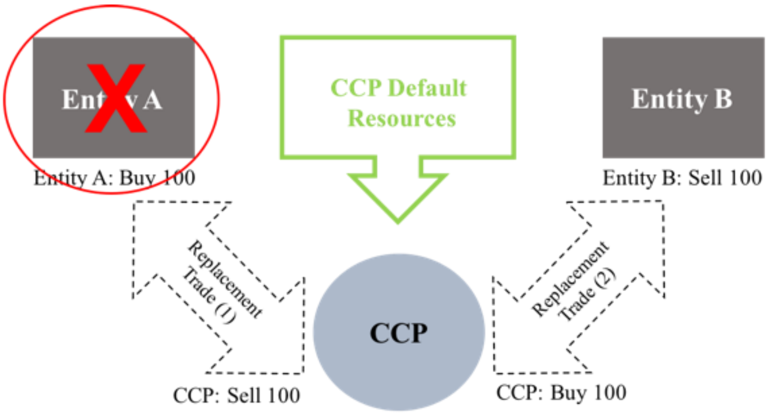
Figures 24 and 25 illustrate what happens if, say, Entity A is not able to meet its obligations with the CCP. When default occurs, the risk exposure of the CCP, so far balanced, becomes unbalanced, as the CCP is still the buyer to Entity B, regardless of Entity A's default. The CCP will have several resources to cover such losses.



	Entity A	CCP	Entity B
Trade	~~Buy 100 (from Entity B)~~		~~Sell 100 (to Entity A)~~
Replacement Trade (1)	~~Buy 100 (from CCP)~~	~~Sell 100 (to Entity A)~~	
Replacement Trade (2)		~~Buy 100 (from Entity B)~~	Sell 100 (to CCP)
Combined Position	~~Buy 100~~	~~Neutral~~ Buy 100	Sell 100

Source: Federal Reserve Bank of Chicago

<u>Figure 24</u> – Consequences of Default (cleared trade)



	Entity A	CCP	Entity B
Trade	~~Buy 100 (from Entity B)~~		~~Sell 100 (to Entity A)~~
Replacement Trade (1)	~~Buy 100 (from CCP)~~	~~Sell 100 (to Entity A)~~	
Replacement Trade (2)		~~Buy 100 (from Entity B)~~	Sell 100 (to CCP)
Combined Position	~~Buy 100~~	~~Neutral~~ Buy 100	Sell 100

Source: Federal Reserve Bank of Chicago

Figure 25 – Consequences of Default: CCP Financial Resources (cleared trade)

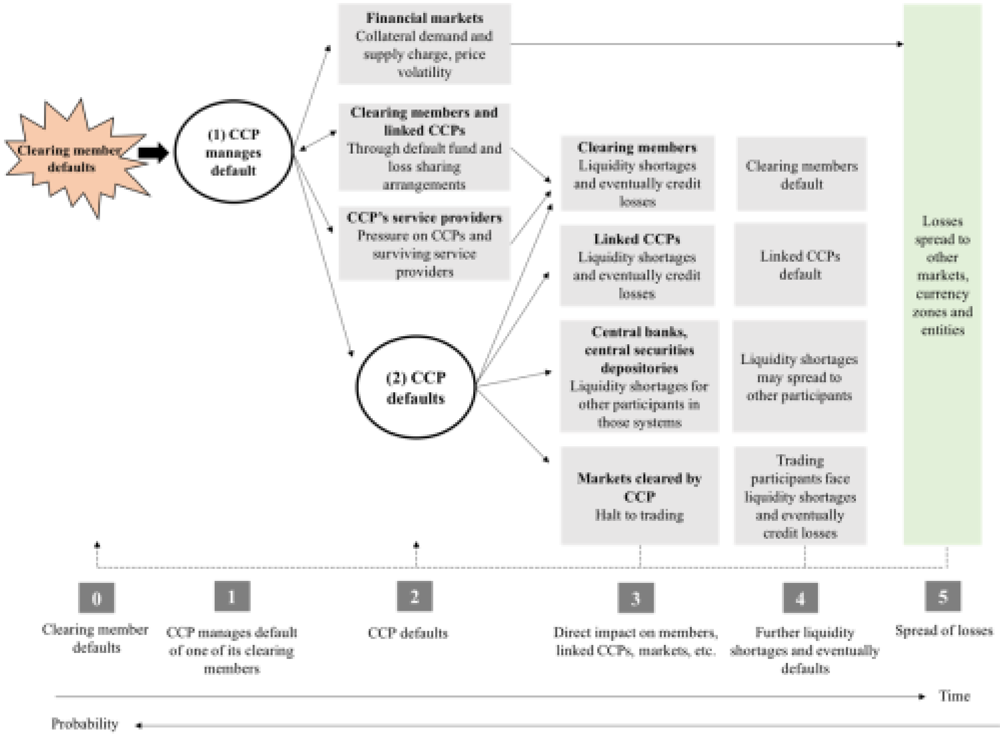
4. Risks associated with CCPs

As illustrated above, CCPs can represent real assets for financial markets. However, if not appropriately operated, CCPs' own functioning features imply potential risks for the stability of the system.

4.1. Interconnectedness among CCPs

The central role of a central counterparty in financial markets and its interconnectedness with other market participants are the main determinants of its systemic importance (Wendt, 2015). The higher the degree of interconnectedness, the greater the impact of a CCP's actions on market participants. As explained earlier, CCPs ensure the settlement of outstanding transactions even in the event of default of a clearing member. In this setting, a CCP that is well-structured and capitalised guarantees protection to the counterparties involved in a transaction. Therefore, CCPs can be considered as prudential instruments that reduce the interdependences between market participants (Arregui, 2013). Nevertheless, the implementation of a CCP also generates new interconnections within the financial system, which are illustrated in Figure 26. The

CCP's interconnectedness with other market participants increases the *risk of contagion* in the event of financial distress and losses, which can be caused by (i) a CCP's procedures to face the default of a clearing member or (ii) the possible default of the CCP itself.



Source: Wendt (2015) – "Central Counterparties: addressing their too-important-to-fail nature"

Figure 26 - Interconnections between CCPs and the financial system

4.2. Interconnections of CCPs and clearing members

Interconnectedness between central counterparties and clearing members is a means through which losses can be propagated. This could happen in several ways. First, one of the clearing members could become unable to meet its obligations with the CCP and, consequently, default. Usually, as explained in Section 4.2.1., CCPs have default waterfalls to ensure protection against losses. The first three layers of the waterfall (i.e. all prefunded resources: (1) margins, (2) CCP's equity and (3) default fund contributions) are generally used to face the losses caused by a defaulting member. The protection system of the CCP holds as long as the losses can be offset within the first three layers of the waterfall. In the extreme event that all the pre-funded resources come out to be insufficient to cover losses, it will be necessary for the CCP to require from the non-defaulting clearing members additional contributions (*rights of assessment*). At this stage, the default of a clearing member will have a negative impact on the other members. As explained by Wendt (2015), this happened at the Korea Exchange in 2013, where the default of HanMag (a Korean securities firm) resulted in losses for other clearing members of the Korea Exchange. The author explains that that in circumstances of financial distress, margins calls from a CCP could increase the pressure on clearing members and could cause a fall of the value of the collateral posted by the clearing members. Nevertheless, a CCP will try to fully collateralise its positions, neglecting the increase in systemic risk that it might generate. The CCP's request of additional margins may constrain the liquidity of its clearing members. In extreme cases, clearing members will have to deal with liquidity shortages and default. As a result, financial stability could be damaged.

Mutualising losses among clearing members is another way through which CCPs can face distressed situations. Loss sharing occurs when the default waterfall has reached its bottom line and all pre-funded resources have been used. CCPs' objective is to redistribute losses among non-defaulting clearing members, allowing for the completion and/or continuation of some fundamental functions. Loss mutualisation may avoid the default of the CCP, but it may also set contingent obligations to clearing members and their clients, which they might not be able to cover. There are several ways to share losses and these will result in different loss allocations. For example, a CCP requesting unlimited margins will expose the clearing members and their clients to (in theory) unlimited obligations, while liquidating and extinguishing positions will generate externalities to counterparties of the defaulting member. In a report published by JP Morgan in 2014, the investment bank explains that the *Variation Margin Gains Haircutting* (VMGH) places the weight on the clearing members or their clients who realised financial gains on their outstanding positions, since the CCP uses those gains to offset the losses of the defaulting party. Further distress could be caused in the event a clearing member performs one or more services for the CCP. For example, globally systemically important banks (GSIBs) (i) may act as a general clearing member (clearing transactions for clients) and (ii) they may provide liquidity to grant credit lines in case of liquidity shortages. Moreover, a CCP can use commercial banks as custodians to deposit securities collateral or can have clearing members providing settlement bank services, such as payment systems or central depositories for securities (Polk, 2016). Lastly, clearing members could also help the CCP in the liquidation and hedging of a defaulting counterparty's positions and by becoming liable for the defaulter's clients.

Many large-sized CCPs receive services from GSIBs. For example, most payments to LCH. Clearnet (UK CCP) are carried out through two GSIBs since the UK based CCP does not have a direct account in the payment system of the Bank of England (IOSCO, 2014); or the Fixed Income Clearing Corporation (US CCP), which uses two GSIBs as settlement banks and custodians. The clearing members providing such services will be influenced more than other members, because, by performing several functions, they could be subject to greater distress during financial instability periods (Steigerwald, 2014). The reason is that they will have to both (i) manage their own operations and (ii) help the CCP by providing it with liquidity, by taking over the clients' accounts of the defaulting party, and by participating in auctions to hedge or liquidate defaulted positions.

A CCP is also especially exposed to the default of a clearing member from which it receives several services, not only because it will have to face the losses from its default, but also because it could lose the collateral stored by that clearing member in its role as custodian, lose the credit lines or other facilities that it used to receive from that clearing member. More broadly, the failure of a large GSIB that provides services to multiple CCPs may cause a significant threat to the stability of the global financial system.

Moreover, clearing members could in turn be influenced by the unlikely default of a CCP. Although it is very unlikely, a CCP could fail in extreme circumstances, for example as a consequence of one or several clearing members' defaults, or it could face losses (other than the default ones, e.g. operational failures or investment losses) exceeding the CCP's resources. Elliot (2013) argues that, in this situation, clearing members would not get payments from the CCP and "may not be able to access their margin and remaining default fund contributions for some time, which, in turn, may cause direct liquidity problems". Based on the jurisdiction and the specific regulatory framework in which it is established, the CCP may employ the clearing members' default contributions and ask for the refurbishment of the default fund and further cash supplements to face additional losses.

4.3. Interconnections of CCPs and financial markets

A distressed CCP trying to avoid default can have a significant negative effect on financial markets. Murphy (2016) argues that the pro-cyclicality that characterises the margin calls may worsen market pressure through feedback loops between market stress and collateral haircuts. *Pro-cyclicality* means the modification in risk management procedures which are positively correlated with market, business, or credit cycle fluctuations and that may cause or worsen a financial crisis (IOSCO, 2012). Financial distress may have a negative effect on volatility and on assets' liquidity. This may cause CCPs to request higher margins and collateral. The CGFS published a report in 2010 on "the role of margin requirements and haircuts in pro-cyclicality", in which it explained that the risk management system of CCPs is generally based on historical data which cover a short time period, and that therefore margin requirements may drastically increased in times of sudden market volatility. Chande (2010) adds that "the potential increase in collateral requirements in a stress event would be smaller than if no collateral had been collected, which is often the case in bilaterally cleared markets".

A CCP could also negatively affect financial markets by trying to liquidate considerable amounts of collateral after one of the clearing members defaults. GSIBs and other large financial entities can be clearing members of multiple CCPs and the failure of one of them could affect all CCPs in which the entity was a clearing member. CCPs could attempt to post collateral to offset losses. If many CCPs attempt to sell the same assets, markets for collateral will be characterised by high volatility and price instability. In the extreme event in which a CCP defaults, trading will be halted in the markets where the CCP performed its clearing services. As a consequence, counterparties will not be able to keep using the CCP to clear their positions, and this in turn, will have a direct effect on their possibility to trade (Elliot, 2013). If this happens, market participants will have direct problems in terms of liquidity and credit and will risk bankruptcy. Moreover, the impossibility to trade would impede investors to trade for hedging purposes.

4.4. Interconnections of CCPs and other financial market infrastructures

Connections among CCPs can be generators of contagion risk. Connections among CCPs allow clearing members belonging to different CCPs to clear positions without being clearing members of every CCP. Moreover, such connections enable for the absorption of shocks, which can be shared by substituting services (for example, by transferring outstanding positions of clearing members' clients to a connected CCP). Nevertheless, interconnectedness among CCPs establishes channels through which risks could be propagated, especially if CCPs can transfer the impact of a member's default to each other (Wendt, 2015). The propagation could occur if, for example, CCPs made contributions to each other's default funds, so that the default of a counterparty in a

CCP would force other CCPs to share the losses through the shared default fund contributions (CGFS, 2011).

Based on the interoperability agreements among the connected CCPs, CCPs may face liquidity constraints, since they will not get the payments from the defaulting CCP and will not have the accessibility to the collateral stored in that defaulting CCP. Moreover, the default of a CCP may also have a negative impact on other associated financial market infrastructures (FMIs). CCPs usually settle payment liabilities in sizeable payment systems (generally managed by central banks) and trade securities in central securities depositories (IOSCO, 2012). Such interconnections may cause a disruption if a late settlement in one system has a direct effect in the settlement of another system, especially if a counterparty's activities are based on the liquidity gathered through the settlement in one system to fulfil its obligations in another system. The interconnectedness among CCPs and between CCPs and other FMIs play a crucial role within a country and across countries.

4.5. Domino effect

In extreme cases, the failure of a clearing member and/or CCP could have a domino effect on financial markets. The *domino effect* refers to the situation in which one event causes a series of related events, one following another [Cambridge Dictionary]. In this setting, it refers to the default of a significant market participant (such as a CCP or a large clearing member) propagating to other markets and to other market participants, causing losses and liquidity shortages across the financial system, and, in very severe situations, leading to the default of one or several banks, CCPs and other financial entities. As can be seen from Figure 26, the *ex-ante* probability that losses will propagate through the interconnections is low, but not zero (Wendt, 2015). If the probability of a counterparty defaulting is low, then it is very unlikely that GSIBs and/or CCPs could fail. However, as the author explains, there is still a small possibility that such improbable event occurs.

The greater implementation of CCPs, especially in the OTC sector, and the globalisation of markets led to an additional increase in that risk. The probability is based on the quality of the risk management procedures (i.e. stress tests and default waterfall), capital buffers and other instruments that the CCP uses if a default occurs (Banque de France, 2010). It is clear that larger financial institutions active in global activities are a greater source of contagion to other markets and to other participants. As stated by Surti (2013), GSIBs and other large financial entities usually are clearing members of all the principal CCPs in OTC derivatives, ETDs and securities markets and in other FMIs. As a result, their default can be simultaneously devastating in several systems. A severe situation could occur if the default of a GSIB, which has an open account in several CCPs, is associated to extremely large price fluctuations. In this case, many CCPs would start liquidating the outstanding positions of the defaulting party, involving the non-defaulting members. Burdens on the CCP and non-defaulting members would be greater if the GSIB was one of the main service providers of the CCP. Higher volatility would make the valuation of outstanding contracts much harder, increasing the possible losses of the CCP. Simultaneously, the value of the collateral of the CCP could fall, causing margin calls to non-defaulting members to increase. As a result, there could be "a global collateral squeeze", leading to sizable losses to one or several CCPs and/or its members. In other words, CCPs' functioning may amplify the effects of an exogenous shock (more generally, a shock not originating from the CCPs themselves) to the financial system. As a typical example, more demanding requirements for initial margins will be normally set by CCPs in response to a situation of increasing instability of financial markets. To meet such higher requirements, CCPs' members may be forced to sell assets or access credit despite difficult conditions, and this will worsen price volatility and increase overall instability of the markets. CCPs should prevent these potentially critical situations by setting higher initial margins when market conditions are favourable (ESRB, 2017).

In the event in which a default has consequences in several jurisdictions, coordination and collaboration on an international scale would be very challenging as interests may differ across the involved areas. For example, the relevant competent authority (of the jurisdiction in which the CCP is established) might deem more important to keep the CCP's functions, whereas other authorities might give priority of their financial system. It must be noted that insufficient coordination could have devastating effects for the financial system.

During a crisis, the effect of a CCP's interconnectedness will depend on the number and volume of outstanding positions among CCPs, clearing members and other market participants and on the number and value of their financial resources (collateral and margins).

Because of the key connecting and scaling roles they accomplish between trading parties, CCPs become the very critical nodes of financial networks. The default of a large CCP will cause the disruption of several trading linkages and business relationships and, possibly, the collapse of the whole network. This is the main reason why it is so important to put in place a well-structured regulatory and supervisory framework, adequate recovery rules and resolution regimes for CCPs.

5. *Rules for CCPs*

As explained in this chapter, it is important for CCPs to be safe and efficient, to guarantee and foster the stability of the financial system. This is because CCPs activities result in risk concentration, which, if not adequately addressed, could lead to disastrous financial consequences. As already mentioned, EMIR, among other things, outlines the rules with which CCPs must comply. Together with the mandatory function for CCPs in the clearing of standardised OTCDs and the reporting requirement for both OTCDs and ETDs, EMIR also details requirements that all CCPs must be subject to, including CCPs that do not deal with OTC financial instruments. The first step to qualify as a CCP is to request a license from the supervisor of the jurisdiction in which the CCP is to be established (Article 17 under EMIR). Moreover, the Regulation specifies the obligations for the collateral to be posted within the CCP and its mobility. Transactions that are centrally cleared must be portable as well. When a CCP has been authorised, it has to communicate which classes of derivative instruments it is willing to centrally clear and eventually, the European Commission will reach a decisive conclusion. To get a license, a central counterparty must fulfil many statutory regulations. For example, CCPs must have at least EUR 7.5 million of initial capital and additional funds are required proportional to its risk exposures. Moreover, the amount of capital must be enough to ensure the continuity of the CCPs' activities in case of liquidation or reorganisation. CCPs must also guarantee a transparent and sound governance framework, with trustworthy and skilled management and have to implement specific systems for preventing conflicting interests. In addition, it is mandatory for CCPs to establish a council of independent users. The admission requirements for becoming a clearing member must be non-discriminatory, transparent and neutral, so as to ensure fair and open entrance. A CCP has to analyse and estimate the liquidity and credit risk arising from its participating members and the Regulation defines how it can constrain these exposures, for example, by means of procedures that are constantly verified and by posting collateral. In addition to margins, a CCP is required to have enough liquidity to carry out its functions and it has also to directly contribute to the default waterfall. By having a direct participation in the funds, CCPs are incentivised to guarantee the well-functioning of the entire infrastructure.

CCPs can only make investments in cash funds or extremely liquid securities that carry a small market and credit risk. Another significant aspect of such regulations is how margins and cleared transactions can be kept at a CCP: *segregation* and *portability*. EMIR outlines three main techniques for asset segregation. A central counterparty must always ensure that the posted margins and the cleared transactions of the participating members are mutually segregated. Moreover, a CCP has to allow a CM to segregate its margins and transactions from the ones of its clients, i.e. *omnibus client segregation*. Also, the CCP has to back mutual segregation of the margins and transactions of each client within the account of a CM, which does not allow for one client's surplus to be used for covering deficits in another client's account. This is known as *individual client segregation*. Both CCPs and CMs have to back these two types of segregation accounts, and must disclose any relevant information of the legal and financial aspects entailed in the omnibus and individual client segregations. In the event of a CM not fulfilling its duties, these two accounts (which are the most relevant ones) allow for transferring the margins and cleared transactions to another CM. Table 9 proposes a different classification of segregation accounts.

Type of Account for indirect clients / **Domain of composition**	***Fully segregated***	***Net omnibus***	***Gross omnibus***
Cost of collateral	No collateral netting allowed with other portfolios	Collateral netted with other portfolios in the omnibus account	No collateral netting allowed with other portfolios
Operational costs	High operational costs for the set-up (reporting, collateral posting in operations, etc.)	Reduced operational costs for the set-up as one single account has to be managed allowing for scaling effect	
Level of protection	Full protection in case of clearing member default as traceability of posted collateral is ensured allowing for appropriate default management. However, no mutualisation of the risks with other portfolios in the case of the client defaulting.	Lower level of protection in case of clearing member defaults as the traceability of posted collateral is netted at group level. Reallocation of the assets is not ensured with the same level of protection as for the full segregated account. However, mutualisation of the risks with other portfolios in the case of client defaulting.	Full protection in case of clearing member defaults as traceability of posted collateral is ensured allowing for appropriate default management. However, no mutualisation of the risks with other portfolios in the case of the client defaulting.

Source: Risk Dynamics, Civillo and Kerstens (2016)

Table 9 – Three main types of segregation accounts

Prior to the implementation of EMIR, there were multiple collections of international standards for the different counterparties participating in the financial infrastructure. These groups of standards have progressively developed since 2001. In 2012 there has been a renewal and such standards have been integrated into a collection of 24 international standards, which are currently called the *Principles for Financial Market Infrastructures*. 22 of these standards have been defined by central banks and supervisors in the financial instrument markets and are appropriate for CCPs. The institutions which are in charge of developing this international framework are the CPSS[40] of the BIS[41] and the IOSCO[42]. For this reasons, such standards are usually known as the CPSS/IOSCO standards and they present three main features:

1. *Principle-based,* which are not rules that define specifically how a framework should be established or operated, since a CCP can fulfil a standard in several ways;
2. *Preventive,* which refers to standards introduced to mitigate risk exposures in advance. In this setting, supervisors will check any systemic alteration at a CCP in advance. Moreover, there are multiple broad standards for guaranteeing impartial and open accessibility to the CCP, together with efficiency and reliable governance;
3. *Minimal,* which are standards indicating minimum requirements with which the CCP must comply, but could also go beyond them.

A CCP that has been established under the EMIR framework automatically fulfils the CPSS/IOSCO standards. These standards also define requirements for the settlement process of transactions. For example, settlement must occur (if possible) on a book supported by a CCP and CMs at a central bank. Moreover, a CCP has to explicitly define when a settlement is completed and therefore, irrevocable. Lastly, a CCP has to avoid that its clients engage into additional risk, for example by not being able to guarantee the contemporaneous settlement of both sides of a trade.

[40] Committee on Payment and Settlement Systems
[41] Bank for International Settlements
[42] International Organisation of Securities Commissions

5.1. EMIR achievements so far in relation to CCPs

Since the implementation of EMIR in 2012, the volume of CCPs' activity (both in EU and in the rest of the world) has progressively increased. The portion of centrally cleared OTC interest rate derivatives has grown from 36% in 2009 to 62% in 2016. The rapid expansion of CCPs functions in the global financial market shows that central clearing requirements have been introduced across several derivatives classes in the European Union (since June 2016) and in third-countries. The amendments of EMIR proposed in May 2017 and in June 2017 will strengthen the growing awareness of the advantages from using central clearing and will create additional incentives (i) for CCPs to provide clearing services of OTCDs to market participants and (ii) for voluntary clearing. Simultaneously, supervisory convergence in the European Union has been enhanced thanks to the implementation of *supervisory colleges* (Article 18 under EMIR) of the CCPs currently authorised under EMIR. These colleges are constituted by (i) all relevant competent authorities for the CCP which have voting capacity in the authorisation and (to some extent) in the supervisory mechanism of the CCP and (ii) ESMA which does not have a voting capacity and has binding mediation powers when necessary. Moreover, as stated in Chapter 2 (Section 2.2.3), ESMA has already recognised 28 non-EU CCPs. Currently, additional 12 CCPs from 10 third-countries have requested for recognition and the Commission is now in the process to assess whether their regulatory and supervisory regimes could be deemed equivalent to EMIR.

The expansion of CCPs activities worldwide is expected to keep increasing in the following years, with the implementation of additional clearing requirements and higher incentives for voluntary clearing. However, there is a high concentration in the market for central clearing as there are few CCPs offering such services, particularly for some specific derivatives classes. Moreover, CCPs are characterised by a high degree of interconnectedness among themselves and with other financial entities. As a result, a CCPs failure could severely destabilise the financial system. In November 2016, the Commission has proposed a Regulation on CCP Recovery and Resolution, which has so far introduced some obligations to guarantee an appropriate risk management framework and tools to mitigate possible costs for counterparties.

5.2. Current proposals and amendments in relation to CCPs

The European Parliament (2017) stated that the scale and importance of CCPs are gradually increasing with the progressive implementation of the G20 commitments to enhance OTCD markets transparency and reduce systemic risks by requiring central clearing of standardised OTC derivatives contracts through CCPs. Moreover, there has been a significant change in the perspectives of OTCD central clearing, originating from mandatory clearing of standardised interest rate derivatives and mainstream index credit derivatives and from bank capital rules to centralise other types of derivatives that are not subject to compulsory clearing (Ball, 2017). As described in Section 4.4., the structure, the functions, the increased volume of cleared trades and interconnections of CCPs makes them *systemically important*. For this reason, regulators have been increasingly focusing on the potential effect of a low-probability but potentially high-impact financial market distress affecting CCPs (European Commission, 2017). In this setting, the EU outlined a thorough regulatory framework for CCPs, to increase their capacity to deal with critical financial events. Nevertheless, there is a need for additional reforms to guarantee a more consistent and sound supervisory structure of CCPs both in EU and in non-EU Member States. Moreover, the exit of the UK from the EU will have a significant effect on central clearing activities in Europe, which will require a reframe of certain core regulatory and supervisory elements. Regulators have focused on three core areas: (i) resolution and recovery, (ii) transparency and (iii) recognition and supervision. This has led the Commission to adopt (1) a legislative proposal on CCP recovery and resolution in November 2016, (2) a proposal for a regulation to amend EMIR in May 2017 and (3) the proposed regulation which was released on June 2017. The three main characteristics of the proposed regulation are:

- The introduction of a new CCP Executive Session Body in ESMA and additional powers for ESMA;
- A new supervisory role for central banks;
- Enhanced supervisory controls over systemically significant non-EU CCPs.

ESMA supervision. The reason for establishing a new CCP Executive Session in ESMA is to encourage a consistent supervisory framework across the European Union that takes advantage from adequate expertise and gives a rapid and effective mechanism for supervisory decisions for CCPs. The CCP Executive Session is the framework that will enable ESMA to oversee existing colleges of national supervisors and implement its (both existing and new) supervisory powers under EMIR. The CCP Executive Session will be constituted by (i) an independent head and two directors, selected based on merit, skills and knowledge of clearing, (ii) the specific clearing members of every

CCP, in addition to a representative for the national competent authority where the CCP is located, and (iii) non-voting representatives from the ECB, other relevant central banks and the European Commission. It is necessary to provide the CCP Executive Session with appropriate resources to perform its mandates. However, especially in a post-Brexit context, the ability of ESMA to gather high-skilled staff and appropriate resources may be questioned since the UK is the headquarters of the largest CCPs in the European Union and, as a result, there is a considerable degree of clearing knowledge in the UK and in the Bank of England, which is charged with the regulation of such CCPs. This new supervisory structure will entail both benefits and costs for clearing members and their clients. On the benefit side, clearing members and clients will be able to clear transactions through safer CCPs. However, on the cost side, CCPs will have to pay supervisory fees (which could be on the shoulders of clearing members). Regulators expect this financial effect to be minimal compared to the size and number of transactions centrally cleared. In relation to non-EU CCPs, depending on the degree of supervision and on whether one or more non-EU CCPs are required to be established in the European Union, there could be greater financial costs and operational effects on clearing members and clients (European Commission, 2017). For example, in the event that a non-EU CCP can receive authorisation only if established in the EU, this could cause higher expenses because it would (i) increase market fragmentation, (ii) adversely affect the liquidity of cleared instruments and (iii) produce losses in margin efficiencies. To minimise these costs, the new proposal implements proportionate risk based requirements to safeguard the interests of clearing members and their clients.

Central banks. Under this new regulatory framework, central banks established in the European Union will have to perform a wider range of roles based on the fact that (1) CCPs implement payment systems whose supervision is a responsibility of the central banks and (2) central banks implement monetary policies that may influence CCPs' activities. EU central banks will also have the responsibility to oversee the management mechanisms for trades denominated in the issue currency of the central bank. Moreover, the new proposal mandates national competent authorities, or ESMA when dealing with third-country CCPs, to seek agreement from relevant central banks for requirements on (i) the authorisation of third-country CCPs, (ii) the enlargement of CCPs' functions and services, (iii) the withdrawal of authorisation, (iv) margin and collateral requirements, (v) liquidity risk controls, (vi) settlement and (vii) the approval of interoperability arrangements concerning the issue currency of the central bank (European Commission, 2017).

Third-country CCPs. The new proposal implements a two-tier system for the recognition of non-EU CCPs and for enhancing their supervision. This will enable regulators and supervisors to improve their quality of monitoring and management of the potential risks that might affect the European Union's financial stability.

- *Tier 1 CCPs* refers to non-systemically important non-EU CCPs, which will be able to continue operating under the existing EMIR equivalence framework;
- *Tier 2 CCPs* refers to systemically important non-EU CCPs, which, instead, will have to comply with stricter obligations.

ESMA will establish the systemic significance of a non-EU CCP based on several features of the CCP, such as the nature, size and complexity of its business, the clearing membership structure, the CCPs interconnectedness with other FMIs. A third-country CCP that is deemed systemically important will be subject to greater controls and supervision. In particular, a non-EU CCP will (i) have to meet the prudential requirements that are also applied to EU CCPs under EMIR and must have in place all essential mechanisms and measures to comply with such obligations, (ii) be required to fulfil EU central banks' requirements in the performance of their function concerning the banks' currency issue and (iii) have to deliver, in accordance with the law, an executive consent to (a) disclose any information stored in it and (b) allow on-site inspections.

Even though non-EU CCPs comply with these stricter requirements, ESMA and the relevant EU central banks may assess that the risks that threaten the European Union's financial stability are so significant that even these intensified obligations on non-EU CCPs come out to be insufficient to mitigate such risks. For this reason, regulators may deny the authorisation to the third-country CCP. In this case, a non-EU CCP willing to perform activities in the EU would have to establish itself in the EU and seek authorisation qualifying as an EU CCP. This provides a considerable extension to ESMA's current roles and, since the UK is the country with the largest CCPs in the EU, seems "targeted at giving ESMA the ability to force a relocation of some or all of those CCPs to the EU once the UK has left the EU following Brexit" (European Commission, 2017).

V. Network analysis of systemic risk in OTC derivatives markets

In order to foster stability in financial markets, it is the EMIR's aim to reduce systemic risk in the OTC derivatives market.

The observation that the structure and dynamics of a financial system can be effectively represented through a network, in which financial entities are the nodes and contractual obligations in being among them are the links, suggests that network analysis can be used as a convenient method of investigation to interpret relevant EMIR's provisions and evaluate their impact on systemic risk and financial stability.

This approach builds on specific inputs from the European Commission, which stressed that "the nature of EMIR data requires new tools and innovation in the field of network analysis, statistical physics and certain mathematical concepts. How to assess systemic risk using transaction-based reporting data is an active and open field of research"[43].

According to this approach, the next paragraph elaborates, in general, on the concept of systemic risk and clarifies the mechanisms through which it impacts on financial stability. Then, by taking forward some relevant elements and considerations presented by the Commission, the case of the OTC derivatives market is examined from the perspective of systemic risk. A brief introduction to the basics of network theory follows and, based on that, a simple network model of the OTC derivatives market is constructed and discussed. In the following paragraph, the model is used to assess systemic risk and stability in three scenarios, assumed to represent for illustrative purposes, the stages of evolution of the OTC derivatives market (unregulated nascent market, unregulated mature market, EMIR market). Finally, relevant EMIR provisions are briefly discussed against the results of such analysis.

1. The general concept and dynamics of systemic risk

In the paper "Measuring systemic risk" (2016), Acharya et al. model systemic risk as an effect of undercapitalization of the financial system, impacting on the real economy in terms of a negative externality. The propensity of a financial entity (e.g., a bank) to be undercapitalized (systemic expected shortfall, SES), when such is the overall condition

[43] European Commission Impact Assessment, SWD (2017) 148 final, 4.5.2017, para 3.1.2.

of the financial sector, which therefore is prone to a systemic crisis, measures the contribution to systemic risk of a single entity of the system.

Founding the concept of systemic risk on an economic basis, as the authors do, is consistent with what should be the very objective of any anti-crisis regulations, which is to avoid an impact on the real economy, caused by the costs of banks' defaults (insured creditors[44] and bailouts) and the spill-over of negative externalities due to the financial system undercapitalization.

The authors maintain that, despite formal attention for systemic risk, actually the scope of financial regulations has often been confined to enforcing capital requirements for each bank[45] up to a minimum threshold just sufficient to limit its risk to entity-level value-at-risk (VaR) or expected shortfall (ES)[46], considered in isolation from the financial system. This approach addresses the financial firm's specific risk but not its contribution to systemic risk. It may be sufficiently prudent in normal times yet leave the financial system vulnerable to shocks.

In the Acharya et al. model, each bank maximizes, based on market conditions, its risk-adjusted return by selecting the amount of capital (equity vs debt) to raise according to its own risk profile. In order to protect the market against systemic risk, the Government's regulation has, instead, to take into account not only the aggregate effect of banks' actions, but also each bank's insured losses in case of default and the externality generated in the context of a systemic crisis which, according with the authors, may occur if the overall amount of capital in the financial system is below a minimum level. Since those latter elements of cost are not considered within the banks' allocation process but are essential for the overall optimization of the financial and economic systems (a case of market failure), the Government imposes to each bank a tax amounting to their sum. More precisely, the tax should equal the sum of the bank's specific risk (the fraction of its liabilities guaranteed by the Government) plus the bank's contribution to systemic risk.

The tax reduces the value of the bank equity, forcing the bank to recalculate its preferred level of capital (equity vs debt), in accordance with a *de facto* increased level of risk, now including higher expected losses, as compared with an individual situation of isolation, in case of a crisis. The provision implies that the tax entity depends on the

[44] It can be assimilated to insurance of bank accounts.
[45] For example, this is the case of Basel capital requirements.
[46] As a measure of losses of the firm in case of an extreme event.

level of risk accepted by the bank and it is zero when the bank's capital already takes fully into account both its specific risk and its systemic risk component. In other terms, the tax provides for the residual of the bank's component of systemic risk that the bank has left uncovered. In this way, the bank has the choice whether to protect on its own initiative against the total risk it is responsible for or to pay a corresponding tax, providing in advance its share for the possible support given ex-post to the financial system by the Government (partial bail-out).

Being able to effectively measure systemic risk is important, since quantifying it in terms of cost of government bailout would reflect only part of its economic impact.

The paper shows that, based on the proposed model, the systemic-risk component is measurable, being equal to the expected amount a bank is undercapitalized in a future systemic event in which the overall financial system is also undercapitalized. According to the authors, this amount can be empirically estimated based on the bank's stress tests[47] as well as by measuring the drops of its equity value and increases in its credit risk (reflected in the price of credit default swaps of the bank's debt) during experienced crises.

Prudence at macro level is not the aggregation of prudence at micro level. The event of few banks' defaulting would not trigger the collapse of the whole system in a domino effect chain, if all other banks have selected their level of equity vs debt taking into account their own possible contribution to systemic risk in addition to their default risk in isolation.

The paper supports the existence of a critical threshold for the system aggregate capital (equity), below which, at any significant shock, systemic risk would erupt into a systemic crisis and determine fire sales[48] and restricted credit supply to the real economy. This threshold is the fraction of the overall assets value of the sector (total assets value equals the sum of aggregate equity and debt) that should be kept in equity.

[47] Financial distress describes a situation in which a company is not able to pay, or has problems meeting, its financial obligations to its creditors, usually due to significant fixed expenses, illiquid assets or revenues that could be affected by economic deterioration. An entity that experiencing financial distress could face expenses related to the situation, such as higher cost for financing, opportunity costs of projects and less productive employees. Employees of a distressed company generally have lower confidence and greater stress due to the higher chance of default, which would force them out of their jobs [Senbet, L. W., & Wang, T. Y. (2012). "Corporate financial distress and bankruptcy: A survey". *Foundations and Trends in Finance*, *5*(4), 243-335].

[48] Fire sales are sales of goods or assets at extremely discounted prices, generally because sellers are in financial distress [Shleifer, A., & Vishny, R. (2011). "Fire sales in finance and macroeconomics". *The Journal of Economic Perspectives*, *25*(1), 29-48].

The intensity of the crisis (externality cost[49]) is a positive function of the gap between the level of aggregate capital and the critical threshold. Financial firms' defaults in a system where debt is low in comparison with equity do not trigger crises. The contrary occurs when the aggregate financial leverage is high[50].

The authors stress the importance of a regulation providing for an ex-ante taxation system, since it would reduce systemic risk by forcing all banks to pay in advance for the default of some of them in case of financial distress. On the contrary, the option for financial resources provided ex-post at the rescue of the system probably by the Government (bailout) would generate ex-ante moral hazard and increase systemic risk.

In brief, studying the nature and dynamics of systemic risk in a financial market, Acharya et al. predicate the imposition of an ex-ante tax to force financial entities to take into account, in their individual optimization processes, total (social) risk and, in particular, their respective systemic risk contribution components. To adopt this rule, it is necessary to be able to measure such component of risk for each involved financial entity. The authors show that this is possible by applying their model to the 2007-2008 crisis data.

However, the paper does not adequately investigate on the two-way logical nexus that must exist between the undercapitalization of each bank and the undercapitalization of the system. If a bank optimizes its position based on market prices, why should it be feeding systemic risk? The only answer to this question, as elaborated below, is that market prices do not fully reflect risk.

Elaborating on the exemplification of the financial system Acharya et al. propose in their paper, it is possible to clarify these points and make more useful for a network analysis of the OTC derivatives market the concept of systemic risk the authors portray.

Any financial firm (e.g., a bank, as in the paper) acting in a financial/economic system will optimize over time its equilibrium between the expected values (revenues) of its assets, which are the liabilities of the firm's counterparties, and the expected values (costs) of its liabilities, which are the assets of the firm's counterparties. Expected values incorporate risks (and opportunities[51]) and therefore differ from notional values.

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[49] The externality cost is zero when the level of aggregate capital is above the threshold.

[50] As examples, the authors mention the case of Barings Bank's failure in the United Kingdom in 1995, which did not provoke any crisis, even locally (the bank was absorbed by the Dutch bank ING), and that of the failures of Bear Stearns or Lehman Brothers in 2008, which generated financial and economic consequences at a global scale, because in the whole system too little capital was available.

[51] Opportunities are a form of (positive) risk. They are associated to assets, whose prices are higher than notional values (equity is an example).

Each firm is subject to a set of risks from the system affecting the performance of its assets and, in turn, does generate a set of risks for the system through its liabilities. The firm needs to assess risks in order to cover against them, according to its own risk profile.

In theory, from the point of view of the firm, risk could be conveniently expressed as the expected value (different from notional value) that an economic asset of the firm would get if a negative event happened. Risk could, therefore, be calculated by multiplying the probability that the negative event (e.g., default of an obligation) do not occur times the notional value of the asset[52] concerned (e.g., principal and coupons of the defaulted obligation). What makes this simple process difficult for the firm to follow is that, though notional values are given, estimating probabilities is not an easy job in the real world. The problem is normally solved by the market, which will implicitly estimate the risk associated to each participating firm by pricing the firm's liabilities at any specific point in time in the future. The lower the price with respect to the notional value of the liability, the higher the cost of debt for the firm, the higher the risk directly associated to that firm, the higher the financial distress of the firm. So, as long as each bank takes into account market prices in its optimization process, no bank should result being undercapitalized (with respect to its risk profile) and no increment of systemic risk should be generated[53]. However, the "invisible hand" of the market may fail and underestimate (overestimate) effective risk, thus overestimating (underestimating) the expected values (i.e., prices) of assets/liabilities and generating systemic risk. Let's see how the systemic risk mechanism works.

The invisible hand of the market is nothing more than the combination of the *independent* assessments that the many buyers and sellers (the firms of the system) of an asset make on the asset value through the demand and supply process on the market. In a dynamic equilibrium such combination of assessments results in the market price of the asset (the price at which the asset is exchanged). The stress here is on independence. Should firms' assessments be biased (buyers and sellers tend to influence one another in a significant way and in the same direction) due to some factor endogenous or exogenous to the market – which result in a situation of incomplete or asymmetric information – the invisible hand will fail and the market will dictate a wrong price for

[52] Since the liabilities of a counterparty are the assets of its counterparties, risk associated to a liability is the same as that associated to the corresponding asset.

[53] Of course, referring back to the paper, with the exception of the part of the bank's liabilities guaranteed by the Government, which are not considered here.

the asset. The more diverging from economic values[54] are prices, the higher the level of systemic risk, the heavier the impact of a possible systemic crisis on the financial and economic systems. Rapidly inflating price bubbles (too high prices of assets), on one side, and bank runs (too low prices of assets), on the other, are but two opposite examples of extremely high levels of systemic risk.

The Acharya et al.'s model illustrates the case of a bank that wants to cover against the risk of default, should it become unable to pay for its liabilities[55]. Given the expected values (future market prices) of its assets and liabilities, the bank decides the amount of own capital (equity) it has to keep. In doing so, the bank has a natural incentive to minimize own capital and increase financial leverage in order to optimize its economic performance. If, for some reason, the market prices are biased (higher than they should, because, for example, of too optimistic expectations), the bank will eventually keep too low a level of equity in relation to own debt. In other terms, expecting growing market price levels[56], the bank will buy more assets and sell more liabilities, thus contributing to the price boom (i.e., to a higher systemic risk level). Since any other bank shares the same incentives and faces identical market prices dynamics, the system as a whole will end up being undercapitalized and incorporate too high a level of systemic risk. In an undercapitalized financial system, the optimizing behavior of each individual bank implies over time a situation of growing moral hazard for the bank and increasing systemic risk for the system. The high market prices resulting from the biased decisions of the banks create, in turn, the incentive for each bank to freely ride the system and so to feed the price, moral hazard and systemic risk increasing trends. If the market prices were not biased, the systemic risk level would be negligible and a systemic crisis would be impossible.

Based on these elements, systemic risk can be interpreted as a potential negative externality cumulated in the system (what is usually called a financial bubble) that, subject to the triggering action of an unexpected event, may erupt into a crisis (the bubble burst), causing the disruption and eventually the collapse of the system, through multiplicative "domino effects", which take place because of financial contagion propagating through interconnectedness, fire sales, rapidly increasing margin

[54] Actually, nobody can tell in advance which is the real economic value of an asset. There may be attempts, however, to estimate which is a reasonable market price and see whether the actual price is by far too high or too low in comparison with the reasonable estimate.

[55] The paper, however, does not expand on the mechanisms through which systemic risk is generated and grows in the system. Such mechanisms are investigated below.

[56] High performance of assets, low cost of liabilities (debt).

(collateral) requirements, liquidity interest rates spirals, bank runs and herd behavior[57] of financial firms. Financial systems can be affected by unforeseeable and therefore unexpected events (uncertainty) which, as such, cannot be quantified into priced risks. An unexpected event may function as the trigger for instability to erupt into a crisis. A high level of systemic risk does not imply per se, however, that a crisis will occur. Yet, the higher the level of systemic risk, the more vulnerable to a crisis the system is, the higher the cost that a crisis will cause, if it occurs.

To this regard, it is interesting to observe, following Schinasi (2004)[58], that a financial system includes "the monetary system with its official understandings, agreements, conventions, and institutions as well as the processes, institutions, and conventions of private financial activities. Given the tight interlinkages between all of these components of the financial system, (expectations of) disturbances in any of the individual components can undermine the overall stability, requiring a systemic perspective. At any given time, stability or instability could be the result of either private institutions and actions, or official institutions and actions, or both simultaneously and/or iteratively". Schinasi's considerations confirm that financial instability may be a consequence of governmental institutions and actions, as a too expansionary monetary policy of the Central Bank or just the administrative management of a key financial player (which justifies the attention EMIR devotes to the role and functions of CCPs).

Going back to the case of market failure and cumulated systemic risk, it is easy to see how derivatives can play a significant role in determining situations of prices bias.

As already illustrated, derivatives are used for hedging (i.e., protecting against risk) by financial and non-financial firms. Derivatives prices reflect the expected values of the underlying assets/liabilities and therefore the risk associated by the market to the issuing firms. Obviously, in case of market bias, rather than reallocating risk among market participants, derivatives may concur to increase the divergence of prices from their reasonable economic level. Derivatives role may be particularly sensible for systemic risk, because they are often instruments of financial speculation, and speculation tends to accentuate rather than mitigate current prices trends. Moreover, while standardized derivatives are exchanged through regulated markets (Exchange Traded Derivatives,

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[57] Herd behavior is the tendency for individuals to mimic the actions (rational or irrational) of a larger group.

[58] Schinasi (2004). "Defining Financial Stability". *IMF Working Paper 04/187*.

ETDs), which act as clearing houses for buyers and sellers and match the requirements of transparency and anonymity necessary for a correct price determination, Over The Counter Derivatives (OTCDs) do not share any of these essential characteristics. OTCDs markets are therefore the major producers of systemic risk for financial systems.

2. *Systemic risk in the OTC derivatives market*[59]

In the ESRB (European Systemic Risk Board) paper "Shedding light on dark markets: first insights from the new EU-wide OTC derivatives data set", Abad et al. (2016) analyze the set of the 2015 relevant EMIR data, collected EU-wide. A summary of their findings is reported below.

The OTC derivatives market is opaque, involves large volumes of transactions and is characterized by a very complex structure. Such an operational context appears to be the most favorable to the development of moral hazard and, as a consequence, of systemic risk and financial instability. A primary objective of the paper is to identify possible sources of systemic risk, on the assumption that systemic danger is inherent in the typical interconnection patterns of this market. A general indication that emerges is that, in derivatives markets, the level and dynamics of systemic risk depend on the interaction among market risk, counterparty risk and liquidity risk, but they are also affected by the distribution of these risks across market participants. A very large majority of trades is concentrated in a little number of financial entities which become the very vulnerabilities of the system in terms of systemic risk. To the purpose of investigating the pattern of distribution of trades, it is very meaningful to examine the statistics of the network structure of the market provided, with other data, by the ESRB paper in the form of graphics and graphs.

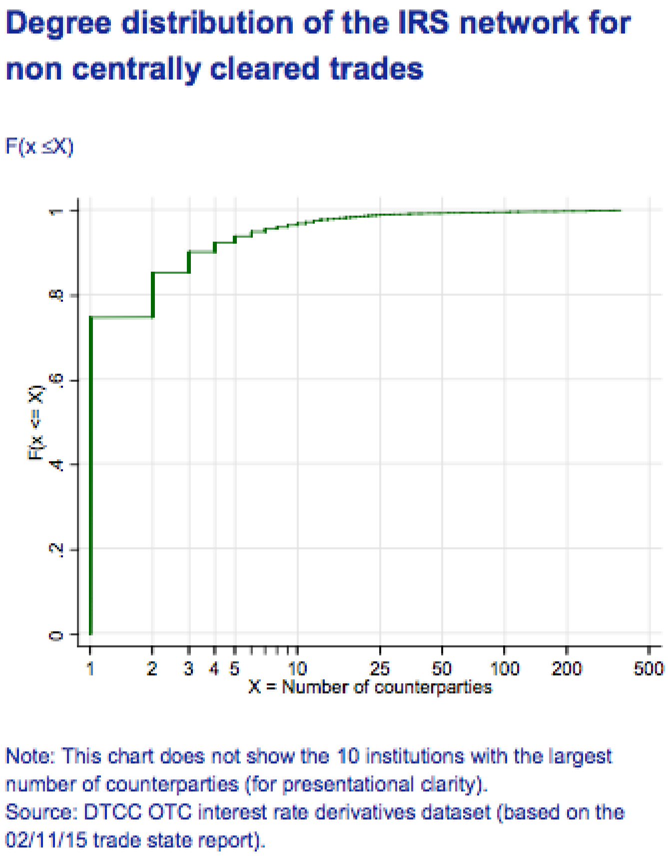
The three largest derivatives sectors of the OTC market are those related to interest rates, foreign exchange and credit.

The *interest rate derivatives sector* accounts for about 75% of the gross notional of all derivatives markets. The intermediation function with end customers is accomplished by a relatively small number of entities (54% of trade for G16 dealers; 31% banks), among which some large banks. Since interest rate swaps are traded over-the-counter,

[59] Abad et al., Shedding light on dark markets: first insights from the new EU-wide OTC derivatives data set, Occasional Paper Series No 11, September 2016, European Systemic Risk Board.

the market network structure of the relative outstanding contracts can be extremely explicative to sort out the main properties of these derivatives.

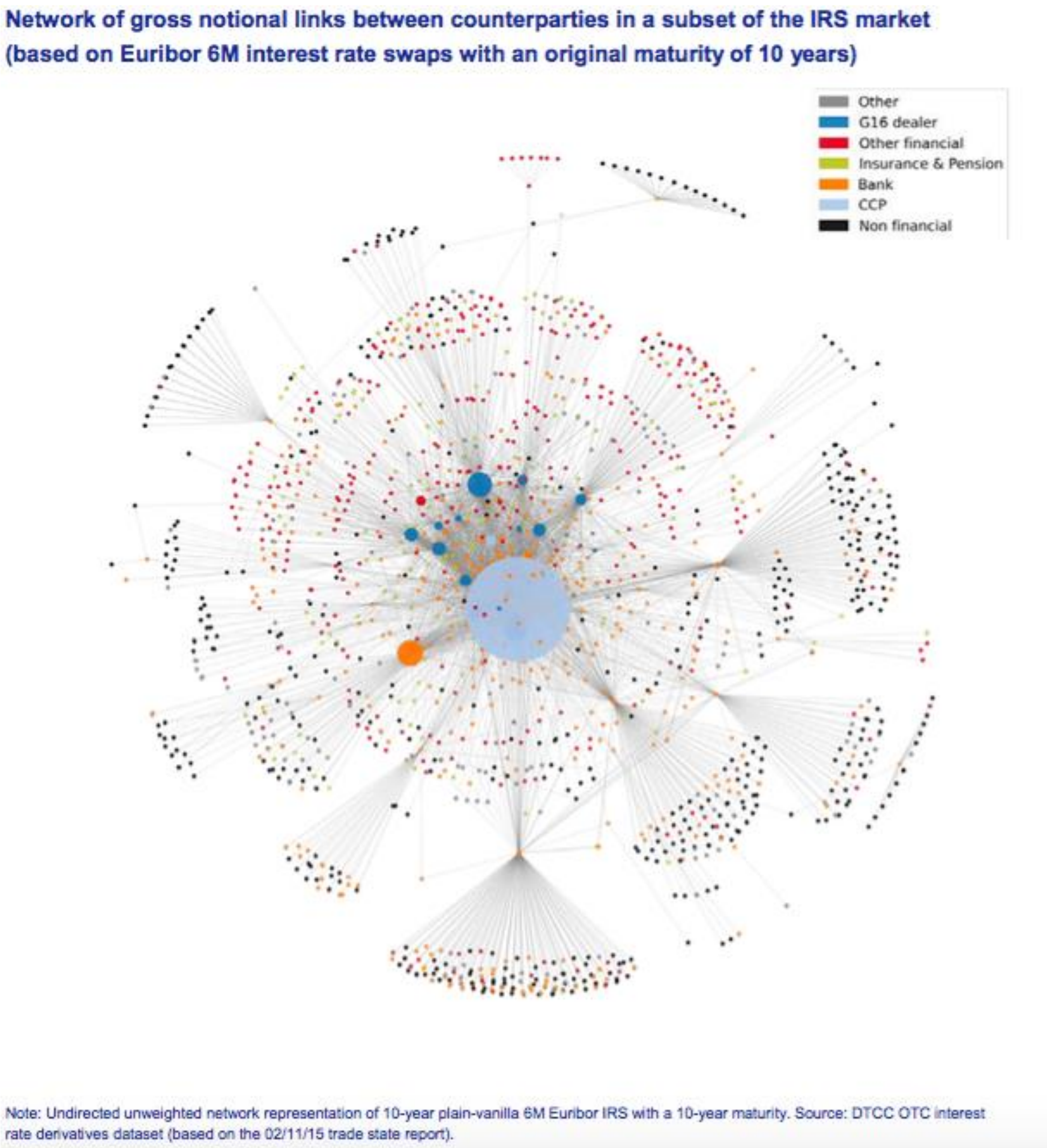
Figure 27 shows the degree distribution of the interest rate swaps (IRS) network for non-centrally cleared trades, with the degree variable being the number of counterparties with which each counterparty trades.



<u>Figure 27</u> – The degree distribution of the IRS network for non-centrally cleared trades (Source: Abad, 2016)

The distribution is right-skewed with a long right tail, and therefore strongly asymmetric. This pattern indicates a highly concentrated structure. As can be seen in the graphic, 75% of the counterparties have just one trade (they have only one counterparty). 90% have only 5 trades or fewer (5 counterparties). The long right tail of the distribution shows that very few counterparties have very large amounts of outstanding contracts (i.e., a large number of counterparties). This is the case also in terms of volumes, since G16 dealers and banks accounted for 95% of the notional value of the sector in 2015. Such central dealers mostly function as intermediaries.

Figure 28 provides a simplified picture of the structure of the network representing the outstanding trades (links) between the different counterparties (nodes) of the interest rates swaps market.



<u>Figure 28</u> – Network of gross notional links between counterparties of the IRS market (Source: Abad, 2016)

The graph confirms the high degree of concentration of the market, as demonstrates the large number of counterparties connected to each G16 dealer and banks. The size of the nodes is a function of its notional degree. These central counterparties are densely linked to each other as well. Several levels of intermediation are present, which connect peripheral counterparty to central dealers. The largest counterparty however is a CCP, since more than 30% of the trades in this market is centrally cleared.

Not very differently from interest rate swaps market, also the *credit default swaps market* is highly concentrated, with most trades linked to the same few counterparties, which account as well for a very large share of the notional value. Such central dealers mostly function as intermediaries.

Credit default swaps, which were at the basis of the Lehman Brothers default, represent a very well known source of systemic risk. They are traded over-the-counter.

Data related to the network structure of the CDS market are organised into Figure 29 and Figure 30 below.

Analogously to what was done for the interest rates swaps sector, the next graphic shows the distribution of the CDS network counterparties degrees. It is a highly concentrated market as well, with almost 90% of the counterparties having 5 contractual links or fewer, while most of the trades are allocated to very few counterparties, the dealers. An 84% share of total interactions are performed by the G16 dealers and major banks.

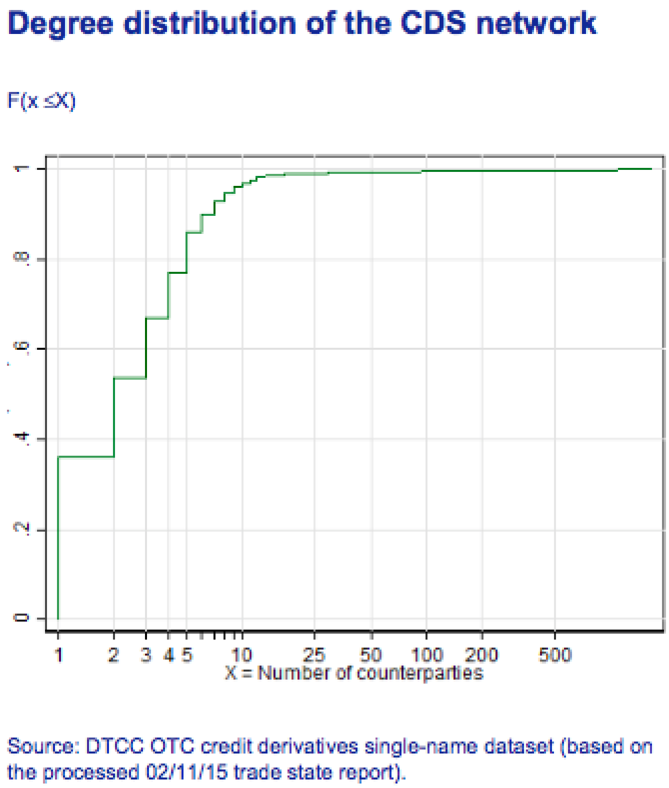
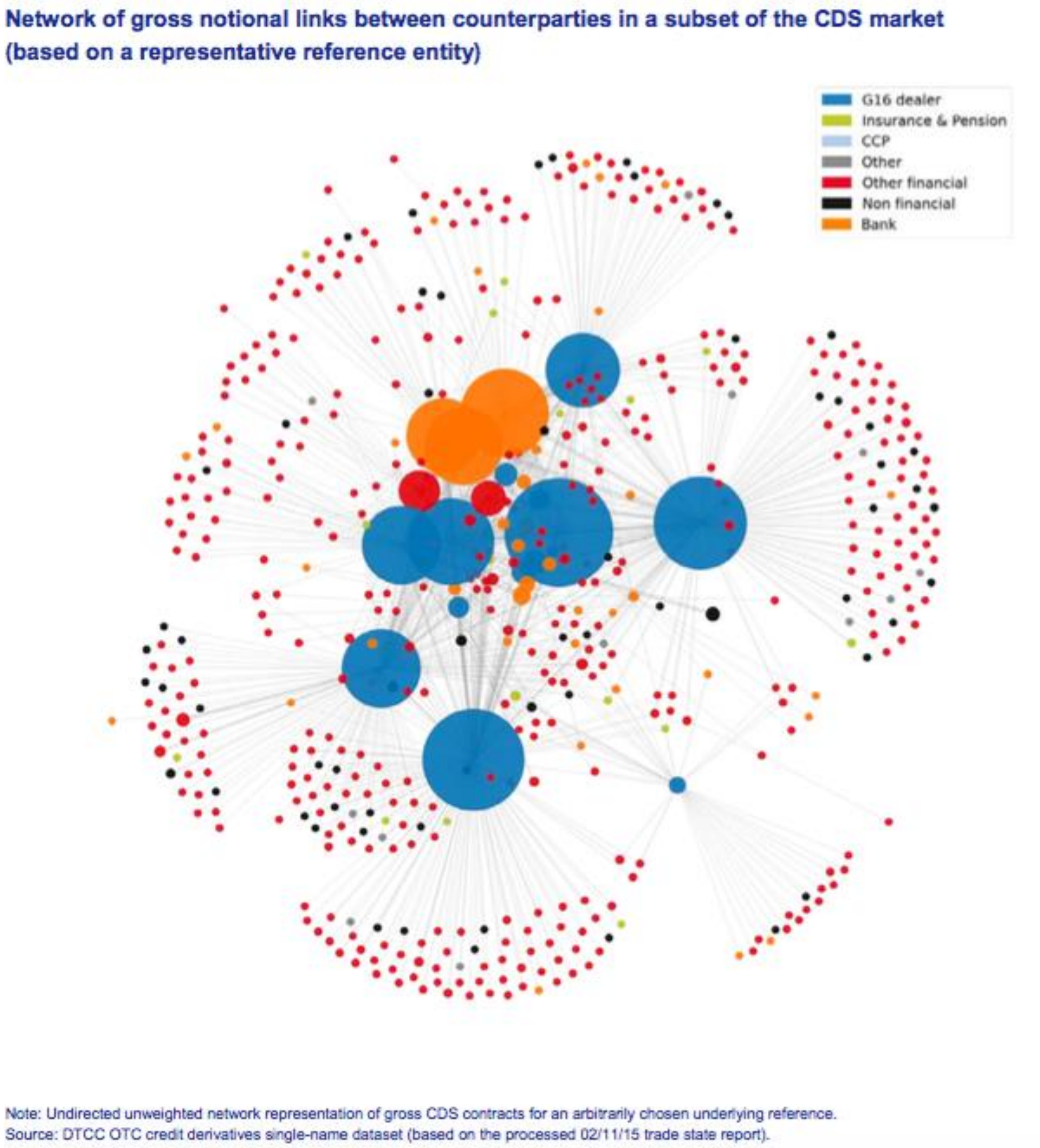


Figure 29 – The degree distribution of the CDS network for non-centrally cleared trades (Source: Abad, 2016)

Similar to the previous OTC sector, the graph of the credit default swaps network is shown below in a simplified version (Figure 30).

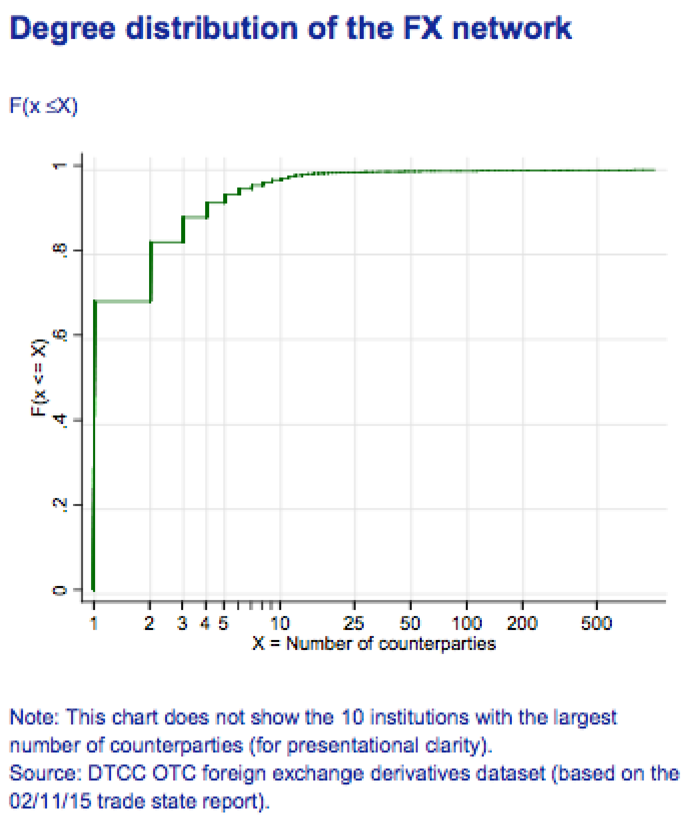


<u>Figure 30</u> – Network of gross notional links between counterparties of the CDS market (Source: Abad, 2016)

The network structure demonstrates the concentration of the market and the centrality of the few G16 dealers and banks.

The third main segment of the OTC derivatives market is that of the *foreign exchange derivatives* (FX), the second largest after the IRS. They are not subject to the EMIR requirement of being centrally cleared. Most of the trades refer to non-financial counterparties. The numbers of the counterparties involved is much bigger than those of the interest rate and credit default swaps.

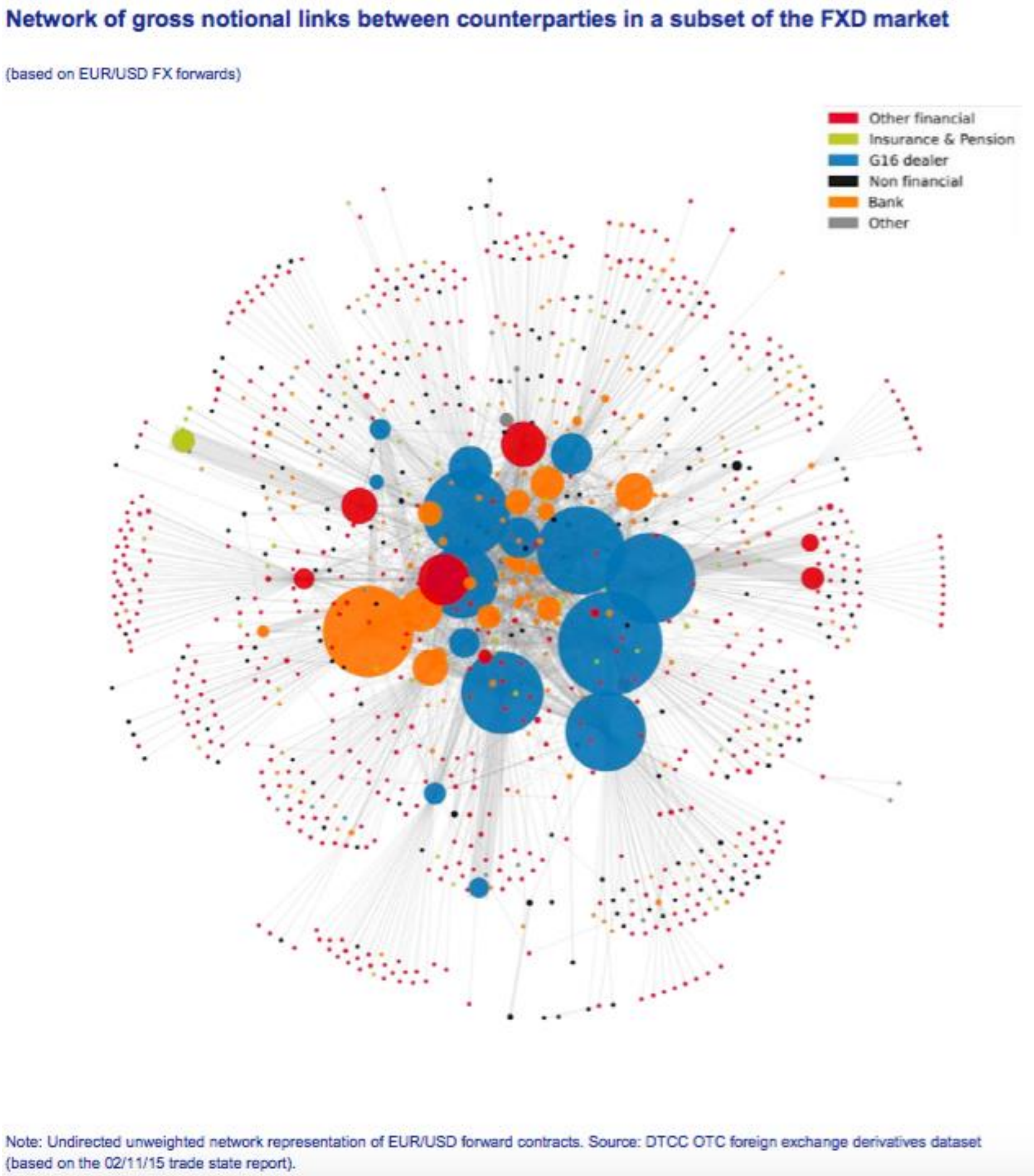
The network properties of the foreign exchange derivatives market are shown below. Figure 31 presents the FX market degree distribution. The properties are the same as those illustrated for the previous sectors.



<u>Figure 31</u> – The degree distribution of the CDS network for non-centrally cleared trades (Source: Abad, 2016)

The network of FX outstanding contracts is shown below (Figure 32).

The network is possibly more complex than the ones of the previous two sectors, due to the total absence of central clearing. The core is constituted by the G16 dealers and banks, which absorb 74% of the transactions. Here, however, other financial entities account for more than 17% of trades, while non-financial entities have a significant weigh (5,7%).



<u>Figure 32</u> – Network of gross notional links between counterparties of the FXD market (Source: Abad, 2016)

3. The basics of networks theory[60]

To the purpose of this work, a *complex* system is defined, in general terms, as a set of a large number of bilaterally interacting elements and their interactions. System configuration (i.e., number and size of elements and interactions; pattern of system structure) changes (evolves) with time. Each element is connected to some (at least one) elements through *bilateral interactions* and to all other elements of the system through paths or *chains of bilateral interactions*. These chains materialise *systemic interactions*. Bilateral interactions are *strong interactions*, because they are the results of the elements' choices, whatever the selection criterion is (if any). Systemic interactions are *weak interactions*, since they are unwanted consequences of many (independent) bilateral interactions. It is the set of systemic interactions, acting as a connective tissue, that characterizes a system as such and either keeps its elements together or puts them apart. Bilateral interactions can be *symmetric* (e.g., a link of knowledge: two persons know each other) or *directional* (e.g., a contract, where one side is the buyer and the other the seller; or a line of risk flow), depending on the system and the type of activity considered.

The high number of component elements and the fact that they evolve with time imply that just a fraction of all possible interactions will be in place at any specific time. Which specific fraction is actually activated and how interactions are distributed among elements (i.e., the pattern of the structure) at a certain time represent, in any case, significant characteristics of the system at that time. Complexity is a function of the number of elements, their interactions, and time changing configuration. The pattern of the system structure and systemic interactions determine the systemic properties of the system[61].

According to the network analysis approach, a system (as defined above) is represented by its *underlying network*, whose N nodes are the system elements and L connections their interactions[62].

A network (N, L) and, in particular, type and efficiency of the connectivity it provides between its nodes are fully described through the following characters:

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[60] Information in this paragraph is a simplified elaboration of Newman el al. (2006),The Structure and Dynamics of Networks, Princeton University Press, finalized to the specific purposes of this work.

[61] This implies that, to a certain extent, systemic properties are determined independently of the nature of the system.

[62] In mathematical terms, a network is a graph, i.e. a set of N nodes (the network dimension) connected by a set of L links.

– probability distribution $P(k)$ of the variable node degree k_i, the number of links of node i, which allows to determine the *general structure* of the network. If N is the number of nodes, $N(N–1)/2$ is the total of possible connections, while the fraction of connections in place is $L = \sum_{i\ (1,\ N)} k_i$.

  $P(k)$ measures the probability that a node has exactly k connections;

– *small world* character (average path length between two nodes randomly taken), which provides an evaluation of the *connectivity* of the network and, therefore, of its capability of transmitting data as well as of its sensitivity to shocks;

– *clustering* character, the nodes propensity to connect in groups, where the nodes belonging to a group are almost all bilaterally connected with each other. The clustering character provides information about the local structure of the network. The clustering coefficient is the probability that two nodes adjacent (bilaterally connected) to a third one are adjacent to each other.

The mentioned characters are each related to each other. The connecting efficiency, which is the variable the network is assumed to optimize through endogenous mechanisms, depends on the three of them. The clustering propensity, in particular, indicates the tendency to higher connectivity within groups than in the network.

The leading character, however, is the probability distribution of the node degree. Based on it, it is possible to distinguish, to the purposes of this work, two main kinds of network structures with very different properties: the random networks and the scale-free networks.

Assuming that the nodes of the network be indistinguishable (all alike) and connected through the same unique standardized type of connection, there will be no room for a choice based on preferences and every node will be indifferent between connecting to one partner node or another. Consequently, two nodes, taken randomly, will have the same probability p to connect to each other as any other arbitrary pair of nodes[63]. In different terms, there will be no reason to expect that two nodes randomly taken have a very different number of connections[64], so that the stochastic variable node degree k will approximately follow a normal distribution with a small variance and, more

[63] In an equilibrium of steady state, the probability p of bilateral (strong) connection of an arbitrary node A with any other node B of the system may be either a direct feature of nodes or a consequence of the size N of the system. In the first case, A will be expected to connect with $k = pN$ nodes, with a confidence given by the variance of the distribution of the stochastic variable k. In the second case, A will have at its disposal a certain number of connections k and, therefore, its probability of connection with an arbitrary node B will be $p = k/N$. Given that connections are in total $L = kN/2$, p can also be written as $p = 2L/N^2$.

[64] Of course, the two nodes will not necessarily be directly connected (bilateral connection).

precisely, a Poisson distribution of probability[65], $P(k) \sim \frac{<k>^k}{k!}$, with $<k>$ being both the mean degree and the variance of the distribution.

An increase in the number N of nodes that makes the network grow may affect the mean node degree but not at all the network structure pattern. Given that N is very high and k relatively very small, no single node can affect the k distribution and system equilibrium.

A network showing the described properties is a *random network*. Interactions are distributed randomly among nodes with a certain probability almost equal for all nodes. A random network is thus characterized by its *scale* (i.e., its mean node degree) and can be described in terms of node connections by a representative node having the mean node degree. A system represented through a random network is a random system whose elements, though having an incentive to interact with each other[66], do not show any specific auto-organizational principle endogenously generated[67].

The typical probability distribution of a random network is shown in Figure 33 below.

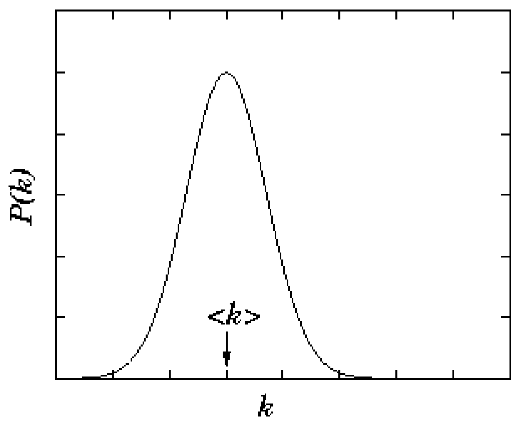


Figure 33 – Typical probability distribution of a random network

The one described above is a completely unstructured system. When connections cannot be considered statistically equiprobable, the network has biases and it shows some level of social stratification and clustering, so that individual nodes are not all alike: differences in their degrees k are not random any longer, distribution variance depends on node choice, and choices are made based on some kind of preferences. As

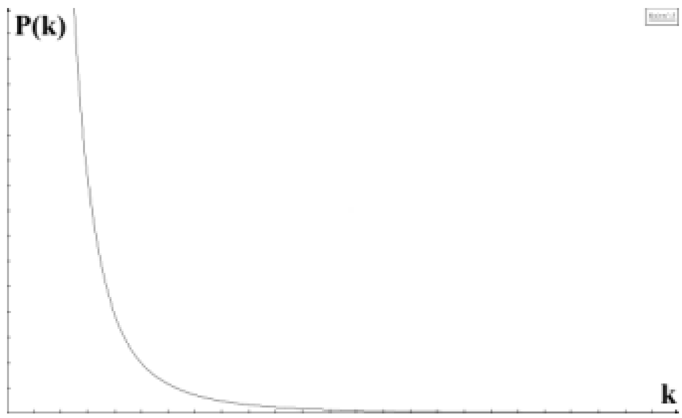
[65] The Poisson distribution responds to the conditions of rare events. In a random network, the number of nodes N is very large and the probability of connection p is low, so that the mean $<k> = pN$ is finite.
[66] Because, otherwise, the system itself would not exist.
[67] In other words, the nodes want to establish a certain number of connections (the mean degree), but do not care which specific nodes to connect with.

anticipated above, a frequent form of structuring in a network is *clustering*. The distribution probability of a clustered network will have the same mean of a corresponding random network, but a larger variance. Random networks – clustered or non-clustered – are *local networks*. Structure at global level reproduces structure at local level, so that the properties of the network can be inferred through a random sample of connection data (inferential statistics).

A random network represents a good model of a perfect competition system/market.

The *scale-free networks* – typical of many complex networks where information has a key role– are not characterized by the scale of the variable node degree[68]. The probability distribution of a scale-free network follows a power law $P(k) \sim k^{-\gamma}$, where γ is a parameter comprised between 2 and 3. As shown in Figure 34, the probability P(k) is heavily asymmetric, decreasing for increasing node degrees, and therefore has its maximum on the left extreme of its dominion[69]. The long tail of this distribution decreases much more slowly than that of the Poisson distribution. This means that there are few nodes, the *hubs* of the network, with a very high number of connections in comparison with all other nodes (the very large majority). Given the big size of the network, the presence of the hubs is significant (low probability x high number of nodes) and shapes the properties of the network.

Scale-free networks are *non-local*. By extracting a random sample of connection data it is not possible to infer the properties of a scale free-network[70].



<u>Figure 34</u> – Asymmetric probability

[68] The mean node degree <k> does not affect structure and properties of the network, as is the case for random networks.

[69] Corresponding to the minimum degree that a node can have (1 in the graphics).

[70] Given the very high number of low degree nodes in comparison with the very few high degree ones (hubs), a random sample of a scale-free network may not include any hub or at least will not include all of them. Since the properties of the network are determined by the hubs, the sample will not approximate the properties of the network.

Figure 35 represents a power law (scale-free network distribution probability of node degree) in logarithmic coordinates (*ln P(k) = ln* $k^{-\gamma}$ = – γ*ln k*).

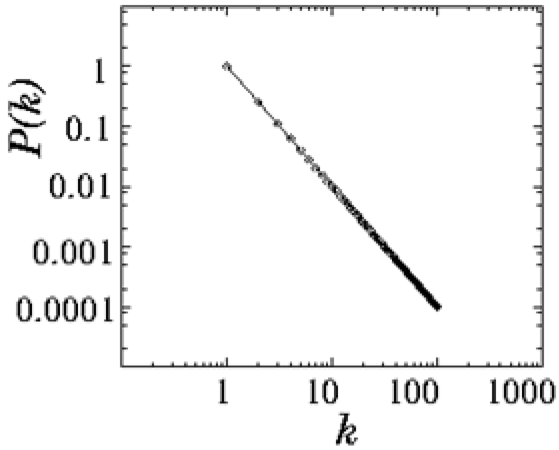


Figure 35 – Power law in logarithmic coordinates

Of course, the variance of a scale-free network distribution is much higher than that of a random network distribution having the same node degree mean (equivalent dimension). Yet, the interesting but not less obvious point is that, increasing the dimension of the two networks (the number of nodes N), the scale-free network variance tends to diverge more and more from that of the equivalent random network variance. This means, in general, that the inequalities in a scale-free network system increase as the system grows[71].

The scale-free network is a model of an oligopolistic system/market.

The *concept of small world* refers to large networks characterised by the property that two randomly selected nodes of the network are separated by a relatively short chain of bilateral connections. Both random and scale-free are small-world networks, though in scale-free networks, because of the hubs presence, this character, measured by the shortest (number of bilateral connections = levels of separation) chain that separates two nodes, is much more accentuated. What is important in practical terms in a scale-free network is the distance of a node from the closest hub. The small-world character describes the connectivity of the network, that is how easily information circulates in the network but also how quickly a crisis (contagion) can spread through the network.

[71] In a random network system inequalities remain constant as the system grows.

A number of empirical analysis and studies show that, *in the real world, large information system underlying networks are scale-free networks*.

It is interesting to see how a random network tends to become a scale-free one when subjected to the dynamics of growth typical of an information system, because the two mechanisms that generate this transformation –*growth* and *preferential attachment*– are those that characterize the dynamics of a scale-free system. A simplified illustration of the model follows.

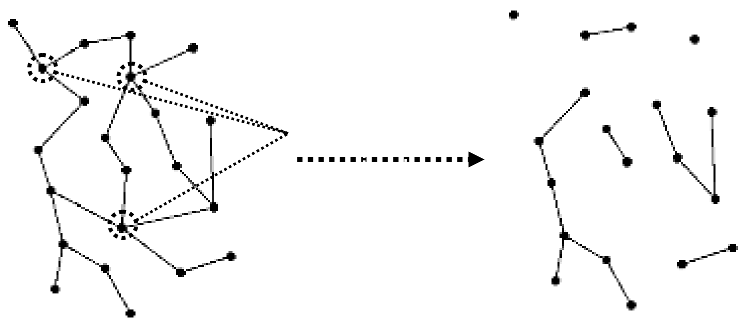
According to the *growth mechanism*, at any time unit a new node enters the network establishing a constant number *m* of connections[72] with *m* nodes of the network. The choice of the entrant node, as to which *m* nodes of the network to connect to, is made based on the *mechanism of preferential attachment*: the preferred partner nodes are those with the highest numbers of connections in the network. In other terms, the entrant node selects partner nodes *i* with probability $\Pi(k_i) = k_i / \Sigma_j k_j$, corresponding to the relative degree of node *i* (i.e., number of connections of *i* relative to the network total number of connections). The dynamics of growth and connection resulting from the combined functioning of the two mechanisms generates the power law probability distribution that characterizes scale-free networks. A small number of giant nodes (the hubs), each with very many connections, ends up dominating the scale-free network. The hubs ensure a high level of small-world properties of the network, by keeping connected a very large number of nodes, each with comparatively much fewer connections.

Random and scale-free networks have different capacity to resist to endogenous and exogenous shocks (crises) and keep their fundamental properties working (stability: continued network connection of component nodes). If shocks are assumed to strike randomly the nodes, then, since each nodes contributes almost equally to connectivity, random networks are characterized by a threshold of inactivated nodes, beyond which the network collapses (crisis: nodes connectivity is lost). In case of a random selection of the stricken nodes, scale-free networks are more robust, since connectivity is guaranteed by few hubs and the probability that one hub is stricken is very low. However, since shocks do not always hit randomly, as real world system crises often show, and tend to concentrate where some risk factors are more pronounced (the case of speculation in financial system is an example), the scale-free topology makes networks

[72] The node's endowment when entering the network (all entering nodes are equal).

much more sensible to crises: if the shock hits a hub –and the probability that this happen is empirically much higher than that for a regular node– in most of the cases the network will collapse and lose its connectivity. This is a network exemplification of a too-big-to-fail situation.

Figure 36 shows how the failure of 3 nodes out of 22 may cause the collapse of a network.

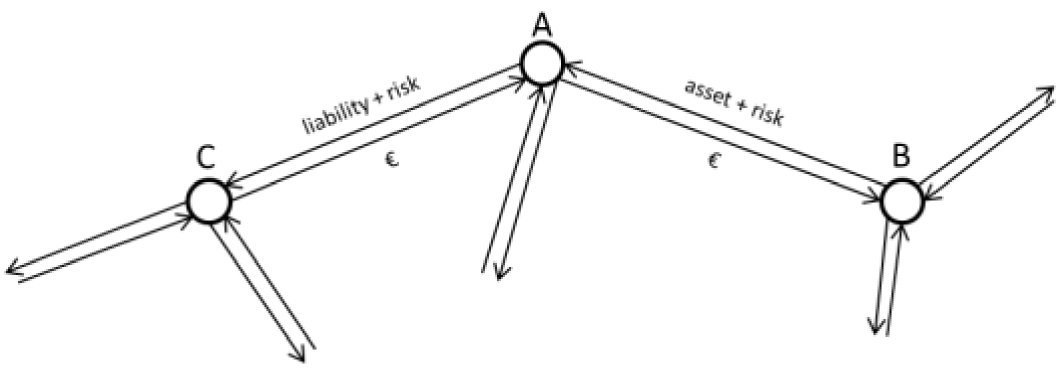


<u>Figure 36</u> – Failure of three nodes may cause the collapse of a network

4. A network model of the OTC derivatives market

In this paragraph the concept of systemic risk as illustrated in the paragraph 5.1. is applied. The different OTC derivatives (interest rate swaps, credit default swaps, foreign exchange derivatives) are considered herein for simplicity as a single type of derivative, incorporating the market (network) properties of the three which, as seen in paragraph 5.2., are quite the same.

In Figure 37 it is represented a portion of the underlying network of a simple financial system, with financial firms A, B, and C. Firm A raises money by selling a liability to firm C (which for C is an asset) and buys an asset from firm B (which for B is a liability) in exchange for money.



<u>Figure 37</u> – Portion of underlying network of a simple financial system

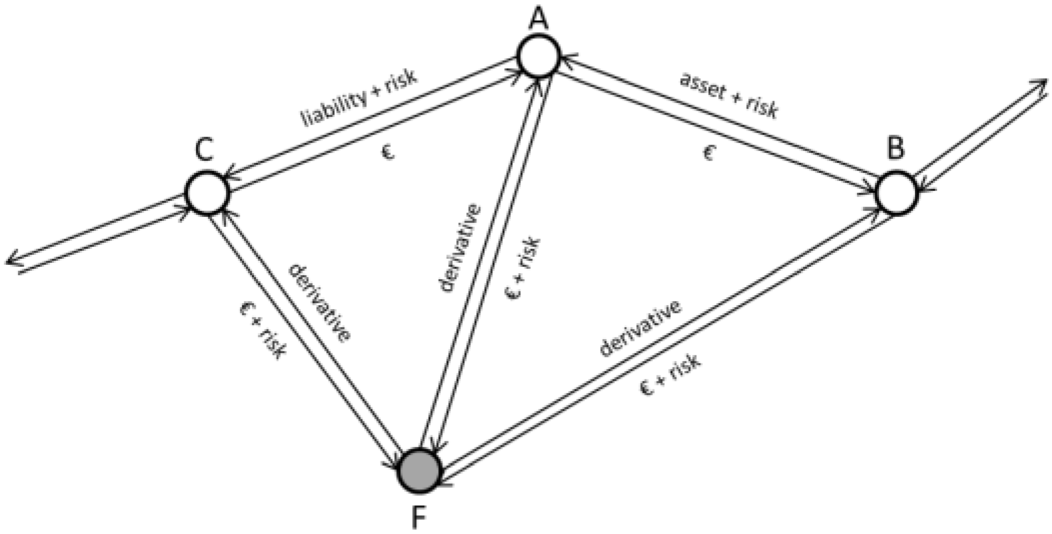
Firm A runs the counterparty (bilateral) risk that B does not honor its obligation and, at the same time, puts on C an analogous counterparty risk for its liability. The same holds for B and C and for all other financial firms of the system. So, in this segment of the network, risk flows from B to A and then to C and so on, along a chain of bilateral connections. Of course, this does not mean that A (as well as B and C) is protected from the risk that B defaults. On the contrary, if B defaults, also A will probably default and spread default contagion to C. This kind of financial crisis would be fairly common if assets were really exchanged on a bilateral basis, because an investing firm A will probably not be able to fully assess the risk associated to firm B and correctly estimate the asset price, and B will have no interest to disclose this information to A, generating a situation of asymmetric information and moral hazard for B. These situations are solved by the institution of financial market, where the whole demand and supply of assets encounter and establish reliable equilibrium prices – and therefore correct evaluations of risk – as a consequence of full transparency of information determined by the free competition among financial firms.

As long as the sizes of the firms are limited and, in any case, comparable among them, the primary condition for free market competition will hold and the market will hardly become biased, except for exogenous factors[73]. Systemic risk will reduce to the sum of counterparty risks.

Before drawing the first deductions through the network analysis, the system, as configured so far, will have to be completed with the introduction of derivative financial products.

As said above, firm A, B, and C are not covered from counterparty risk and therefore they will decide to buy appropriate derivatives to protect against a possible counterparty failure. The resulting situation of the network is depicted in Figure 38.

[73] Too favorable or unfavorable expectations determined by events external to the financial system.



<u>Figure 38</u> – A, B, and C are not covered from counterparty risk and decide to buy derivatives for hedging

Firm F sells risk insurances for money and, at the same time, it buys counterparty risks from firms A, B, and C, which it will pay only in case of default. From Figure 38, it can easily be seen that risk tends to concentrate on firm F. A, B, and C are protected unless F defaults. In this way, F has become a vulnerability of the system much more than A, B, and C were before protecting.

Before proceeding, three assumptions have to be made that then will be removed. The first is that the derivatives in question are ETD (Exchange Traded Derivatives) and, therefore, are priced through a transparent market. The second assumption is that there are many firms like F, selling derivatives (although in Figure 38 only one is represented). The third assumption is that there is no speculation.

In the configuration illustrated, the financial system remains based on a competitive mechanism. Although they sell specific products, firms of F type can be assimilated to any other financial firm operating in the market. The role firms F play tends to reduce financial instability, because their action, probably specifically specialized on risk assessment and management, will increase the transparency of the market, spread the risk among a much wider set of counterparties, and minimize the effects on the system of possible defaults. Apart from this beneficial contributions to the market, there is substantially no change with respect of the first configuration of the system, without firms of type F.

The need for customised contracts to cover from firm specific risks leads to removing assumption one, so that OTC derivatives are introduced in the financial system. Figure 38 still describes the situation but, now, there will be no longer a free competitive market for derivatives. However, since F firms are numerous and have modest dimensions, they can be considered as any other financial firm in the market. Transparency is reduced no more than in the first situation addressed, where there were no derivatives at all, while the risk associated to firms F is not different from counterparty risk of firm A, B, and C.

This situation represents the *scenario of a nascent OTC derivative market* within a financial system. The system underlying network is a random network with all the properties illustrated in paragraph above. The node degree (number of trades per firm) is low and almost the same (the mean node degree) for all firms. Systemic risk remains confined to the sum of counterparty risks – mitigated by the presence of the assets competitive market – apart from externally generated expectations. The system underlying random network will collapse only if a number of firms larger than a high critical threshold defaults.

As the financial system grows[74], its underlying network, that had a random connotation in the nascent OTC derivatives market, tends over time to become a scale-free network, through the mechanism of preferential attachment described in paragraph 5.3. F type firms progressively find out, thanks to the knowledge and experience they have acquired on the market, that they can exploit large and apparently easy economies of scale, as they increase their volume of business. The more derivatives they sell, the more advantageous conditions they can offer to buyers, the comparatively less onerous become the margins (own capital) they must keep for covering against risk. In brief, F type firms will have a stronger and stronger incentive to increase their dimensions. The most competitive of them will absorb or throw out of the market many others less competitive. By allowing better conditions to A type firms, they get large portions of the market. After a while, only very few F type firms will survive. They have become the hubs of the OTC derivatives market.

This transition leads to the *scenario of a mature OTC derivatives market*. The underlying network of the financial system takes now the topology of a scale-free

[74] There has been an extraordinary growth of the financial system(s) in the last decades with the rapid development of globalization and the invention of very new types of financial products.

network. The terms of this transition are fully confirmed by the ESRB's paper illustrated at paragraph 5.2.

The structure of the network is reproduced in Figure 39, with only one hub (firm F) represented.

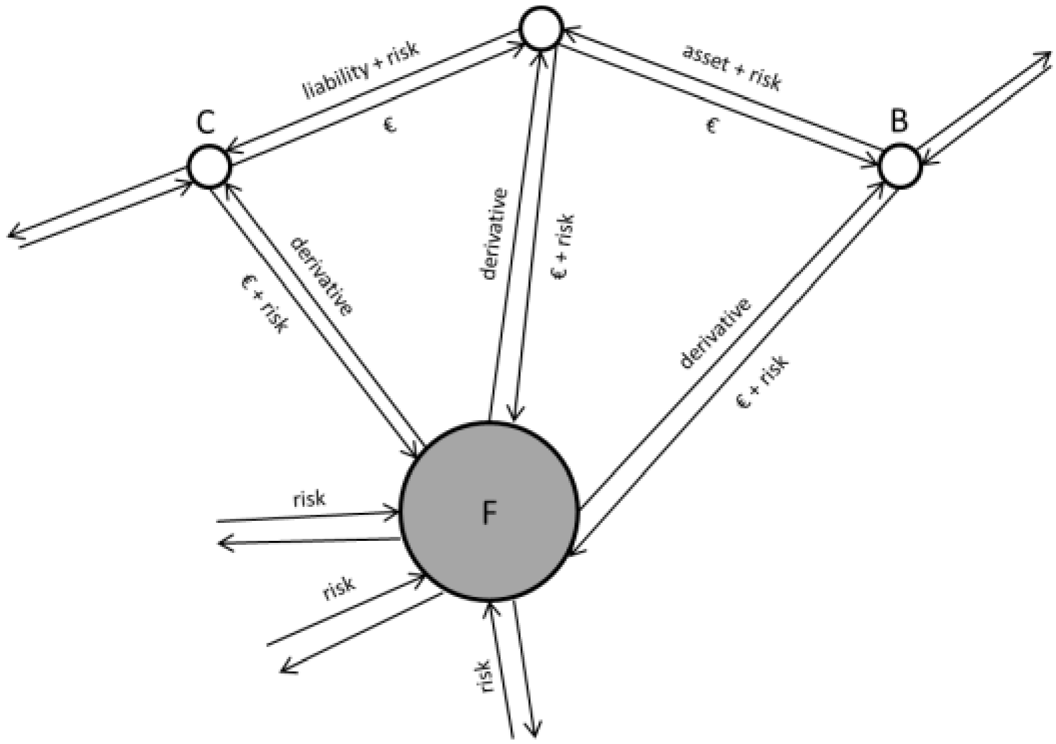


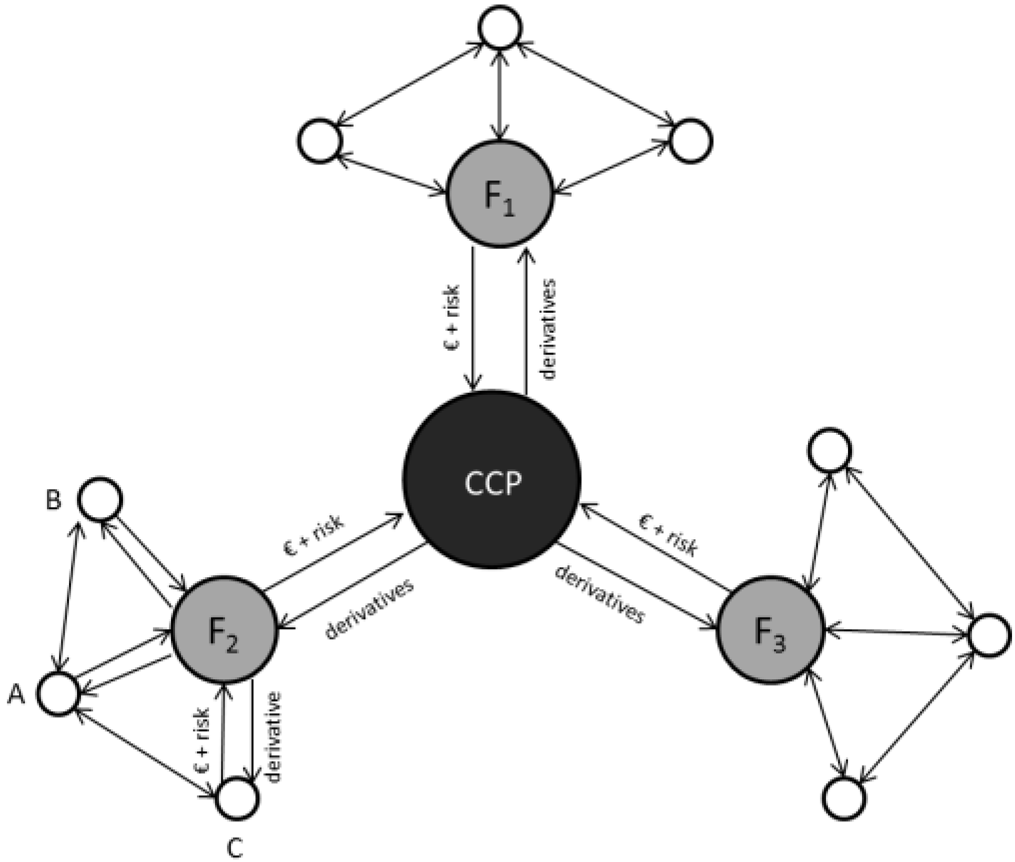
Figure 39 – Structure of the network

The hubs dominate the OTC derivatives sector. There is no competitive market for these products. Firms F interact with financial counterparties as counterparties themselves, establishing a very large number of bilateral trades, in which they are an interested side of the contracts. So, they do not guarantee the anonymity and the consequent information transparency of a competitive market. They have an incentive to select and bias information in order to feed their business volume and, in doing so, they increase over and over their market power to the detriments of financial firms. F type hubs not only become concentrations of large amounts of the financial system counterparty risk, but also become a primary source of endogenous bias of derivatives prices and therefore of systemic risk for all firms as well as for the parallel economic system.

As the network theory and the experience of several real-world crises amply show, it will suffice that just one or two of these F type hubs default to make the whole financial system and consequently the economic system to collapse. This actual possibility leads directly to the syndrome commonly known as too-big-to-fail, furtherly increasing the level of moral hazard for the F hubs and therefore of the amount of systemic risk in the financial system.

At this point the third assumption too can be removed. The possibility of speculating on the risk of financial counterparties increases enormously the level of systemic risk. As a matter of fact, if a financial hub speculates, that is it makes a bet on the direction of the price fluctuation of an underlying asset issued by a counterparty, the whole amount of the hub's very many transactions will be orientated in its bet direction. The hub's action will, therefore, sensibly affect the current price of the concerned asset and its related derivatives in that same direction of the bet as well the risk attached to issuing firm, thus strongly biasing the market. This is quite different from a free market assessment that is the balanced result of the same very many bets, this time made, however, by independent operators, each pursuing its own individual interest and therefore not necessarily pointing in the same direction and with identical intensities.

Figure 40 represents the *EMIR OTC derivatives market scenario*. F hubs are now subjected to the obligation of central clearing through the CCP and have become clearing members of the CCP.



<u>Figure 40</u> – EMIR OTC derivatives market scenario

All the transactions that were previously made bilaterally through the hubs with individual counterparties must now be made by the clearing members through the CCP. The great advantage here is that the market function and power are entrusted to the CCP, which has no own interest in the course of prices and can keep under check the systemic risk associated with clearing members bets, by appropriate mitigation measures defined under the EMIR. Trade Repositories guarantee the necessary transparency of the OTC market by collecting and sharing all information related to OTC trades. The level of moral hazard associated to the F hubs (now clearing members) and the amount of systemic risk in the system are therefore minimised.

5. An example of OTC market network quantitative analysis

The network analysis conducted in the previous paragraphs in qualitative terms is just one of the advantages of using network analysis for market functioning investigations. Since networks can be mathematically represented through matrices and these offer well developed methodologies of calculation, the network analysis can help a lot in quantitative terms as well. The review of a paper from Markose et al. is a good illustrative example.

Markose et al. (2017)[75] observe that imposing on clearing members of CCPs large initial and variation margins, and contributions to the default fund may result in systemic risk depending on a trade-off between liquidity and solvency difficulties[76]. However, the crisis showed that, in 2007, the system liquidity was insufficient to cover the huge notional volume of positions on derivatives and the losses in their underlying assets, so to effectively confront not only with failures of major financial entities but also with their contributions (negative externalities) to systemic risk, although cascade defaults were already known as a typical vulnerability of highly interconnected financial systems. In the crisis contingency, systemic risk was accentuated by the fact that much of the interconnectedness was hidden behind the OTC market opacity. Experience showed as well that financial contagion was mostly brought about by large financial entities.

[75] Markose, G., and Shaghaghi, R. (2017). "A systemic risk assessment of OTC derivatives reforms and skin-in-the-game for CCPs". *Banque de France Financial Stability Review*, no. 21 - The impact of financial reforms.

[76] They mention the case of the American Insurance Group (AIG) which, in 2007 at the first symptoms of the crisis, was stressed by rapidly increasing margin calls on its derivatives positions, while the market value of the underlying assets was going down. As a consequence, AIG was confronted with a risk of default from both solvency and liquidity difficulties.

The point on which Markose et al. concentrate their attention is whether and at which conditions the EMIR provisions, with the progressive centralisation of OTC derivatives clearing and the risk mitigation requirements they impose, would eventually make the CCPs themselves major financial entities and dangerous sources of systemic risk and instability.

By applying network analysis, the authors provide an assessment of systemic risk arising from the moral hazard of CCPs (free riding on the clearing members' default fund or on tax payers money) associated to their too-interconnected-to-fail condition.

Actually, moral hazard is not negligible for CCPs, because they are competing private firms and may be tempted to set inadequately low requirements for their own capitalization and clearing members' margins and contributions. To confront with such possibility, EMIR has introduced[77] what the authors call the skin-in-the-game requirements, that is formal additional capital requirements for CCPs to which, in case of default of clearing members, they must give precedence over the mutualisation of losses to the surviving members in the waterfall procedure.

As for the adequacy of this additional capital requirement, it has been argued that it should be at least as large as the first loss tranche. Actually, a lower level, possibly associated with insufficient margins and contributions from clearing members as a result of competition, would push up CCPs' moral hazard and make taxpayer bailout more likely. On the contrary, with a too high level of additional capital requirements CCPs may lose their authority over clearing members because the threat of loss mutualisation they need to exercise would appear less credible.

Consideration of the degree of multilateral netting and exposure compression a CCP is able to achieve, which depends on the number and size of its clearing members, is important to determine levels of margins and collateral.

Given this setting, Markose et al. apply network analysis to empirical data concerning transactions from 2012 to 2015 among 40 (16 of them large) systemically significant banks, clearing their positions on the global derivatives market either bilaterally (OTC) or centrally through 5 interconnected CCPs with common clearing members[78]. The stability of the financial system (the network) depends on the dynamical evolution of the reciprocal positions (contractual obligations) of the interacting entities, given the

[77] Reg. 153/2013, article 35, §2, prescribes a 25% addition to the minimum CCP capital requirement.
[78] The illustration of the network analysis of the financial system that follows is simplified, being its rigorous mathematical presentation beyond the scope of this work.

measures (available relevant resources) taken for mitigating risks. The network system is represented through a matrix constructed by reporting in each of its cells[79] the appropriate mathematical relation describing the interaction between two entities (bank-to-bank, bank-to-CCP or CCP-to-CCP) of the network. The dynamics of the matrix and, consequently, the stability of the system are assessed by applying appropriate iteration algorithms to the mathematical relations in the cells. If a characteristic parameter of the matrix[80] - the systemic risk index - goes beyond a certain value, the system (the network) becomes unstable and may collapse as a consequence of an arbitrary size shock. The default fund and skin-in-the-game capital requirement for each CCP can be calculated from the instability conditions. The system skin-in-the-game requirement (the sum of all CCPs requirements) is the liquidity needed to stabilize the system in case of shock with default fund percent losses lower than the systemic risk index.

According to the Markose et al. model, the global derivatives market in 2015 is characterized by a lower systemic risk index and therefore is more stable than it was in 2012. This result is in line with the observation that, in the corresponding period, CCPs have allowed for a significant compression (USD 100 trillion) of derivatives in terms of notional as well as for a reduction (over 30 %) of their fair values.

6. *Assessing some relevant EMIR provisions*

As illustrated above, the case of systemic risk is a typical situation of market failure in which the public authority must intervene in the common interest. Thus, economic doctrine justifies in principle the EMIR adoption, though it remains to be seen whether the type and measure of the specific rules impose excessive limitation or distortion on market competition. On these grounds, perfectly in line with the stated EMIR aim, financial stability can be defined as the capability of the system to reduce and control systemic risk[81].

From the analysis conducted, it seems evident that the key provisions of the EMIR are those related to the institution of CCPs and TRs. While in a random network financial

[79] Rows and columns of the matrix list in the same order the entities of the financial system (each entity being a node of the network). At the crossing of each row with each column, a cell contains the contractual obligation between the corresponding two entities (the cell representing the link of the network between the two entities).

[80] The maximum eigenvalue of the matrix.

[81] A more general and complete definition is given by Schinasi (2004): "A financial system is in a range of stability whenever it is capable of facilitating (rather than impeding) the performance of an economy, and of dissipating financial imbalances that arise endogenously or as a result of significant adverse and unanticipated events".

system there exists a threshold of capitalization below which the system may collapse, the stability of scale-free network financial systems depends solely on CCPs. The measures to protect the CCPs from default are, therefore, absolutely the most important ones, since almost all systemic risk and thus the whole vulnerability of the financial system are now concentrated in the CCPs. If they default, the system defaults. However, in spite of their robustness, CCPs will not work properly if they cannot rely on complete and reliable information on the OTC derivatives. So, the supporting functions of Trade Repositories are also essential to establish an acceptable low level of systemic risk.
Finally, the connections and interoperability requirement for different CCPs and TRs are also of great important in consideration of the global character of the financial system.

VI. Distributed Ledgers Technology (DLT) and financial markets

Distributed ledger technology (and its principal sub-type, the blockchain technology) has drawn attention by many market participants and regulators for its potential implementation in financial markets' post-trading activities (in particular, clearing and settlement). This revolutionary technology carries significant benefits, such as a faster processing of transactions and an easier information reporting on the counterparties to the transactions and on the securities being traded, which could, in turn, have a considerable cost reduction as well as strengthened security (European Parliament, 2016). In addition, contract uncertainty and counterparty risk would be reduced and risk management and supervision activities would be facilitated.

Nevertheless, regulators have spotted potential operational, governance, privacy and legal risks that should be carefully treated before DLTs are implemented as a pillar for the backing of the financial system. In this setting, ESMA delivered a conference on the implementation of DLT to securities markets. On May 2016, the European Parliament delegated the European Commission to assemble a "horizontal task force for DLTs, constituted by technical and regulatory experts to analyse the various sectors in which the distributed ledger could be applied" (Delivorias, 2016).

1. Distributed Ledgers Technologies

Distributed Ledgers Technologies (DLTs) provide users with the storage and accessibility of information on a set of assets and their owners in a common database of either transactions or account balances (Pinna and Wiener, 2016). Such data is disclosed and disseminated among the network participants and is used for the settlement of their transactions of, for example, securities and cash, without the necessity of a central authority to control, verify and accept the legitimacy of such trades.

In the past years, the financial system has experienced a considerable dematerialisation of financial transactions, moving from the traditional physical settlement towards a new mechanism of transfers in digital databases.

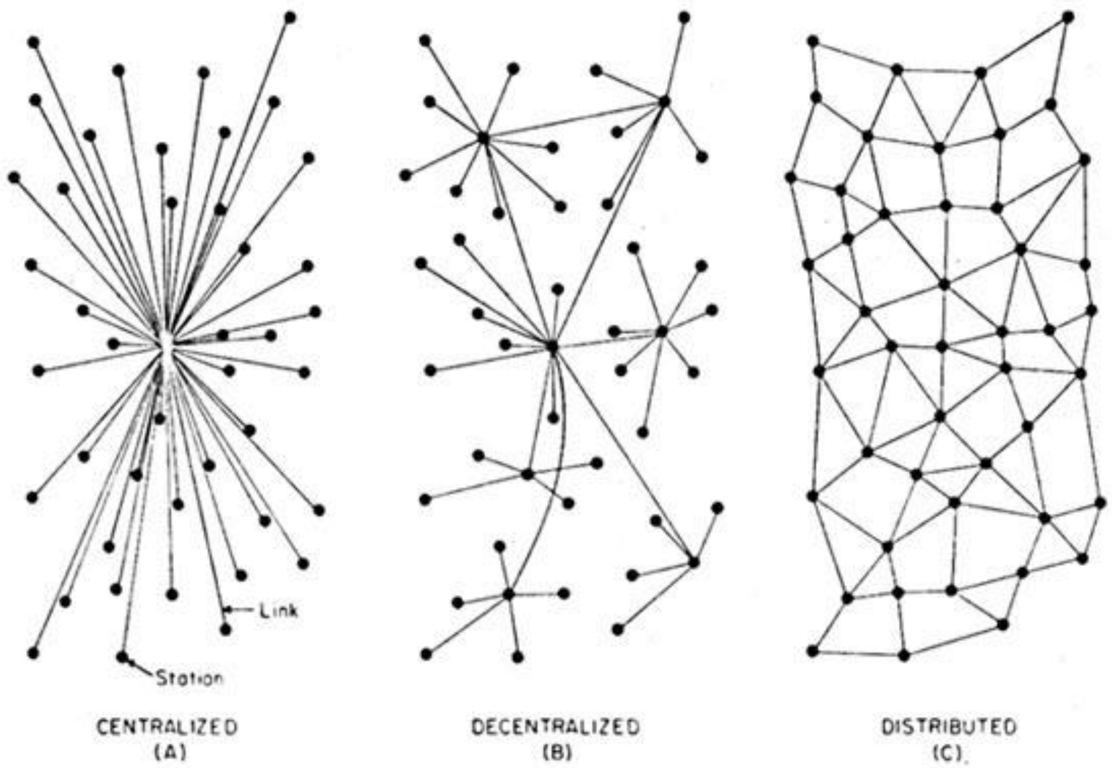
To get a better idea on the revolutionary structure of a DLT, the three main types of ledgers (centralised, decentralised and distributed) are discussed below and are illustrated in Figure 41.

The *Centralised Ledger* represents a centralised network ("one-to-many") where all transactions must be managed by and refer to a single authority or centralised system (Figure 41, (A)). In the Centralised Ledger, the trust lies in the authority that is at the centre of the network. Therefore, banks and public authorities must be able to diffuse such trust. Trust means that market participants can engage in bilateral transactions (buy or sell) even without knowing each other's identity and without assessing the reliability of their counterparty. This is because there is a third party that guarantees for everyone. Moreover, the manager of the Ledger also controls the access to the information stored in the ledger.

The *Decentralised Ledger* represents centralisation at a local level, with satellites. Each satellite is a smaller centralised system, which recreates the one-to-many network. In other words, the single, large central authority is replaced by several smaller central authorities (Figure 41(B)).

In these cases, trust is delegated to a central authority or multiple smaller central authorities. With *digitalisation*, these processes underwent through radical changes. In an initial phase of digitalisation, ledgers became faster, easier to use and more productive. However, the logic of the ledger had not changed yet: there was still a central authority managing and supervising the whole network which had also the discretion to choose which participants could have access to what information.

The true change is represented by the *Distributed Ledger*, that is a network in which there is no central authority (decentralised network) and where the logic of governance is built around a new concept of trust among all the network participants. Therefore, in a distributed ledger it is not necessary to have a central authority that verifies, controls and authorises the legitimacy of a transaction (Paech, 2015). This can be seen in Figure 41 (C).



<u>Figure 41</u> – Centralised Ledger, Decentralised Ledger and Distributed Ledger.

A Distributed Ledger is a database that is physically available on several computers simultaneously, which are all perfectly synchronised on the same documents. For example, such database can be found on all computers connected to the network. Therefore, all network participants have access to the information in the network and all accounts are constantly and automatically consolidated through the Internet (Paech, 2015). This allows information to be rapidly available. There are two main processes that grant the correct functioning of the distributed databases and avoid incompleteness of data in each node. These are (i) database replication and (ii) duplication. The *database replication* process is carried out through a software, which is in charge of analysing the database to identify any alterations. Once the alterations are found, the software replicates them to ensure that all databases are identical. The *Duplication* process ensures that all databases store the same information. In practice, the process identifies a master database that will be duplicated on all the other databases. The participants to the network can only make changes on the master database, ensuring that local data are not erroneously overwritten.

This structure allows for a wider interpretation of the database with respect to the previous models implemented. Therefore, it is no longer correct to talk about ledgers and refer to them as archives. As of today, we are dealing with a new revolutionary Distributed Ledgers Technology which creates a relationship between market participants and information.

It is important to note that distributed ledgers are currently applied to crypto-currencies. In the field of trading and post-trading of financial instruments, DLTs are still under development.

1.1. Restricted vs. unrestricted DLTs

Distributed Ledgers Technologies can be (i) restricted or (ii) unrestricted. *Restricted DLTs* are closed networks whose participants can be identified and accounted for, at least by their governance body. As a result, any wrongdoer can be detected. Moreover, alterations or updates to the ledger can only be suggested and accepted by authorised entities (which are part of the network). The authorised participants are also subject to some regulations applying to off-ledger transactions. *Unrestricted DLTs* are open networks, whose database can be accessed by any market participants, which are, in certain circumstances, allowed to provide contributions in the update of the ledger. In addition, unrestricted participants are not subject to off-ledger activity regulations. This, paired with anonymity, eliminates the incentives (such as loss of reputation or fines) that could encourage such participants to respect the regulation of the distributed ledger. As a result, unrestricted DLTs require their users to use their own resources to guarantee its well-functioning. Pinna et al. argue that this could "be done by means of an ex-ante investment in computational power, or ex-post in the form of assets that are native to the ledger and are posted as collateral". A common feature of these two DLTs which makes the distributed ledger *authoritative* is consensus: a transaction must be validated by each authorised network participant or by the majority of them. This characteristic could be significant to strengthen the resilience of a clearing or settlement system, as a protection from hostile users or external entities willing to interrupt its operations. For example, it could be useful to enhance its capacity to deal with cyber-attacks. A DLT could achieve this by granting a correct update of the database (i.e. distributed ledger) even in the case in which a restricted number of authorised nodes are not online.

Over the past decades, the financial sector has become a system of mutually trusting entities, implementing legal arrangements and regulatory mechanisms to mitigate risks (e.g. operational and counterparty risks). Every institution in the financial system trades with many other counterparties under the scrutiny of regulatory authorities. This framework generates a ground for implementing restricted DLTs among financial market participants.

1.2. Validation Methods

When a new transaction presented by a DLT participant is verified by the set of authorised entities in the network, the update is transmitted to the other network participants and their copy of the ledger is modified appropriately. The authorised entities must examine whether the assets that would be transferred through a trade are owned by the counterparty that initiated the transaction based on the most recent data. This information must be delivered by such counterparty, as well as the basic information on the volume of the securities and the counterparties involved in the transaction.

There are two main methods through which authorised entities reach a consensus on whether to validate a transaction or not. These are (i) proof of work (PoW) and (ii) proof of stake (PoS).

The *proof of work process* involves complex mathematical problems which can only be resolved through iteration. Once the solutions to such problems are found, they are easily verified. The PoW is usually used in unrestricted DLTs, and is made to be expensive for the initiator of the transaction but cheap for the server validating the transaction. In a PoW process, each entity required to validate the transaction chooses a group of on-hold transactions that can be proved to be legal as they comply with the standard bookkeeping requirements. The solution to such complex mathematical problems are then forwarded to the other network participants, who, in turn, must verify that (i) the update includes only legal transactions, and (ii) the authorised entity worked to obtain an exact solution to the problem. If these two requirements are met, the authorised entities validate the new update and apply it to verify other on-hold transactions. Moreover, it may occur that an authorised entity charged with the validation of transactions resolves the PoW for a group of trades willing to incorporate them in the ledger after another authorised entity has successfully carried out a different alteration to the former status of the ledger (where both entities initiated the PoW process based on the same ledger). In this setting, the trades of the first entity cannot be included in the database, since the ledger has now been modified. These trades go back to the group of on-hold transactions, and can only be authenticated by starting a new mathematical problem using the new updated ledger.

The *proof of stake process* allocates shares of validation rights to network participants based on their stake in the network and is usually used in restricted DLT. The way in which an entity's stake is assessed is a fundamental feature in this type of network, and the valuation methods differ among different DLTs. Pinna et al. (2016) argue that it could be potentially measured (i) the amount of native tokens owned, (ii) the amount of particular native tokens or off-ledger assets invested in the ledger as collateral or (iii) the reputation of an entity whose role is to validate transactions in a restricted DLT (proof of identity).

The different characteristics that DLTs have relating to the requirements to participate in the ledger can have an indirect impact on the network's efficiency. Contrary to unrestricted DLTs, in restricted DLTs it is not necessary to require every entity to participate with a large amount of resources in the management of the ledger, as fewer participants are involved and such participants carry out their activities in good faith knowing that improper behaviour is detected more easily. Therefore, DLTs can decide to implement cheaper validation algorithms with respect to the ones applied in unrestricted DLTs. In this setting, restricted networks present a validation process that is not complex expensive (on purpose) for all users, but only for attackers willing to disrupt the network.

A PoS process necessitating collateral enables one or multiple entities to hold assets of the participants in guarantee (potentially off-ledger, by means of a trusted third-party). If a network counterparty is found to have tried to authenticate an unlawful trade, its collateral will remain in the ledger.

Closed networks, such as the one constituted by FMIs and financial intermediaries, can be deemed secure if at least 2/3 of the entities authorised to verify transactions have been proven to be in good safe. An entity willing to outbreak the network would have to be in control of the references of more than 1/3 of the financial entities charged with the authentication procedure to hamper the well-functioning of the ledger. Currently, regulators have not yet assessed if a restricted DLT grants a higher degree of security compared to a centralised system. Overall, it is based on the relative probability that a cyberattack is successful.

When new trades have been authenticated and incorporated in the latest version of the database, they could or could not be deemed as settled or as on-hold, based on the specific requirements of the DLT. For example, in some DLTs, the update of the ledger may be reversed during a predefined period of time after authentication has been verified.

Some unrestricted DLTs developers have stated that they are willing to implement restricted DLTs to be able to fulfil the needs of financial institutions, whose main interest lies on settlement, clearing and in the expenses to manage the ledger, and not on its accessibility to anonymous counterparties.

2. The blockchain as a DLT

In the paper "A Strategist's Guide to Blockchain", Plansky, O'Donnell and Richards (2016) define a *blockchain* as a "self-sustaining, peer-to-peer database technology for managing and recording data without involving central banks or central counterparties". On the same note, the World Economic Forum states that a "blockchain or distributed ledger technology (DLT) is a technological protocol that enables data to be exchanged directly between different contracting parties within a network without the need for intermediaries". The blockchain system is managed through algorithms and agreement among several computers. For this reason, it is believed to be unaffected by interferences, abuse or political control. It fosters the protection of the network from any possible dominant position by any individual computer or set of computers. Interactions between the entities participating in the network is carried out by means of pseudonyms. In this way, their true identity is kept private through encryption. The distributed ledger employs *public-key cryptography* (or asymmetrical cryptography), which Naor and Segev (2009) define as a method that makes use of pairs of keys: (i) public keys, which can be disclosed and (ii) private keys, which are held by the owner. The public-key cryptography carries out two main tasks, authentication and encryption. *Authentication* refers to the public key being used to validate that the owner of the paired private key has forwarded the message. *Encryption* refers to the process through which only the owner of the paired private key can decipher the message encrypted within the public key. In this setting, breaking the public-key encryption is virtually impossible, because it is possible to unlock a message only when a public and private component are connected. In addition, each main transaction is treated only once in one common electronic ledger. As a result, blockchain decreases the repetition and the deferment that characterises the current banking system.

The denomination "blockchain" derives from the procedures implemented to store transactions. Plansky et al. (2016) provide the following example to get a better understanding. When a bitcoin is created or changes owner, the ledger automatically makes a new transaction record made of blocks of data, each encrypted by changing part of the previous block. The cryptographic connection between each block and the next one constitutes one link of the chain, called *hash*. This system makes it harder to commit frauds, because these blocks of and individual transactions are verified on a continuous basis. Moreover, also the IDs for every individual buyer and seller involved in a transaction are recorded in the block of data.

One of the most important characteristics of the blockchain structure is the *decentralised technology*, which allows assets to be stored in a network of computers and which are accessible only through the Internet and help ensure that the reporting of the transaction is reliable (Pon, 2016). When a blockchain trade (e.g. bitcoin sale) occurs, several different computers that are linked across the network process the algorithm and validate each other's calculations. A new block of transactions can only be added in the blockchain following a process of control, validation and encryption. Therefore, validation must be based on consensus. This process must be carried out for every new block, and it entails complex mathematical procedures. Such operation is called *mining* and it is performed by the so-called *miners*, which perform a fundamental role in the management of the blockchain.

The ledger collects the basic data on each individual transaction (e.g. sender, recipient, time asset type and quantity) and the recording and storage of transaction data extends on a continuous basis while being distributed in real time by thousands of entities.

Overall, the blockchain mechanism grants authenticity, security, efficiency and reliability of trades by mathematically connecting every new transaction to the previous ones, block of code after block after block (where a block is an aggregated set of data).

The dynamics of a blockchain transaction are illustrated with the following simple example.

Example.

Two network participants, say Entity A and Entity B, decide to enter into a bilateral transaction, for example Entity B is willing to buy a security from Entity A (Figure 42).

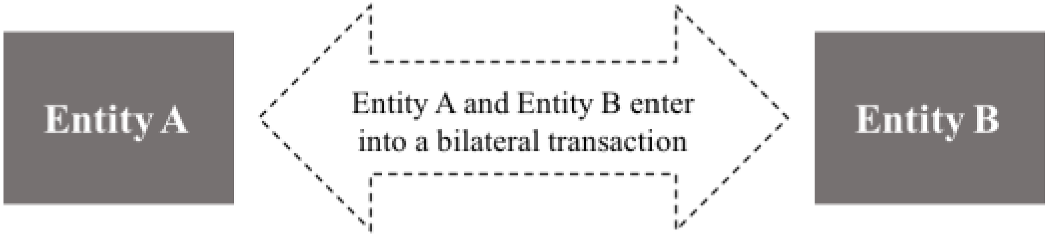


Figure 42 – **Transaction Request**

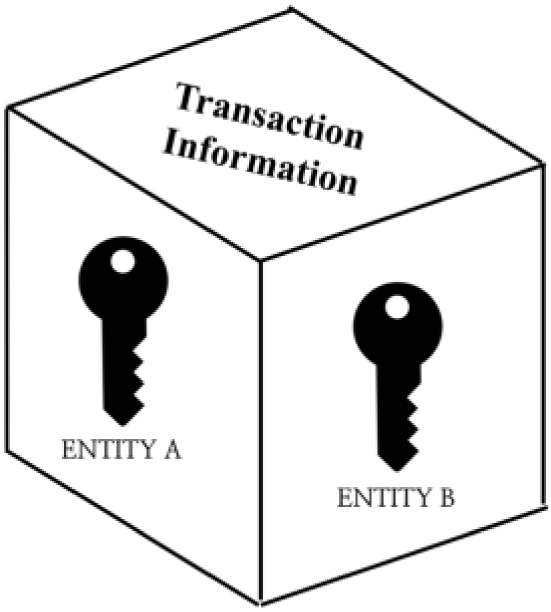
Information relating to such transaction is created and two specific Cryptographic Keys are applied to Entity A and Entity B (Figure 43). The information will concern the general description of the security, the economic availability of Entity B, the effective ownership of the security from Entity A, date and time of the transaction, etc.

Figure 43 – **Cryptographic Keys**

Then, the transaction request is submitted to the nodes of the blockchain network for verification and approval by means of algorithms and historic transaction information (Figure 44).

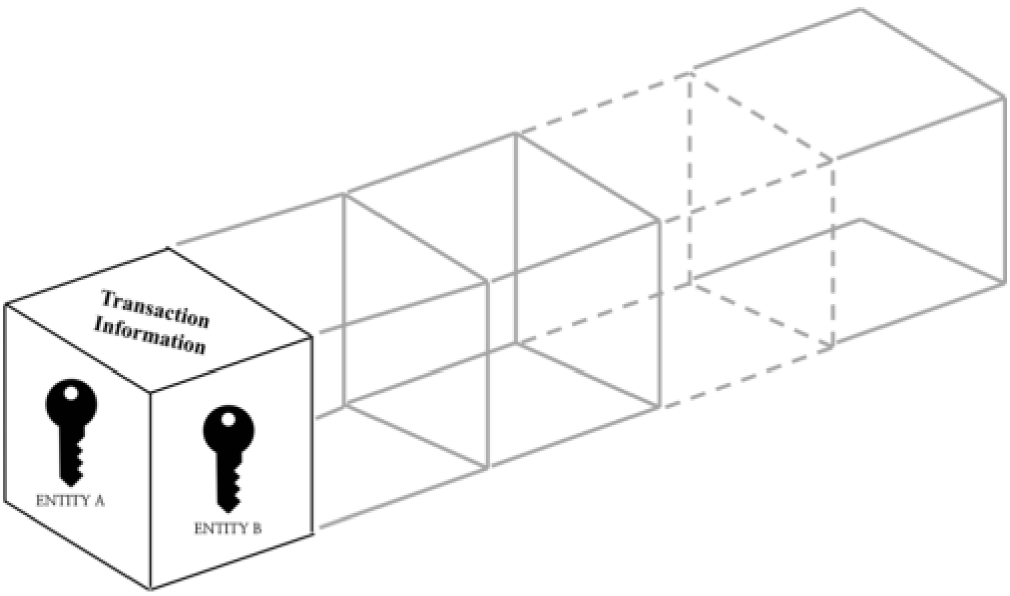
Figure 44 – **Network Verification**

If the nodes of the network achieve consensus and approve the transaction, a new block is created containing all the relevant data on the transaction between Entity A and Entity B. In this stage, the security changes ownership. Entity B is now the owner of the security (Figure 45).



<u>Figure 45</u> – Transaction approval and creation of a new block

The new block is added to the previous blocks that form the blockchain. It becomes accessible to all network participants and is incorporated in all the databases of the nodes (Figure 46). The transaction is concluded.



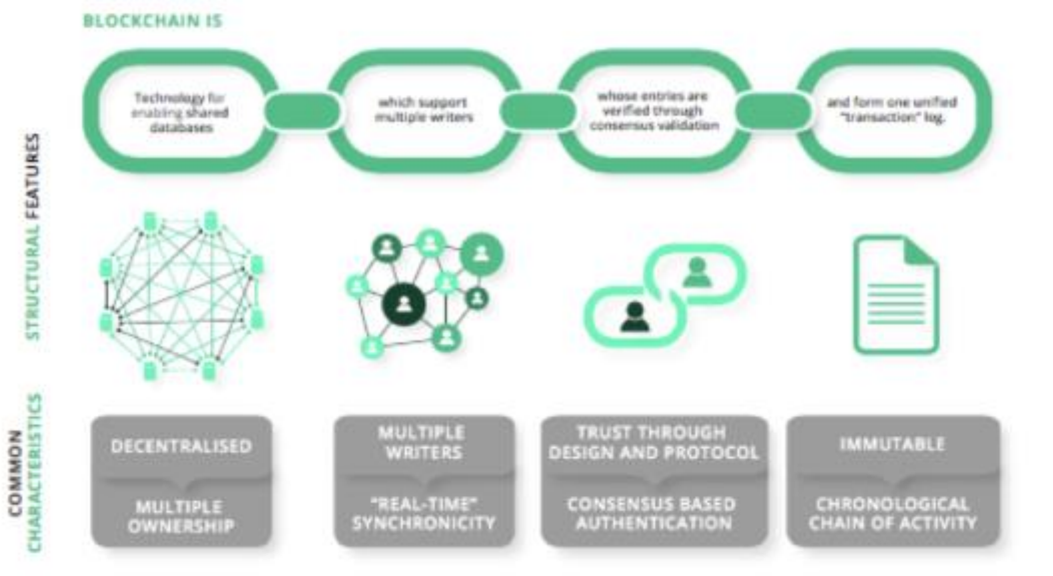
<u>Figure 46</u> – The new bloc is added to the blockchain

There are several companies operating in the financial-services sector that have been interested in this new revolutionary technology. For example, R3 (a financial technology company) declared in 2015 that 25 banks had joined its group sharing the same business interest, trying to create a common platform based on crypto-technology. These banks include, among others, Citi, Bank of America, Deutsche Bank, Morgan Stanley and UniCredit. Another example is that of Nasdaq, whose Chief Executive Officer, Robert Greifeld, presented Nasdaq Linq in 2015, a blockchain-based digital ledger whose purpose is to transfer shares of non-listed companies. Plansky et al. (2016) argue that if these attempts turn out to be successful, the blockchain technology could revolutionise the way in which trading occurs, by promoting trust and protecting against identity fraud. In fact, some banks are already investigating on the impact that the blockchain technology could have on their mechanisms to trade and settlement, back-office operations, and investment and capital assets management. They acknowledged that this new technology could significantly improve their ability to perform their activities faster and more efficiently, while ensuring a greater security, privacy and reliability.

However, even if the potential is extremely large, this new technology is so complex and so apt for sudden change, that it is very hard to foresee what structure it will eventually have and there is great uncertainty on whether it will even function. In the report "Gartner's Hype Cycles for 2015", Burton and Willis (2015) stated that the crypto-currency had left the Peak of Inflated Expectations (where the expectations for the success of the new technology are high) and was moving towards the Trough of Disillusionment (where the interest for the new technology fades out as its implementation fails or delivers results below the expectations). Forrester (2015) continued by suggesting companies to take a five-to-ten-year span before implementing the blockchain technology. Instead, Haldane (2015) encourages strong R&D in this area, sustaining that distributed ledgers have true potential.

The interest that many institutions have shown for this new revolutionary technology is based on several benefits that a blockchain carries with it.

First, the blockchain is *reliable*. Not being centrally managed and by giving to all direct participants a share of control of the entire chain, the blockchain becomes a system which is less centralised and less governable while at the same time being more secure and reliable, for example from cyberattacks. In fact, if one of the nodes of the chains is subject to an attack or is damaged, all the other nodes of the distributed database will continue to be active and operating, settling the chain and avoiding to lose important information. Second, *transparency*. The transactions carried out through a blockchain are available to all participants, thereby ensuring transparency of operations. Third, *convenience*. Carrying out transactions through a blockchain is convenient for all participants in that there are less third-parties involved, which are usually necessary in all conventional transactions between two or multiple parties (such as banks and central counterparties). Fourth, *solidity*. Information already stored in the blockchain cannot be modified in any way. In this setting, information recorded in the blockchain is more solid and reliable, since it cannot be altered and therefore stays unchanged from the moment it is registered (*immutability)*. Firth, *irrevocability*. Through the blockchain it is possible to realise irrevocable transactions, while at the same time being easily traceable. In this way, transactions are granted to be final, without any possibility to be modified or cancelled. Lastly, *digitalisation*. With the blockchain, the network becomes virtual. Thanks to digitalisation, this new technology becomes implementable in many other areas. Figure 47 summarises the general features of the blockchain technology.



Source: EY (2016) - *Blockchain, DLT and the Capital Markets Journey: Navigating the Regulatory and Legal Landscape*

<u>Figure 47</u> – Main features of the blockchain technology

Moreover, it is also interesting to take a look at the comparative risk matrix proposed by EY consultants in 2016, which displays the impact that the blockchain technology would have in the major risk areas (Figure 48).

RISK	BLOCKCHAIN IMPACT	REASONING	MITIGATION MEASURES
Principal risk	↓	Blockchain can ensure synchronicity of activities in the respective seller's and buyer's securities and cash accounts	The delivery of securities will need to be synchronised with the corresponding delivery of cash (DVP)
Replacement risk	↓	As blockchain eliminates the delay between trading and settlement, this risk would be brought close to zero	
Operational risk	↓	Blockchain should reduce current operational risks from reconciliation activity, weakly interoperable systems or delays in STP	
Systemic risk	↔	Blockchain creates co-dependency as the model only works if there is consensus around transactions. If the single record is found to be false, unravelling trades and identifying the ownership environment would be time consuming and expensive	The reduction in trade failures is expected to off-set this increase in risk. There would need to be a mechanism for reversing erroneous trades, subject to some form of governance
Unjust enrichment	↑	With an immutable record, instantly updated, erroneous trades would not be capable of being cancelled in order to prevent the transfer of the legal title to the security	A mechanism for reversing erroneous trades subject to governance
Financial crime risk	↔	By enshrining an illicit transaction in the immutable blockchain record, a transaction becomes cloaked in legitimacy, and it becomes harder to track its unlawful origins. In the absence of a digital passport, the technology can be highly manipulatable	Blockchain may in time allow for the creation of a digital passport to reveal the entire transaction history enabling rapid and potentially automatic KYC / CDD There will need to be a single entity upon whom the court can serve an order should the fraudster refuse or disappear.
Cybersecurity risk	↔	A decentralised ledger removes the risk of a single centrally-stored database being compromised. However, a shared ledger increases the number of entry points for a fraudulent or criminal transfer of value to be effected	Regulators will need to be satisfied that any blockchain solution improves rather than increases cybersecurity risk

Source: EY (2016) - *Blockchain, DLT and the Capital Markets Journey: Navigating the Regulatory and Legal Landscape*

Figure 48 – Comparative risk matrix

Bitcoin. The blockchain was originally designed for Bitcoin, a crypto-currency created in 2008 from an anonymous inventor, known with the pseudonym of Satoshi Nakamoto. Contrary to most traditional currencies, Bitcoin does not make use of a central authority: it uses a database distributed among the nodes of the network that keep track of the transactions, while exploiting encryption to manage the functional aspects. The Bitcoin network allows to anonymously hold and transfer currencies; the necessary data to use bitcoin can be recorded on one or more personal computers under the form of *digital portfolio*, or can be stored by third-parties whose functions are similar to those of a bank. In any case, bitcoins can be transferred through Internet to any counterparty owning a "bitcoin address". The *peer-to-peer structure* of the Bitcoin network and the absence of a central entity make it impossible to any authority to seizure or block transfers of bitcoins without owning the relative keys or their devaluation due to emission of new currency.

In 2009, 1.000 bitcoins were worth less than USD 3. But crypto-currency was considered as a potential tool for valid and legal financial transactions and as an investment vehicle. For this reason, its market value started to increase very quickly after 2010. On November 2013, each bitcoin was worth USD 1.124,76. Then, its price decreased and settled between USD 200 and USD 400 for most part of 2015. As of September 2017, one bitcoin is on sale for USD 4.620,19. This represents an astonishing increase of 153.906,33% since 2009. The trends of Bitcoin market capitalisation and price in USD from 2013 to today is illustrated in Figure 49.

Figure 49 – Trends of Bitcoin market capitalization and price in USD from September 2013 to September 2017 (source: coinmarketcap.com)

The system for creating bitcoins is known as *mining* and was implemented to ensure protection of the value of the currency through scarcity (Van Alstyne, 2014). The rate at which bitcoins can be made is limited. In fact, a bitcoin can be made, on average, in ten minutes and every new coin is a little harder to make than the previous one. Furthermore, the power (e.g. electricity) necessary in the production process so significant that bitcoins have been blamed for fuelling climate change, due to the carbon used in the functioning of the computers (Bradbury, 2014). Moreover, bitcoins, like the EUR and other currencies, do not carry intrinsic value: they are available for purchase or sale, but cannot be redeemed for other commodities, such as gold (Yermack, 2013). Contrary to currencies which are supported by the government or central bank, bitcoin relies on the authentication by the network that produces it. Market participants buying a bitcoin are aware that it is valid because it has (and all other bitcoins have) been traced by a common distributed ledger, from the moment it was made. Such distributed ledger[82] displays the greatest innovative and possibly influential characteristic of this new technology.

[82] The first blockchain that has ever been created was for bitcoins and established the model for others.

3. Smart contracts

A *smart contract* is a contract that is translated into codes and which is able to self-execute its clauses without external intervention, i.e. computer execution (Jha, 2017). It an instrument used to translate the contractual requirements which users are subject to into the digital distributed ledger (Bharadwaj, 2016). The objective of such tool is to guarantee that all provisions are abided by through an automatized process to update the databases of network participants. Smart contracts have access to several databases and can change ownership of the assets based on the contractual agreements.

Therefore, such contracts allow for automatic trades (e.g. paying a dividend or coupon) to be settled in the ledger as a result of ad-hoc corporate activity or market events. Smart contracts are stipulated in the distributed ledger and approval of their implementation is subject to the same process of all other transactions. If a distributed ledger technology is capable of guaranteeing that the updates in the databases are resilient to cyberattacks, then the implementation and settlement of its smart contracts are safeguarded in a similar way. This is the major dissimilarity between smart contracts and similar processes stored in non-DLT databases (Pinna and Ruttemberg, 2016).

When a network participant creates a smart contract by incorporating some rows of code to the database, the other parties can agree to the new contract and make it implementable. The acceptance by the participants on the clauses stipulated in the contract is then approved and the contract can no longer be cancelled. It is important to note that the effects of a smart contract should not be neglected, since the lines of the code have a direct and instantaneous impact on securities and cash accounts in the database when an occurrence causes its implementation.

If DLTs were established in securities markets, smart contracts would be the factor bringing the major change. As previously stated in Section 6.1.1., the constraints of unrestricted DLTs and the necessity to guarantee conformity with regulations reflects the fact that intervention from intermediaries will still be needed, especially in post-trade stage. In this setting, smart contracts could carry out several functions that are currently performed by different post-trade specialised entities. The post-trade framework will be discussed in more detail in Section 6.7.

However, there are some draw backs on smart contracts. First, there are still some technical problems regarding the consistency of the updates to the database. Second, the execution of one of such contracts may alter any account to which it has access. Third, executing a smart contract involves complex calculations.

Therefore, the implementation of smart contracts might require the payment of an opportunity cost, established through a market pricing process. This mechanism would be established to avoid the accomplishment of other authorisations, such as settlements of transactions, and to impede “denial of service” attacks in the event in which the DLT is inaccessible due to an overload of requests (Atzei et al., 2017).

4. *Possible benefits and applications of DLT for securities market*

There are several potential benefits that could enhance post-trading in securities markets if distributed ledger technologies were to be implemented. First, *speed of execution*. On average, securities and bonds in the US are settled within 3 business days, whereas in Europe settlement occurs within 2 business days. ESMA stated that DLT could potentially make the clearing and settlement of cash financial trades much faster (almost instantaneous). This is because issuers and investors would participate in the same ledger, which could possibly enhance efficiency in the trading cycle and reduce the number of intermediaries required to complete the transaction. A shorter trading cycle could also decrease the volume of collateral required for settlement and the collateral guaranteed in the transaction would be freed up faster, resulting in *collateral savings*. Moreover, by using a unique common database, DLT could ease the registration of information on the securities being traded and the protection of assets and the automatic update of the records could save expenses during the reconciliation process. In addition, uncertainty entailed in contract conditions could be diminished and the processing of activities could become more automated by making use of smart contracts, leading *automated corporate actions*. *Tracking of securities ownership* would also be facilitated, as asset servicing could be simplified if financial instruments were issued straight-through the ledger and the DLT were implemented for tracking of security’s ownership (ECB, 2016). Furthermore, DLTs could *assist SMEs to have access to funding*: if such enterprises were able to issue stock directly on the DLT, they could access a larger pool of investors and potentially extend their funding possibilities. Lastly, DLT could make it easier to collect, consolidate and distribute information, that could be used by authorities in their reporting, supervisory and risk management mandates. In this setting, information could be accessed much faster and regulators could gather a more comprehensive perspective on a specific issue, such as systemic risk in OTC derivatives markets. As a result, DLTs could improve significantly *regulatory reporting*.

ESMA declares that the implementation of DLTs could possibly mitigate counterparty credit risk, by reducing the timespan in which a counterparty is exposed to the risk of failure of another counterparty. As a result, counterparties would be required to post a lower amount of collateral, which, in turn, would increase market liquidity. Moreover, transactions would also benefit from higher security arising from the distributed feature of the ledger, from encryption and from consensus to authenticate transactions. Furthermore, costs would be reduced due to, for example, a decrease in transaction expenses. DTLs foster *transparency*, as all network participants could have total transparency on the trading activities regarding their accounts on the ledger. The European Central Bank adds that in a DLT there would be no need for a central operator and the ledger would be *24/7 processing* all the transactions, which would promote the globalisation of securities markets.

5. Key issues and possible risks linked to DLTs

There are several issues and potential risks linked to DLTs.

Operational issues. Concerning Bitcoin, Walch (2015) discusses if the blockchain is sufficiently sound to become the main pillar for payment, settlement clearing and trading processes overall. In this setting, Delivorias (2016) argues that the probability that such technology presents some malfunctions is small, but if such events materialise, they could have strong negative consequences. DLTs could be exposed to cyber-attacks and could present some bugs if the network participants are not able to evenly update their ledgers. Moreover, DLTs' functioning is very complex to understand, and this could lead to significant systemic risks.

ESMA has also pointed to the operational risks relating to (i) the scalability of DLTs, in that what has been implemented for specific activities could be very complex to be translated at a macro-level comprising several classes of instruments and many market participants, (ii) the interoperability with existing processes (FMIs, such as CCPs and TRs) and across different networks (different databases for different classes of financial instruments), (iii) legal and technical issues generating from the necessity for settling central bank money, i.e. full delivery-vs-payment, (iv) the possible implementation of the technology, which is currently mainly used for spot trades, for registering structured finance instruments, whose transactions and collateral requirements are calculated through netting and (v) complexities in the implementation for margin finance and for short sales, which require the ownership of the asset.

Governance issues. Pinna and Ruttenberg (2016) argue that the implementation of DLT in the financial instruments post-trade stage will have to deal with the same problems concerning the current post-trade framework, namely the harmonisation of technical standards and business rules. ESMA furthers this argument by stating that if DLTs will be implemented, there will be the necessity to apply rules for the approval or rejection of authorised entities and to manage the links between them.

Moreover, Walch (2015) state that risks can also arise from the open-source nature of the technology, in particular if there is no entity supervising and managing the technology to ensure its functioning, because the framework of the software could be influenced by conflicts of interests and because general agreement on updates could not be reached, leading to bifurcations in the network. In addition, entities charged with the creation of the framework will have to be subject to stringent rules so as to minimise the insurgence of conflicts of interests.

Privacy issues. As stated in Section 6.1., among other things, DLTs allow for public access to the data stored in the ledgers concerning the history of the trades and the balance of cash and assets stored on the network's accounts. ESMA argues that there is the need to balance the public disclosure of information with the necessity of the network participants to be anonymous and keep some of their information private.

Regulatory and legal issues. Heterogeneous regulations on securities and companies across the European Union could hamper the implementation of DLTs in securities markets. Moreover, supervision and management of DLTs could be significantly more difficult than that required for central market infrastructures.

Possible risks. Theoretically, DLTs should increase traceability of trades and transparency in financial markets. In practice, however, the difficult level of cryptography could increase the complexity of the financial system, especially for a short time horizon. Moreover, switching to a new process always carries risks. ESMA also highlights that, although DLTs enhance security, a cyber-attack hacking the system could gather private sensible information, damaging the whole network. In addition, DLTs generally implement similar protocols. As a result, the attack to one network could threaten many other networks.

Also, without sufficient supervision, DLTs could be subject to *money laundering*[83] by exploiting the encryption characteristic of public/private keys, allowing to obscure identities and the history of the trades. Lastly, implementing DLTs could also increase herding behaviour and enhance market volatility in distressed situations.

6. *DLTs and post-trade services (Pinna and Ruttemberg, 2016)*

The financial instruments market is very complex, as it generates a strong interconnectedness among many market participants and requires many technical and legal provisions. A security's transaction goes through multiple stages before it is completed, and requires the participation of many entities (Figure 50).

Source: European Central Bank (2016) – *Distributed Ledger Technology*

<u>Figure 50</u> – Actors involved in the security's transaction life-cycle

Barucci et al. (2016) discuss that DLTs, (especially if paired with crypto-currencies) could offer not only a technological platform but also a form of decentralised market (OTC) in which individual entities exchange financial instruments. The authors state that this is possible since the technology provides crucial elements of trust that enable the execution of transactions: network participants know exactly who is the owner of the security. In the paper "Blockchain, DLT and the Capital Markets Journey: Navigating the Regulatory and Legal Landscape", Ernst & Young (2016) states that DLTs can possibly be used as instruments for issuing and transferring securities. The settlement and depository services would not be necessary in a well-designed DLT network. This illustrates the potential for total or partial disintermediation of market counterparties that are endeavouring these services.

[83] Process through which resources obtained illicitly from crimes are transformed into legitimate resources (such as assets or cash).

Under today's clearing and settlement system, CCPs not only perform clearing functions, but also net risk exposures, payments or transfers services, reduce balance sheets, and improve market transparency (Chapter 4).

Central Securities Depositories (CSDs) store securities in a dematerialised shape. As a result, transactions between counterparties can be carried out by book entry, without issuing physical authentication documents of ownership (Afme, 2015). Moreover, CSDs can deliver clearing and settlement services and possibly mitigate operational risk. The Central Securities Depositories Regulation (CSDR) implements harmonised EU guidelines to CSDs with the purpose of enhancing the safety of settlement. However, because of the regulatory obligations outlined in the CSDR, the disintermediation of CSDs through the application of DLTs would not be possible without changing the current legislation.

While CSDs' main function is that of transferring securities ownership, CCPs mediate execution and settlement of trades and perform a core function in controlling for counterparty credit risk. Regulators are probable to back disintermediation through DLTs if and only if the new technologies present analogous benefits as CCPs and CSDs, without adding systemic risk.

Despite the possibility of achieving disintermediation, EY consultants believe that regulations will require that any DLT network has an adequate and well-functioning governance framework, and clarity on which market participants should be held responsible for the correct function of the DLT must be ensured.

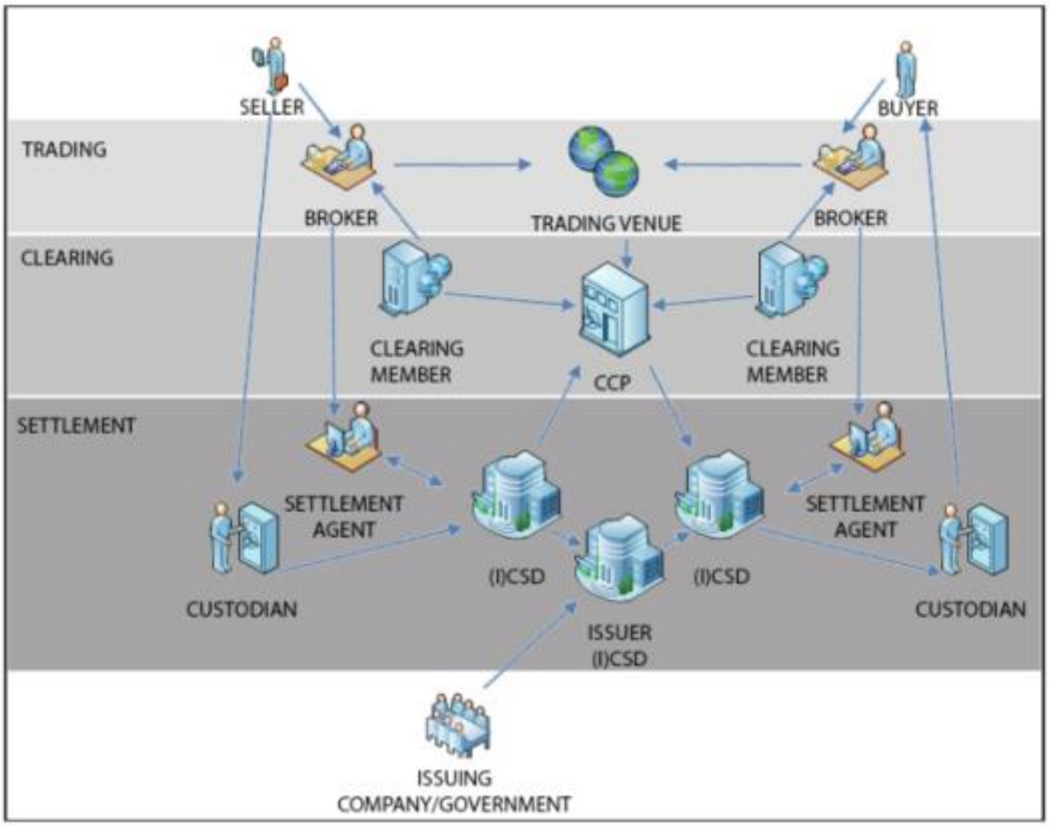
6.1. The current post-trade framework in securities markets

For a new trade to be accepted in a DLT, network participants must exchange messages to achieve a consensus. Once common agreement is reached, the distributed ledger is updated. Such mechanism can slow down the settlement process, in contrast to that of a centralised system. However, the absence of interoperability between proprietary databases results in slow settlement processes even in the current centralised systems. The decision to adopt of DLTs in securities market should not be based only on the volume of transactions passing through the system, but also on the possible effects on ongoing business procedures.

Currently, financial intermediaries hold several different accounts for the same data. There is an incorrect idea that DLTs could reduce back-office expenses by eliminating information duplication. In reality, data repetition is maximised in DLTs, and it could also be useful for addressing cyberattacks, since several nodes hold a copy of the ledger or a portion of it. It is important to note that the elevated back-office expenses in financial instruments markets do not refer to the costs of recording several times the same information, but to the costs arising from repetitive business procedures.

At present, the low interest rates and the expectations of a rise in the request for collateral have shrank the margins of financial intermediaries, increasing the weight of fixed expenses from back-office operations. Regulators wish that the implementation of DLTs could make some reconciliation procedures useless and diminish the level of collateral and capital required in the settlement process.

Each time a new trade occurs, financial intermediaries have to include such transaction in their own databases and have to disclose any significant outcome to the relevant entities, at different stages of the post-trade landscape, so as to unify their databases to include the new trade and communicate their interested entities of any modification. The movement of securities from trading to settlement requires time, even if carrying out the matched settlement directions at the settlement stage can be immediate.



Source: Pinna, A., & Ruttenberg, W. (2016) - *Distributed Ledger Technologies in Securities Post-Trading Revolution or Evolution?*

<u>Figure 51</u> – Current post-trade landscape in securities markets

Figure 51 displays a simplified illustration of a security trade between a buyer and a seller. The two end-users will have to give guidance to their brokers on the transaction they want to carry out. The buyer's and seller's requests are sent to an authorised trading venue where they can be matched and conduct the trade. The information of the transaction is usually reported to a CCP that reconciles the requests, potentially netting them with other on-hold orders to reduce the outstanding exposures of its clearing participants, i.e. *netting by novation*. The clearing members communicate to their brokers the requirements they have to comply with, who, in turn, give instructions to their settlement agents. The custodian of the seller transfers the securities to the settlement agent of the broker of the seller, which credits them to the CCP. The CCP then gives directions for the financial instruments that have to be inserted in the account of the settlement agent of the buyer, who, in turn, credits them to the custodian of the buyer. There may be the need to reconcile the central security depository (CDS) of the buyer with the CDS of the seller, for example, enabling the execution of the notary function and of *asset servicing*[84]. Every stage could need the records of each entity to be conciliated with the ones of other entities at the different layers of the post-trade process.

6.2. DLTs and the potential post-trade framework of securities markets

From mid-2015, DLTs have started to become increasingly popular and more and more entities are adopting this new technology. For example, Ripple is currently active in the FX market where it connects banks performing gateways functions in its consensus ledger; NASDAQ and Symbiont have issued private shares on private and public blockchains, respectively; and Overstock[85] has demanded authorisation to the SEC[86] to issue a portion of its stock on a proprietary blockchain that would be totally publicly distributed.

Moreover, DLTs could be implemented in each layer of the post-trade chain.

Possible effect on the settlement layer. The notary function is crucial for the stability of the financial system because many national markets rely on a regulated monopoly,

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[84] Administration services performed by CSDs or custodians linked with the custody and/or safekeeping of securities (European Central Bank definition).

[85] A public company

[86] Securities and Exchange Commission

which is responsible for the authenticity of the emission of financial instruments and the settlement of its transactions. This function will still be fundamental if DLTs are to be implemented. This is because it is necessary to have a reliable entity that guarantees the coherence between the transactions registered in the distributed ledger and the description of the emission of securities given in a global certificate, potentially recorded as an immutable blockchain entry. It is not possible to charge issuing companies or governments with the notary function, as this would generate conflicting economic incentives. As a result, a third-party is needed to service this task.

The reliability of the claims that financial instruments face over the underlying real assets is of crucial importance for enabling both financing in the primary market and hedging in secondary markets. As a result, it would almost surely be impractical to introduce peer-to-peer emission or settlement between issuing parties and end-users trading in a DLT. In general, the intervention of regulated parties is necessary, regardless of the technology implemented.

Authorisation (i.e. settlement) of trades could be tasked to the nodes of the network, which are managed and controlled by several market participants. However, this poses questions on confidentiality, based on the current DLT technology, and trades could necessitate to be dealt with privacy and authorised by third-party entities, as it is in the current FMIs. The challenge emerges from the need to have access to the specific information of the transactions to assess its authenticity in order to efficiently validate such a trade in a DLT. Nevertheless, market participants are willing to maintain their trading strategies private, and multiple new DLT characteristics are being introduced to ensure privacy during the authentication and authorisation processes.

A securities transaction usually involves the delivery of securities, i.e. *securities leg*, and the transfer of cash funds (i.e. *cash leg*). The latter embodies a different area for the DLT, independent from the securities leg. As of today, market participants have paid insufficient attention to the link between technologies implemented in both legs of a transaction. EY (2016) reports that delivery vs. payment is a fundamental necessity of market participants, meaning that the buyer's receipt of securities is timed exactly with the seller's receipt of the stipulated consideration, usually cash. The DLT would be able to credit the seller's books with the cash leg in the exact time the securities are transferred. Even if it is not currently possible to foresee if and when central bank currencies will be ready for use on DLTs, cash accounts are required to support transfers of securities to ensure direct processing in the current DVP model[87], since it is very probable that sellers will still want to be paid with tangible money rather than in crypto-currencies.

As a result, any DLT for financial instruments transactions needs at least one trustworthy party to connect the securities and cash accounts of distinct network counterparties.

In the current distributed ledger technologies, the single financial instruments accounts would require to be accessible for the seller and the buyer and they would be controlled and supervised by an entitled ledger authority or directly managed by the network participants that are allowed to carry out identity inspections.

The idea of *settlement finality*, which refers to the settlement or transfer which is irrevocable and unconditional (Sandel, 2005), is fundamental to grant the well-functioning of the financial system.

The way in which settlement finality is reached when registering financial instruments in a DLT may differ among DLTs and distinct technologies entail different operations.

The financial instruments that are currently being exchanged could be used as collateral to enable them to be digitally settled on the DLT.

Some jurisdictions already demand to hold tangible securities, performing only the bookkeeping on an electronic form. The likelihood that all outstanding securities are moved to a DLT is not realistic, but a temporary dual process with the settlement of trades both in traditional and DLT systems is practically achievable.

The effect of a distributed ledger technology on cyber resilience does not rely upon only on the validation techniques implemented in the ledger, but also on the capability of single network participants to face an off-ledger cyberattack. If each node had the same security characteristics of a centralised system, an external attacker would have to get in control of several of such nodes to be able to disrupt the network. This would reflect a strong progress to security. Nevertheless, if the authentication and authorisation function is allocated among less cyber-resilient entities, the general progress relies upon the respective negative and positive consequences, namely (i) the reduced security of each node and (ii) the fact of having several nodes and not just one, respectively. In any case, the repetition of the databases across the several network participants is probable

[87] *Delivery Versus Payment model* – a procedure in the securities settlement layer in which the payment of the buyer for the financial instruments is due prior to or at the moment of delivery.

to make the network recover much faster and in an easier way, in the event of a system failure.

Possible effect on the custody layer. A DLT enables to hold financial instruments directly by end-users or through their financial intermediary, such as a broker or a commercial bank. In addition, smart contracts can guarantee the automatic execution of corporate actions and actions essential for collateral eligibility requirements compliance and optimisation. Such contracts could also be considered as a potential way of easing asset servicing. Every transaction that can be registered or reported digitally can be part of the self-executing algorithm that automatically maintain ledgers up to date. There are several kinds of asset servicing that could possibly be carried out by smart contracts, including (i) collecting income from the issuer’s cash account to credit automatically calculated dividends/coupons on stakeholders’ accounts at their due date, (ii) withholding or reclaiming tax, (iii) splitting or redeeming stocks, (iv) and overall, any crediting or debiting of accounts in the ledger that is performed following instructions generated from an event that can be authenticated either in the ledger or via a reliable off-ledger entity. When the ledger has been planned to carry out the tasks just mentioned, there are not many more functions remaining to the chain of custodians. Identifying end-users and issuers and managing their degree of accessibility to the ledger are the two remaining operations that currently still require human intervention. This kind of *gatekeeping* function could be carried out by the network participant responsible for the management the ledger, however the obligation to examine identities may eventually require physical interaction with end-users. For example, a commercial bank or public authorised entity may be charged with this task.
The evolution of smart contracts to deal with corporate actions and other supplementary services, e.g. management of collateral and lending of financial instruments, may result in the current custodian function to become repetitive.

Possible effect on the clearing layer. The effect of distributed ledger technologies on trade enhancement, validation, and matching is dependent on the possibility and the way that trading platforms could be merged with distributed ledgers (Symons, 2016). If the two processes are not integrated, the effect of DLT would be narrowed to simpler netting and risk management processes. DLTs have the capacity to enable trading and settlement of financial instruments to occur almost simultaneously (on the same day) and possibly with immediate settlement[88]. When trading platforms are linked to DLTs, end-investors (buyers and sellers) are able to post orders on the trading venue or OTC, based on the merged DLT having verified the disposability of financial instruments in the books of the seller and cash in the books of the buyer. The instruments to achieve instantaneous settlements have already been applied to the current traditional processes, but it would not be possible to apply them on a global scale for the colossal volume of trades in financial markets, with the business mechanisms and databases staying unchanged.

The potential for immediate settlement would have an impact on the clearing function for cash trades. Having the possibility to demand the disposability of financial instruments and cash would remove liquidity and credit risks from every transaction carried out for instant delivery. However, regulators have not yet established the potential effect generating from the elimination of netting on market liquidity and on the price discovery process.

In the case the DLT has some *latency*[89], or the transaction concerns derivatives contracts which are not carried out immediately, central clearing would still be needed for risk hedging purposes until financial instruments and cash are exchanged irrevocably (Platt, 2016). Smart contracts enable for automatically netting out of transactions and, in the event in which collateral management procedures are connected to the DLT, also margin calls. Overall, the effect of DLTs on CCPs is dependent on the degree of technology being applied, the level of willingness of authorised entities to delegate the clearing function to smart contracts, and the type of financial instruments traded on the distributed ledger.

In distributed ledger systems, where settlement is not immediate, and central clearing is still required before financial instruments can be settled, smart contracts could possibly modify the methods in which netting and collateral are controlled. By encrypting smart contracts in the DLT, a CCP could automatically execute margin calls in the books of its clearing participants.

It would also be reasonable for trading parties to have to borrow financial instruments or cash from a third entity as a condition for carrying out the transaction. Under this

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[88] The ledger is updated immediately following the execution and validation of a transaction.

[89] *Latency* is the amount of time a message takes to traverse a system. In a computer network, it is an expression of how much time it takes for a packet of data to get from one designated point to another. [Definition retrieved from: http://www.linfo.org/latency.html].

kind of framework, an order could be placed only when the securities or cash has been retrieved from the books of the lender, and any collateral is frozen in the books of the borrowing party. The realisation of the transaction relocates the financial instruments and cash at the same time, given that the securities and cash of the network participants are disposable to the series of smart contracts carrying out the transaction in the DLT. This kind of progress could cause central clearing to become avoidable for both matching and risk management functions. As a result, the collateral that is held by CCPs or used for hedging bilateral transactions would be freed up and could be used for other purposes.

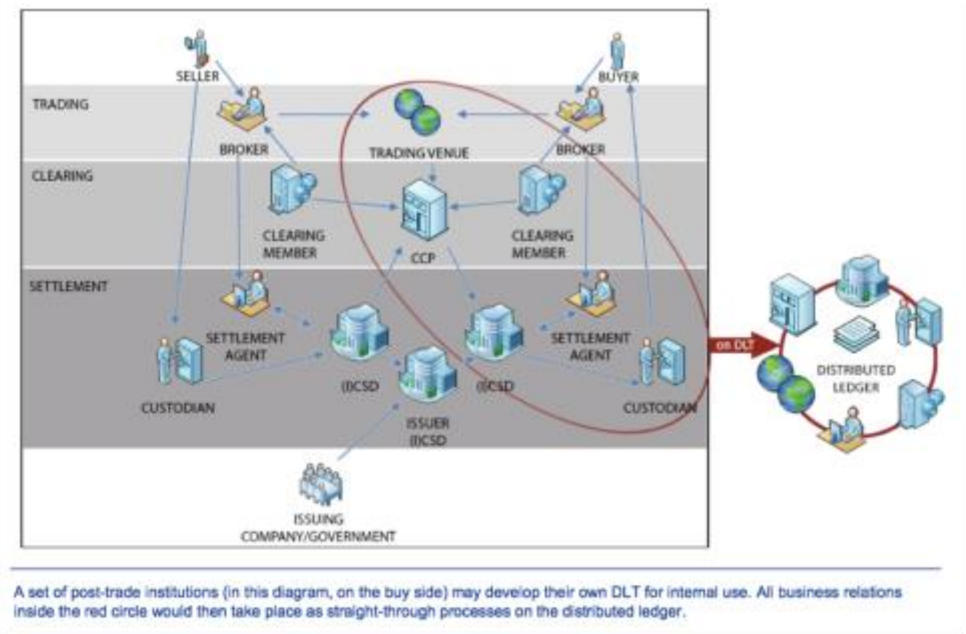
CCPs are identified as FMI that carry a low level of risk, and the netting of transactions they perform enable their clearing members to bear smaller capital burdens. This specific feature might offset the intention of financial intermediaries to refrain from central clearing. Moreover, as Pirrong (2016) argues in his paper "A Pitch Perfect Illustration of Blockchain Hype", there are some main functions of central clearing that cannot be replaced a blockchain technology. First of all, the author reports that blockchains do not provide for loss mutualisation and are not able to control for defaulted positions, which are two of the major features of a CCP. According to Pirrong, the blockchain performs some of the tasks carried out by a central counterparty, but not all of them, especially when dealing with OTC derivative contracts.

6.3. Overall potential effect of DLTs in the post-trade securities market framework

Given the effect of DLTs in the three levels of the value chain, any provisions introduced by authorised institutions on the implementation of DLTs are probably going to have a large influence on the future shape of the post-trading framework. Even if financial technology companies may produce innovative alternatives, it is very difficult that they will be able to face the competition posed by DLTs, unless regulation is modified. Significant financial entities could choose to apply DLTs for settlement internalisation, but it has not yet been assessed if such institutions can reach the amounts sufficient to start benefiting from the technology investment. Pinna and Ruttenberg (2016) take three scenarios under consideration: (1) the incumbent institutions implement DLT to enhance cluster/internal efficiency, without changing the business practice, (2) core market participants implement market-wide DLTs and (3) issuing companies, governments or financial technology companies govern the implementation of peer-to-peer systems for financial instruments transactions, thus revolutionising the post-trade industry.

1. *The incumbent institutions implement DLT to enhance cluster/internal efficiency, without changing the business practice.*

If several institutions are independently successful in the development of their most suitable technologies, this will be beneficial for their internal efficiency. However, there would be a small possibility to connect the distinct market infrastructures and market counterparties to a settlement system characterised by high speed and interoperability for the European Union and for other third-countries. In this setting, the ongoing business practices could be substituted by a similar system constituted by distinct DLTs, with a small impact on the participating institutions. Figure 52 illustrates the case in which there is a common DLT between intermediaries (for example, on the buy-side of the trade).



Source: Pinna, A., & Ruttenberg, W. (2016) - *Distributed Ledger Technologies in Securities Post-Trading Revolution or Evolution?*

Figure 52 – How a DLT could affect the efficiency of post-trade in securities market, assuming current business practice continues

In this situation, institutions would be willing to implement distributed ledgers technologies to save reconciliation expenses. The only progress would be represented by the extent in which securities change ownership, i.e. securities would be transferred as part of the almost real time update executed using the data available to the group of intermediaries that can directly access the same database.

The effect of this innovation would be limited in terms of the number of counterparties implicated in the network.

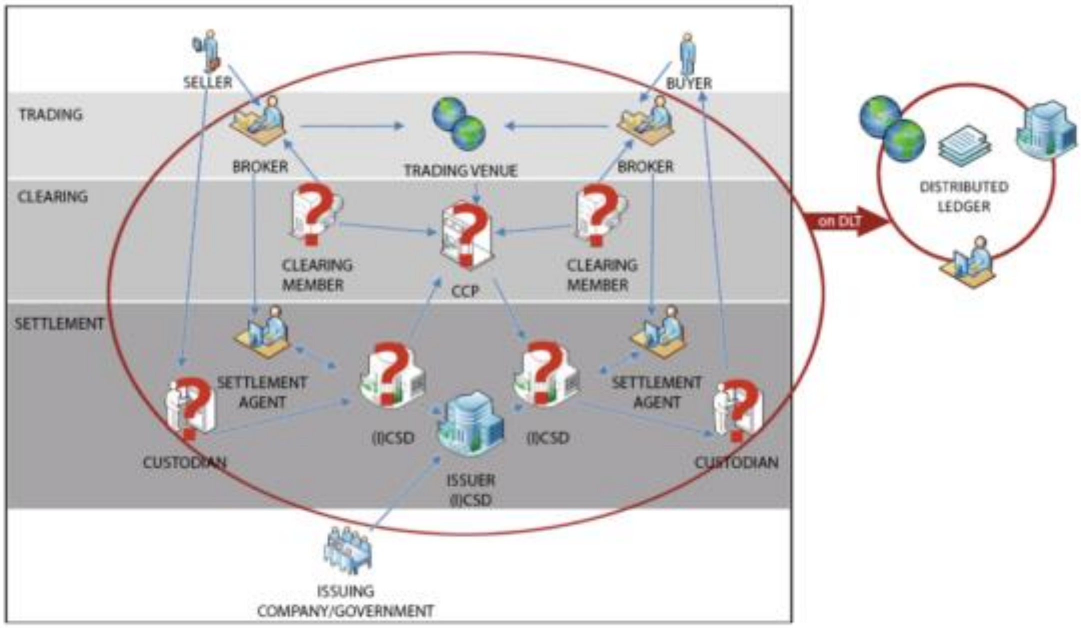
With several groups of institutions still using *siloed*[90] distributed ledgers, the necessity to connect these databases for account reconciliation along the chain of intermediaries would not be modified.

Under this framework, the interoperability among international CSDs, CCPs and collateral management service providers could be reached on a small extent, at least among institutions that share the same distributed ledger technology. This would represent an enhancement in efficiency, but the level of market integration would not be significantly affected.

2. *Core market participants implement market-wide DLTs*

In this setting, some peripheral network participants could become repetitive. The DLT would improve the current post-trading framework in terms of speed and automatization, with financial instruments and transactions being executed and settled on a shared distributed ledger and not among siloed databases.

[90] Information silo – an information management system that cannot communicate with other management systems. The communication in an information silo is vertical. As a result, it is very challenging or even not possible for such system to be employed with other unconnected systems.



If the whole post-trade industry migrated to a distributed ledger settlement process, securities accounts would be updated automatically. Depending on the extent of the implementation of smart contracts, some layers of the industry could become redundant.

Source: Pinna, A., & Ruttenberg, W. (2016) - *Distributed Ledger Technologies in Securities Post-Trading Revolution or Evolution?*

<u>Figure 53</u> – How a market-wide DLT could affect the post-trade landscape of securities markets

Figure 53 illustrates the situation of a DLT in which either a trading venue or settlement agents of several brokers enable external trading participants to have access to the distributed ledger. In this setting, the crediting and debiting of trading parties' books could be carried out with equal expenses and timing effectiveness that already characterises the current internalised settlement process performed by custodian banks. The advantage of DLTs is that the settlement would occur in the distributed ledger, which means that the segregation of financial instruments in the end-users' books would be performed without additional expenses.

Registration of information would be automatic and almost in real time. Regulatory entities could be able to track every trade and outstanding positions and the interoperability among financial intermediaries and FMIs could be reached.

The implementation of smart contracts could cause the functions performed by such intermediaries (for example, custodians and CCPs) to become repetitive, since such roles could become automatized. The efficiency advantage generating from the adoption of this framework would be significant especially for sectors in which there is a deficiency of interoperability and where the absence of automation results in long and time-consuming settlement processes.

Moreover, for structured finance products traded in OTC markets, the implementation of a market-wide DLT would enhance transparency, as long as regulatory entities can access the ledger, as such ledger would be supplied with the same kind of information that is presently sent to trade repositories.

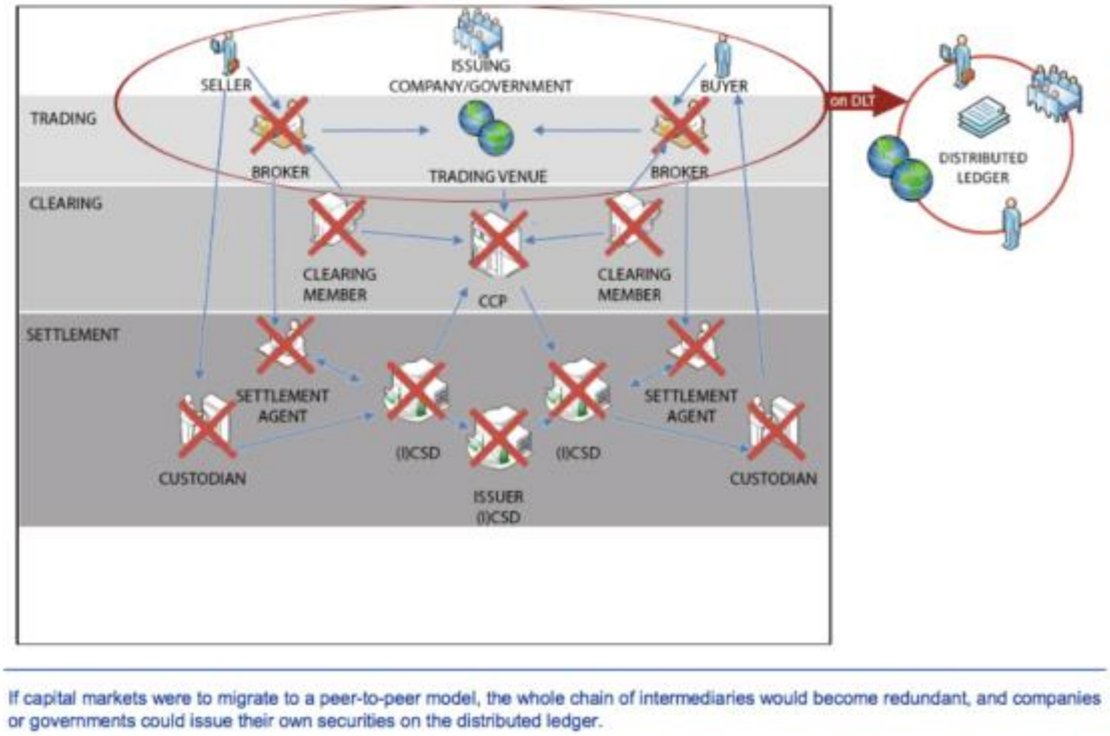
3. *Issuing companies, governments or financial technology companies govern the implementation of peer-to-peer systems for financial instruments transactions, thus revolutionising the post-trade industry*

In this extreme setting, today's post-trade mechanism would be discarded by automatic clearing and settlement systems, occurring through a network of issuing entities and end-investors. This scenario is illustrated in Figure 54. This kind of innovation could potentially help financing from small investors and small-and-medium enterprises, in a niche market that could function aligned with the more complex market for larger volume issuances. Entities and public institutions could directly issue their securities on the distributed ledger, which could be especially interesting for start-ups emitting stock through private placements, while smart contracts would carry out any corporate action in an automatic fashion. However, the *know-your-customer*[91] and *Anti-Money Laundering* rules represent a main barrier to the achievement of this new revolutionary post-trading framework, where the price discovery process occurs through open trading platforms and settlement is carried out automatically on the distributed ledgers.

Developments in the field of *e-identity*[92] could possibly help achieving the main modifications that would be required. Overall, trustworthy third-parties have to carry out identity authentication of potential investors, for enabling them to create an account and trade on a DLT while complying with the current rules. It is important to note that the e-identity does not require to be guaranteed by a financial intermediary and could be integrated to become one of the e-government instruments.

[91] Process through which a business identifies and assesses the identity of its clients (PWC, 2013).

[92] *Electronic identity* - is a means for people to prove electronically that they are who they say they are and thus gain access to services. The identity allows an entity (citizen, business, administration) to be distinguished from any other (European Commission, 2016).



Source: Pinna, A., & Ruttenberg, W. (2016) - *Distributed Ledger Technologies in Securities Post-Trading Revolution or Evolution?*

Figure 54 – How a peer-to-peer market for securities based on DLTs could affect the post-trade landscape

The authentication and verification technologies that are currently implemented do not offer privacy protection and allowing for direct access to DLTs could enable skilled investors to seek wrongful trading. Being able to track the transactions of unskilled competitors, authorised entities could gather insights on liquidity necessities, which, in turn, allow for front-running practices, thereby increasing the trading expenses of these competitors. It would therefore be necessary to have some degree of confidentiality, to avoid that information on concluded transactions is accessible to traders in real time. Complicated solutions to this issue are currently being introduced, by means of *zero-knowledge proof algorithms*, that is, verification and authentication techniques used for the settlement of transactions in the network which do not distribute trading information with non-involved network participants.

7. DLT applicability to the current EU regulatory framework

Distributed ledger technologies will have to be subject to and comply with the regulatory and legal framework in which they are implemented. This is a characteristic difficulty of DLTs, which would have to perform their functions internationally to achieve their optimal application. Despite pieces of legislation are becoming increasingly harmonised across the Member States of the European Union, currently there is no single regulatory framework for all the EU jurisdictions and, in particular, there is no general framework for DLTs. The legal grounds that are applicable for DLTs are mainly based on specific DLTs applications. However, as the use of such technologies increases, it is crucial to address their legal and regulatory concerns.

Central clearing. As already mentioned in the previous chapters, in the European Union, central clearing services are controlled and managed by the EMIR (which covers OTC derivatives, CCPs and TRs) and MiFID/MiFIR (which cover the provisions relating to investment activities in financial products by financial institutions and the functioning of traditional exchanges and other types of trading venues).

ESMA conceives three possible scenarios: (1) centrally clear OTC derivatives in a DLT, where the network participants must be subject to EMIR, (2) centrally clear ETDs in a DLT, where based on Art. 29 under MIFIR, the network participants are required to clear their trades through a central counterparty (as a consequence, EMIR still applies), and (3) centrally clear other classes of financial instruments, e.g. securities lending and repos, in a DLT. In this last situation, the regulation that can be applied depends on the eligibility of such assets to be centrally cleared by a CCP: if the assets are eligible, then the CCP is subject to EMIR; if the assets are not eligible, then the national rules are applied.

Settlement activities. Settlement activities are mostly controlled and managed by the SFD[93], which seeks to diminish and mitigate systemic risk linked to participation in payment and securities settlement processes, more specifically the risk connected to a network counterparty becoming insolvent, and by the CSDR[94], which seeks to align some features of the settlement cycle and discipline, and adopts common requirements for central securities depositories.

ESMA conceives two possible scenarios: (1) settle securities trades by a DLT that is not envisaged as a securities-settlement system by its domestic MS or (2) settle securities by a DLT that is envisaged as a securities-settlement system. In (1), the SFD would not be applicable and the network could not be recognised as a CSD. Two options could arise: (i) the DLT is not recognised as a settlement internaliser under the CSDR and therefore the reporting obligations under the CSDR do not apply or (ii) the DLT is

[93] The Settlement Finality Directive

[94] Central Securities Depositories Regulation

recognised as a settlement internaliser under the CSDR and the reporting obligations are mandatory (under Art. 9 of the CSDR), in which case Art. 2 of SFD and Art. 18 of CSDR would be applicable.

Safekeeping and recordkeeping of ownership of financial instruments and rights linked to such securities. As opposed to central clearing and settlement, the rules to which securities and rights linked to securities are subject are not harmonised throughout the European Union. Instead, such rules are implemented nationally. ESMA pointed out two possible situations: (1) the recordkeeping of ownership is carried out by the issuer, and the applicable rules will be based on the specific country national law, and (2) the recordkeeping of ownership is carried out by the investor, who will be subject to different pieces of legislation based on the type of investment, for example: MiFID, UCITS[95] and AIFMD[96].

Reporting activities. Different EU laws, e.g. MiFID, EMIR and SFTR[97], have implemented a requirement for market counterparties to report to national competent authorities or third-parties (trade repositories) the relevant information on their transactions. ESMA states that if such counterparties are willing to implement a DLT to act as a trade repository, such TR will have to comply with EMIR.

On May 2016, the European Parliament introduced a resolution on crypto-currencies. Such resolution identifies that crypto-currencies and blockchain technologies could potentially enhance individuals' welfare and foster economic development, but emphasises the need to adequately manage and deal with the risks linked to such technologies, so as to reinforce their reliability. In this setting, the European Parliament advises to implement a sound and robust legal framework that is sufficiently flexible to keep up with innovation, but states that if such rules are implemented too early, it could not be correctly applied to transactions that have not yet been settled, and could

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[95] Undertakings for the Collective Investment Transferable Securities Directive – seeks the harmonisation of EU legislations, rules and administrative provisions linked for the management and sale of mutual funds.

[96] Alternative Investment Fund Managers Directive – seeks to improve transparency, to enhance investor protection and to grant regulations with the necessary information and instruments to supervise and react to the potential stability risks that such funds (hedge funds, private equity funds, and real estate funds) could generate.

[97] Securities Financing Transaction Regulation – seeks to increase transparency by mandating the reporting of financial instruments transactions in OTC markets. It is applicable to repos, securities lending and borrowing, commodities lending and borrowing, buy/sell back and sell/buy back transactions and reuse of collateral.

therefore deliver an incorrect message to market participants about the benefits of such technologies.

In addition, the European Parliament argues that the key financial markets EU laws, such as EMIR, CSDR, SFD, MiFID/MiFIR and AIFMD, could represent a suitable regulatory framework for the aforementioned activities, regardless of the underlying technology, although some ad-hoc rules might be necessary.

Moreover, such resolutions require the introduction of a *horizontal Trask Force DLT* directed by the Commission and constituted of technical and regulatory experts, whose purposes would be to:

- ensure adequate knowledge and competences across the different areas in which DLTs could be applied;
- Unify stakeholders and back the relevant market participants at EU and MS level in their objectives to control and manage DLTs implementation at EU level and worldwide;
- Improve knowledge, and examine the advantages and risks of DLTs implementations to efficiently exploit their potential;
- Provide and encourage timely, detailed and adequate reactions to incoming opportunities and threats that may generate from DLTs;
- Introduce stress tests for all the significant characteristics of DLTs that achieve a level of application that would classify them as systemically relevant for financial stability.

Conclusions

The collapse of Lehman Brothers, the almost default of Bear Sterns, the bail-out of AIG and the 2008 financial crisis in its entirety showed the functional weaknesses that characterised the OTCD market. Since the OTCD market is global in nature, the Group of 20 decided to cooperate and commit to address the weaknesses of such market and to increase financial stability, improve transparency in the derivatives market, mitigate counterparty and systemic risk and protect against market abuse. In the 2009 Pittsburgh Summit, the international leaders conceived five commitments to restructure the OTC derivatives market: (i) standardised OTC derivatives should be centrally cleared through central counterparties; (ii) non-centrally cleared derivatives should be subject to higher capital requirements; (iii) non-centrally cleared derivatives should be subject to minimum standards for margin requirements; (iv) OTC derivatives trade information should be reported to trade repositories; and (v) standardised OTC derivatives should be traded on exchanges or electronic trading platforms, where appropriate. The European Markets Infrastructure Regulation (EMIR) represents the regulators' main tool to achieve these objectives.

The implementation of EMIR's reforms has taken longer than expected due to the large volume and the complexity in the regulation of this previously unregulated market. As of 2017, (i) central clearing frameworks have been, or are being, implemented; (ii) interim higher capital requirements for non-centrally cleared derivatives are mostly in force; (iii) margin requirements for non-centrally cleared derivatives have begun to be implemented; (iv) comprehensive trade reporting requirements for OTC derivatives are mostly in force; and (v) platform trading frameworks are relatively undeveloped in most jurisdictions. Overall, the implementation of these reforms has tended to be most rapid in the biggest OTCD markets, especially in the interest rate derivatives market.

Greater central clearing activity performed by central counterparties (CCPs) is a crucial aspect of the reforms that is helping to mitigate systemic risk (which generates from the size of its clearing members). In addition, increasing the use of CCPs is beginning to lower counterparty credit risks in the financial system by substituting complex and opaque networks between counterparties trading in OTC markets with lit and transparent connections between CCPs and the associated clearing members (backed by strong resilience and risk management). Counterparty and systemic risk mitigation (and hence, financial stability) is achieved through the main activities performed by and the structure of CCPs, namely (i) risk management, through novation, multilateral netting and default waterfall, (ii) promoting liquidity, (iii) enhancing transparency and (iv) reducing costs. However, despite their robustness, CCPs will not work properly if they cannot rely on complete and reliable information on the OTC derivatives. So, the supporting functions of trade repositories are also essential to establish an acceptable low level of systemic risk. Moreover, the central role of a central counterparty in financial markets and its interconnectedness with other market participants are the main determinants of its systemic importance (Wendt, 2015). The higher the degree of interconnectedness, the greater the impact of a CCP's actions on market participants. In this setting, CCPs' activities could have strong negative externalities or (in extreme cases) their default could have a domino effect (in a systemic fashion) in the financial system. Lucantoni (2017) adds that it is important to keep in mind that the presence of a central counterparty clearing individual positions, despite averting the domino effect caused by the default of a single market participant (by mutualising losses among the other clearing members), could discourage counterparty reliability monitoring. Becoming the buyer to every seller and the seller to every buyer makes it impossible to make a distinction among the counterparties (and, therefore, to select them) based on solvency margins. There are two consequences to this, which are opposite compared to those envisaged by the legislator, namely (i) a significant increase in information asymmetry in centrally-cleared markets compared to bilaterally-cleared markets, where the financial counterparty is more motivated to assess (and, hence, price) counterparty risk, and (ii) that CCPs are assigned derivative contracts that are riskier to clear bilaterally. Therefore, it is fundamental that the CCP manages its clearing members also from a solvency perspective, evaluating the contracts on a case-by-case basis and not only based on standardised requirements. Again, the role played by trade repositories becomes of crucial importance for the informative contribution they provide to CCPs.

Introducing to the network analysis of systemic risk in OTC derivatives markets, a paper by Acharya et al. (2016) is illustrated, which models systemic risk as an effect of undercapitalization of banks and, therefore, of the financial system, affecting the real economy as a negative externality. Authors show that there exists an empirically measurable critical threshold for the system aggregate capital, below which, at any relevant shock, systemic risk would erupt into a systemic crisis. However, they do not explain why a bank should be feeding systemic risk if it optimizes its position based on market prices. A possible answer is that market prices do not fully reflect risk. Actually, the market "invisible hand" may fail and wrongly estimate risk and consequent prices. The market response is the result of the combination of a great deal of *independent* assessments made by the many firms of the system through the demand and supply process. Should firms' assessments be biased (orientated in the same direction), due to some endogenous or exogenous factor, market prices would be incorrect. The more diverging from (reasonable) economic values are prices, the higher the level of systemic risk, the heavier the impact of a possible systemic crisis on the financial and economic systems. Too high or too low market prices resulting from biased decisions create, in turn, the incentive to freely ride the system and so to furtherly feed price, moral hazard and systemic risk anomalous trends. Systemic risk can thus be interpreted as a potential negative externality cumulated in the system (a "bubble") that, subject to an unexpected event, may erupt into a crisis, causing the disruption and eventually the collapse of the system, through multiplicative "domino effects", due to financial contagion propagating through interconnectedness. Derivatives, and especially OTC ones which are not dealt with within a regulated market, can play a relevant role in price biasing. Actually a very critical one, since they are expected to edge against risks and, even more, because they are often tools of financial speculation. In case of market bias, instead of reallocating risk among market parties, OTC derivatives may thus strongly amplify wrong price trends and systemic risk. According to Abad et al. (2016), OTCDs market is opaque, involves large volumes of transactions and has a very complex structure. The large majority of trades is concentrated in a little number of financial entities, which become the very vulnerabilities of the system in terms of systemic risk. For all the three largest OTCDs sectors (interest rates, foreign exchange and credit) the trade distribution is right-skewed (with a long right tail), and hence strongly asymmetric. This pattern indicates a highly concentrated structure. Such characteristic trade distribution shows that mature OTCDs markets and, more generally, financial systems can be represented by scale-free networks. Actually, according to network analysis, a system is represented by its *underlying network*, whose nodes are the system elements and connections their interactions. The probability distribution of the variable node degree, the small world character, and the clustering character describe the structure of the network and its connectivity properties (sensitivity to shocks). Accordingly, it is possible to distinguish *random networks* from *scale-free networks*, exemplifying respectively systems based on perfect competition markets and systems based on oligopolistic markets. A system represented through a random network is a random system whose elements, though having an incentive to interact with each other, do not show any specific auto-organizational principle. When connections cannot be considered statistically equiprobable, the network has biases and shows some level of stratification, clustering and concentration, so that individual nodes are not any longer all alike. *Scale-free networks* –typical of many complex information systems– are characterized by a power law node degree probability distribution, heavily asymmetric, decreasing for increasing node degrees, with a long right tail. This means there are few *hubs* (giant nodes) of the network, with a very high number of connections in comparison to all other nodes, which shape the properties of the network. A process of growth led by the mechanism of *preferential attachment* (entrant nodes connect to existing ones based on their relative degree) inevitably transforms a random network –a nascent OTCD market– into a scale-free network –a mature OTCD market. Hubs have incentives to select and bias information to feed their business and, in doing so, they increase over and over their market power, not only becoming concentrations of large amounts of the financial system counterparty risk, but also becoming a primary source of endogenous bias of prices and therefore of systemic risk. While a random network system will collapse only if a number of firms larger than a high critical threshold defaults, in scale-free network system it will suffice that just one or two hubs default to make the whole financial system and consequently the economic system to collapse. This actual possibility leads directly to the syndrome commonly known as too-big-to-fail, furtherly increasing the level of moral hazard for the hubs and therefore of the amount of systemic risk in the financial system. Speculation (one direction price large bets) furtherly increases the level of systemic risk. In a scale-free network system *EMIR OTCDs market scenario*, hubs are subject to CCPs clearing and have become clearing members (CMs) of CCPs. Moral hazard associated to the hubs (now CMs) is minimized, while systemic risk is concentrated in the CCPs. Since networks can be mathematically represented through matrices and these allow for quantitative methodologies, network analysis permits calculations of the financial requirements for CCPs and CMs. Markose et al. (2017) illustrate an introduction to this kind of application. In conclusion, systemic risk is a typical situation of market failure where public authorities must intervene in the common interest. Thus, economic doctrine justifies in principle EMIR adoption. While in a random network financial system there exists a threshold of capitalization below which the system may collapse, the stability of scale-free network financial systems depends solely on CCPs. Therefore, measures to protect the CCPs are absolutely the most important ones.

Distributed Ledger Technology (DLT) represents a potentially revolutionary instrument that could lead to partial or total disintermediation of securities markets in the post-trading landscape, depending on its degree of implementation. By providing a faster, more reliable, transparent, convenient, secure and solid trading platform, central clearing and settlement activities performed by market intermediaries may become redundant. However, there are some major drawbacks linked to DLTs. ESMA points to *operational risks* relating to (i) scalability of DLTs: what has been implemented for specific activities could be very complex to be translated at a macro-level comprising several classes of securities and many participants and (ii) interoperability with existing processes (such as CCPs and TRs) and across different networks (distinct databases for different securities' classes). Also, ESMA argues that there is the need to balance public disclosure of data with anonymity of the network participants and stresses that although DLTs enhance security, a cyber-attack could gather private sensible data, damaging the whole network and since DLTs generally implement similar protocols, attacks to one network could threaten many other networks.

As trade settlement involves security and cash legs, DLTs could work for the transfer of securities, but it is likely that sellers would still require real money rather than crypto-currencies. Hence, cash accounts would still be needed. Moreover, it is highly improbable that central banks will recognize cryptocurrencies as common currencies.

In general, the effect of DLTs on CCPs is dependent on the level of applied technology, the extent to which authorised entities delegate the clearing function to smart contracts and the type of securities traded on the DLT. However, there are major CCPs' tasks that cannot be replaced (Pirrong, 2016): DLTs do not provide for loss mutualisation and do not control for defaulted positions, which are two of the main features of a CCP. Overall, DLTs do not perform all the tasks carried out by a CCP, especially when dealing with OTCDs.

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Executive Summary

Over-the-counter (OTC) markets have long been considered “dark markets” as they lack transparency in the products being traded, in the market participants and, consequently, in the price discovery process, generating a complex web of mutual interdependence among counterparties. After the 2008 financial crisis, the G20 leaders committed to reform the OTC sector. The main purpose of EMIR is to enhance the OTCD market transparency and reduce systemic risk making all eligible OTC derivatives contracts subject either to mandatory central clearing through a Central Counterparty (CCP) or to suitable risk mitigation techniques, while all relevant data on outstanding OTCDs and ETDs must be reported to a trade repository (TR).

In this context, the dissertation investigates the scope and functioning of CCPs in OTC derivatives markets, with particular focus on *systemic risk*. In particular, *Chapter 1* provides a general overview on the OTCD markets, with a detailed analysis of the standardised OTCDs subject to clearing, namely credit default swaps, interest rate swaps and non-deliverable FX forward agreements. *Chapter 2* summarises EMIR’s main features and objectives, its current implementation status and future perspectives, including a brief comparison with the US Dodd Frank Act. In *Chapter 3*, the reporting system arising from TRs will be introduced and explained in all its main aspects. *Chapter 4* explains the clearing system, namely CCPs operational framework, key benefits and major risks associated with clearing, as well as the main rules ensuring the soundness and reliability of this financial market infrastructure. Taking forward a suggestion of the European Commission, *Chapter 5* proposes an introduction to a possible qualitative and quantitative network analysis of systemic risk in OTC markets based on Network Theory. It also draws some considerations on the potentialities that network analysis offers to regulators. Lastly, *Chapter 6* outlines the possible impact of distributed ledger technologies (DLTs) in the securities markets’ post-trading landscape (clearing and settlement), which could potentially overcome the major role played by CCPs in OTC markets.

***Chapter 1*. <u>The over-the-counter (OTC) derivatives market</u>**

A *derivative* is a structured finance product which derives its value from an underlying asset or a basket of assets. Its main aim being reallocation of risk among market participants, it is used for hedging or speculation. The extent of standardisation of derivative contracts may differ. *Exchange traded derivatives* (ETDs) are financial instruments with a high degree of standardisation and are *anonymously* traded through regulated trading venues. ETDs allow for high level of standardisation, reduced exposure to counterparty credit risk (thanks to the counterparties’ anonymity and centralisation of trades through exchanges and easier price discovery process), increased transparency and enhanced liquidity (Heckinger, 2013). O*TC derivatives* are customised financial contracts bilaterally traded between counterparties. OTCDs allow as much standardisation as tailoring to meet counterparties' risk preferences. Despite their flexibility, there are some drawbacks, including that the value to the buyer of OTCDs is positively correlated with the OTCD seller's credit-worthiness, it is difficult to transfer OTCDs to a third-party due to customisation of the contract and it is hard to infer the true OTCD price due to lack of transparency in the pricing process. The OTC sector is featured by private negotiations between multiple counterparties with limited public disclosure of information. The bilateral nature of trades generates a complex web of mutual interdependence. Paired with lack of transparency, this produces a situation in which it is hard for market entities and regulators to thoroughly understand the real nature and levels of risk to which they are exposed, causing uncertainty to grow and impairing financial stability. In OTC markets, there are few large market participants negotiating considerable volumes of OTCDs. All other players account for a minor share of the market. While the latter are not systemically significant, the default of one of the formers can impair the financial system. Hence, OTCD market can be regarded as a possible generator of *systemic risk*, i.e. one large institution defaulting can generate losses or even the default to other large institutions which, in turn, can lead to more losses and defaults, eventually causing the collapse of the financial system. OTCD activity volume was $544 trillion by the end-2016. Hence, OTCD have a relevant impact on the real economy and on the financial system. The five main classes of OTCDs are: interest rate derivatives, FX derivatives, credit derivatives, equity and commodity, whose market shares were 80.46%, 15.75%, 2.20%, 0.32%, 1.24% respectively (end-2016). Standardisation could promote legal certainty, reduce legal risk and enhance operational efficiency, by enabling automation of the mechanism of trading and post-trading (EC, 2009). Standardisation could also mitigate counterparty credit risk, allowing for greater use of CCP services or exchange trading and eases reporting and sharing of data for regulatory purposes. Standardisation seeks to deliver efficient, safe and healthy derivatives markets. However, a high degree of standardisation is a necessary but not sufficient condition for clearing-eligibility. In addition, an OTCD must be traded by specific market participants and the volume of trades must exceed some clearing thresholds. Not all OTCDs can be standardised, since some are too complex to meet basic standards and their restructuring would be too costly, while standardisation may hamper their hedging role (Hull, 2010). OTCDs with a sufficient degree of standardisation are *credit default swaps*, *interest rate swaps* and *non-deliverable FX forward agreements*.

***Chapter 2*. <u>The European Markets Infrastructure Regulation (EMIR)</u>**

Implemented on August 2012, EMIR directly applies to the Member States of the EEA. The main purpose of EMIR is to enhance the OTCD market transparency and reduce systemic risk, helping the

EU, and ESMA in particular, to have a better overview on the volume, market entities and any possible market abuse. EMIR also seeks to lower the number of market entities involved in OTCD trades, mitigating their operational risk. To achieve its aims, EMIR requires that all eligible OTCDs contracts be subject to mandatory clearing through a CCP (Art. 4); non-cleared OTCDs must be subject to suitable risk mitigation techniques (Art. 11(3)); and that all relevant data on outstanding OTCDs and ETDs must be reported to a TR (Art. 9). EMIR sets rules on derivatives (ETDs and OTCDs) and on *financial* (FCs) and *non-financial counterparties* (NFCs). FCs are EU-regulated entities, such as banks, investment firms, insurance undertakings, undertakings for collective investment in transferable securities and occupational retirement funds. NFCs are all other EU-entities engaging in OTCD trades not defined as FCs. NFCs can be classified as (i) NFCs engaging in large trade volumes of OTCDs for purposes other than hedging and (ii) NFCs trading OTCDs to a smaller extent or for hedging purposes. NFCs fall in one of the two classes based on whether their trading volumes exceeds a pre-set clearing threshold. Generally, an NFC exceeding the clearing threshold is considered NFC+, whereas a NFC falling below such threshold is considered NFC-. There are some cases in which exemptions from clearing are allowed, e.g. NFCs trading for hedging purposes or pension schemes having to give up some investments to have enough liquidity for margin requirements. Also, EMIR requires that all derivatives trades deemed sufficiently liquid and subject to clearing must be traded through a *regulated market*, a *multilateral trading facility*, an *organised trading facility* or a non-EU trading venue. As of 2017, EMIR reforms have not yet been completely implemented. However, relevant authorities increasingly notice the positive impact of such reforms and the progress that is being made to achieve the G20s goals, especially towards systemic risk mitigation. Also, greater CCPs' clearing activity is starting to lower counterparty credit risks in the financial system by substituting complex and opaque networks between parties trading OTC with lit and transparent links between CCPs and the associated CMs. Also, reporting obligations on OTCDs trades have enhanced post-trade transparency in OTC markets to relevant authorities and other entities having access to TRs databases, using such data primarily to control for systemic risk. The Dodd Frank Act (DFA) is the US equivalent of EMIR, whose main goals are to minimise systemic risk in OTC trading, create transparency in OTC markets and prohibit parties holding customer deposits from engaging in speculative derivatives activity, dealing mainly with swaps. Overall, the EMIR and the DFA are very alike but these similarities may not be as strong as to ensure global harmonisation in the financial system (Quaglia, 2012). Since EU and the US are the principal actors in OTCD trading, implementing similar regulatory rules would be very important for preventing *gold-plating*, i.e. risk of regulatory arbitrage (Vinals, 2013). EMIR and of the DFA, both still works in progress, seek to achieve the same end-result: financial stability.

Chapter 3. <u>Trade repositories (TRs) – the reporting system</u>

TRs are registries that centrally collect and maintain electronic databases of OTCDs records and ETD contracts (ESMA, 2017). Their main function is to enhance *market transparency* by providing good quality data to public and private market participants and by ensuring timeliness and appropriateness of the disclosed information. Heitfield (2014) adds that TRs mitigate systemic risk and help assessing financial stability. A crucial benefit of TRs is that they encourage *standardisation* of data and ensure quality of and access to OTCD post-trade information (IOSCO, 2013). However, data recorded by TRs cannot be considered equivalent to data registered by single entities. In fact, it is crucial that entities record their own trade data and compare it with their counterparties or TRs in a consistent manner (IOSCO, 2011). Also, a well-structured TR enhances a CCP's ability to efficiently clear OTCD trades (BIS, 2011). TRs can promote market transparency for securities and market segments that are not yet receiving benefits from clearing, since in the EEA trade reporting is mandatory for all OTCD contracts (clearing eligible and non-eligible) and ETDs. Overall, TRs are a fundamental pillar of the framework sustaining OTCD markets, since data stored in a TR may be used as source of analysis by many market entities. Hence, consistent availability and adequacy of TR data is extremely important. EMIR indicates *data aggregation* as a fundamental component for authorities to accomplish their mandates, including assessing systemic risk, conducting market surveillance and enforcement, supervising market entities, conducting resolution activities and increasing transparency of OTCDs markets. There are three main ways to aggregate data: (1) *legal entity aggregation*, which produces a report on OTCDs activity attributed to a group of related entities and it can be conducted among TRs to establish group-level concentrations on a global scale (ECB, 2016). Here, each legal entity is to be identified with a *Legal Entity Identifier* (LEI), a standard, global 20-digit *alphanumeric code* that facilitates relevant authorities identifying OTCDs trades to a single counterparty or group of counterparties. (2) *Product aggregation*, which refers to collecting OTCDs "activity in one product with other OTCDs products sharing common risk factors" (ESMA, 2017). In this setting, regulators have introduced the *Unique Product Identifier* (UPI), an identification code to uniquely tag accurately the derivative products being traded. (3) *Trade aggregation*, which is carried out through *Unique Trade Identifiers* (UTI), to identify trades in OTCDs market. Overall, when a transaction is reported to a TR, regulators are willing to have (i) a LEI, to identify each counterparty, (ii) an UTI, to get the identity of the specific transaction and (iii) an UPI, to get what has been traded (Grody, 2014).

Chapter 4. <u>Central Counterparties (CCPs) – the clearing system</u>

A CCP is defined as a financial market infrastructure (FMI) that stands between counterparties to the contracts traded on OTC market, becoming the buyer to every seller and the seller to every buyer, insulating them from each other's default (Duffie et al., 2011). As such, the CCP effectively guarantees the obligations under the contract agreed by the two counterparties: if one them defaults, the other is preserved thanks to the default management processes and internal resources of the CCP. Also, by centralising trades, CCPs simplify the complex web of interdependence that characterises OTC markets, reducing the overall level of exposures and enhancing the trading network's transparency. By interposing itself between all trades with its *Clearing Members* (CMs) to which it guarantees the settlement, CCPs are extremely interconnected with the market participants and financial markets (Wendt, 2015). CCPs represent crucial hubs in the network. Their services or default may have extremely strong externalities on CMs and on the financial system. For this reason, central banks and regulators usually treat CCPs as systemically significant institutions and subject CCPs to strict supervision, which makes them *too-interconnected-to-fail*.

Four main actors are involved in central clearing: (i) the CCP, (ii) clearing members (CMs), (iii) clients and, (iv) indirect clients (Art. 2). A *CM* is an undertaking participating in a CCP and is responsible for discharging financial obligations arising from that participation. A *client* is an undertaking with a contractual relationship with a CM of a CCP enabling that undertaking to clear its trades with that CCP. An *indirect client* is a client of a client of a CM, who complies *indirectly* with the clearing obligation (Art. 4(3)), since they are not able to be direct members of the CCP. CCP's participants must post initial and variation margins (IMs and VMs) as collateral, to provide a compensation for their potential default. As explained by the EC, there are several key benefits linked to central clearing. (1) CCPs' *risk management procedures*. CCPs engage into trades only with CMs that have proven to be financially stable, with adequate competences and skills (through admission criteria), which not only guarantees soundness in the CCP's framework, but also ensures transparency: all CCP's members know that they all fulfil such obligations (Schuil, 2013). (2) *Counterparty risk mitigation through novation*, mechanism through which the initial bilateral contract is substituted with two equal and opposing contracts (CCP-buyer and CCP-seller) with the CCP, which is considered the most creditworthy and sound infrastructure in OTC markets (Rahman, 2015). (3) *Multilateral netting*, i.e. CCPs offset an amount due from a CM on one trade against an amount owed to that CM on another, to reach a single, smaller net exposure (Rehlon, 2013), hence promoting *market liquidity*, through capital reallocation that can be used for other purposes. (4) *Loss mutualisation*. CCPs reduce and control for contagion risk by managing defaults in an orderly way, i.e. mechanism known as *default waterfall*, referring to the collection of funds held in the CCP employed to compensate losses generated by a defaulting CM. CMs, clients and the CCP itself contribute to this fund by posting IMs and VMs as collateral, as well as the CCP's own equity. Should this come out to be insufficient to restore the correct functioning of the infrastructure, the

CCP would become insolvent and default. Also, *anonymity* is ensured, since the CCP becomes the counterparty to both parties to the contract which, in turn, remain anonymous to each other. Hence, CCPs can represent real assets for financial markets. However, if not appropriately operated, CCPs' own functioning features imply potential risks for financial stability. In fact, the CCP central role in financial markets and its interconnectedness with other market participants are the main determinants of its systemic importance (Wendt, 2015). The higher the interconnectedness, the greater the impact of a CCP's actions on market participants. Despite protecting counterparties involved in a trade and simplifying the complex web of mutual interdependence that characterises the OTC sector, the implementation of a CCP generates new interconnections within the financial system. The CCP's interconnectedness with other market participants increases the *risk of contagion* in the event of financial distress and losses, which can be caused by a CCP's procedures to face the default of a CM or the possible default of the CCP itself, which could cause a *domino effect*. However, the event of a CCP default has a very low probability, since such FMIs are based on a sound and robust regulatory framework. Overall, it is crucial for CCPs to be safe and efficient, to guarantee and foster the stability of the financial system. This is because CCPs activities result in *risk concentration*, which, if not adequately addressed, could lead to disastrous financial consequences. EMIR outlines the rules with which CCPs must comply. Since the implementation of EMIR in 2012, the volume of CCPs' activity (both in EU and in the rest of the world) has progressively increased. The rapid expansion of CCPs functions in the global financial market shows that central clearing requirements have been implemented across several derivatives classes in the EU (since June 2016) and in third-countries. The growing importance of CCPs and the related systemic implications have led the EC to adopt a proposal on CCP recovery and resolution in November 2016, a proposal for a regulation to amend EMIR in May 2017 and the proposed regulation which was released on June 2017. The three main characteristics of the proposed regulation are (i) the introduction of a new CCP Executive Session Body in ESMA, a new framework to encourage consistent supervision across the EU which will enable ESMA to oversee existing colleges of national supervisors and implement its supervisory powers under EMIR; (ii) a new supervisory role for central banks (CBs) based on the fact that CCPs implement payment systems whose supervision is a responsibility of CBs and CBs implement monetary policies that may influence CCPs activities; and (iii) enhanced supervisory controls over systemically significant non-EU CCPs.

***Chapter 5*. Network analysis of systemic risk in OTC derivatives markets**

Bringing forward a suggestion of the European Commission, chapter 5 presents an introduction to the network analysis of systemic risk in OTC derivatives markets. Acharya et al. (2016) model systemic risk as an effect of undercapitalization of the financial system, affecting the real economy as a negative externality. The propensity of a bank to be undercapitalized, when such is the overall financial sector's condition, measures its contribution to systemic risk. Each bank maximizes, based on market prices, its risk-adjusted return by selecting the amount of own capital to raise according to its risk profile (equity vs debt). To protect against systemic risk, the Government considers not only the aggregate effect of banks' actions, but also each bank's insured losses in case of default (savers' deposits) and the negative externality (due to the bank's capital deficit) generated in case of a systemic crisis. Since those latter elements of cost are not considered within the banks' allocation process but are essential for the system overall optimization (a case of market failure), the Government imposes to each bank a tax amounting to their sum. The tax reduces the value of the bank equity, which is forced to recalculate its preferred level of capital (equity vs debt), in accordance with a *de facto* increased level of risk. The paper concludes that there exists a critical threshold for the system aggregate capital (equity), below which, at any relevant shock, systemic risk would erupt into a systemic crisis. This threshold can be calculated because the systemic-risk component due to banks' incentives is empirically measurable, being equal to the expected amount a bank is undercapitalized in a future systemic event in which the overall financial system is also undercapitalized. Though being quite insightful, the paper does not adequately investigate on the two-way logical nexus between undercapitalization of each bank and undercapitalization of the system. If a bank optimizes its position based on market prices, why should it be feeding systemic risk? A possible answer is that market prices do not fully reflect risk. Any financial firm will optimize over time its equilibrium between expected values (revenues) of its assets, which are the liabilities of the firm's counterparties, and expected values (costs) of its liabilities, which are the assets of the firm's counterparties. Expected values incorporate risks and hence differ from notional values. Each firm is subject to a set of risks from the system affecting the performance of its assets and, in turn, does generate a set of risks for the system through its liabilities. The firm needs to assess risks to cover against them, according to its own risk profile. In theory, from the firm's perspective, risk could be conveniently expressed as the expected value an economic asset of the firm would get if a negative event happened and calculated by multiplying the probability that the negative event does not occur times the notional value of the asset concerned. What makes this simple process difficult for the firm, though notional values are given, estimating probabilities is not easy in the real world. The market normally solves this issue, implicitly estimating the risk associated to each participating firm by pricing the firm's liabilities at any specific point in time in the future. The lower the price with respect to the notional value of the liability, the higher the cost of debt for the firm, the higher the risk directly associated to that firm, the higher the financial distress of the firm. So, if each bank considers market prices in its optimization process, no bank should result being undercapitalized (with respect to its risk profile) and no increment of systemic risk should be generated. However, the market "invisible hand" may fail and underestimate (overestimate) effective risk, thus overestimating (underestimating) the expected values (i.e., prices) of assets/liabilities and generating systemic risk. Let's see how the systemic risk mechanism works. The invisible hand of the market is the combination of *independent* assessments that the many buyers and sellers (the firms of the system) of an asset make on the asset value through the demand and supply process on the market. In a dynamic equilibrium, such combination of assessments results in the market price of the asset. The stress here is on independence. Should firms' assessments be biased (buyers and sellers tend to influence one another in a significant way and in the same direction) due to some factor endogenous or exogenous to the market – which result in a situation of incomplete or asymmetric information – the invisible hand will fail and the market will dictate a wrong price for the asset. The more diverging from economic values are prices, the higher the level of systemic risk, the heavier the impact of a possible systemic crisis on the financial and economic systems. Rapidly inflating price bubbles (too high prices of assets), on one side, and bank runs (too low prices of assets), on the other, are but two opposite examples of extremely high levels of systemic risk. The Acharya et al. bank's behavior can be easily explained as follows. Given expected values (market future prices) of their assets and liabilities, bank decide the amount of own capital (equity) to keep. Hence, banks have a natural incentive to minimize own capital and increase financial leverage, to optimize economic performance. If market prices are biased (e.g. higher than they should because of too optimistic expectations), banks will eventually keep too low a level of equity in relation to own debt. In other terms, expecting growing market price levels, banks will buy more assets and sell more liabilities, thus contributing to the price boom (i.e. higher systemic risk level). Since any other bank shares the same incentives and faces identical market prices dynamics, the system will end up being undercapitalized and incorporate too high a level of systemic risk. In an undercapitalized financial system, the optimizing behavior of each individual bank implies over time a situation of growing moral hazard for the bank and increasing systemic risk for the system. High market prices resulting from banks' biased decisions create, in turn, the incentive for each bank to freely ride the system and so to feed the price, moral hazard and systemic risk increasing trends. If the market prices were not biased, the systemic risk level would be negligible and a systemic crisis would be impossible. Systemic risk can thus be interpreted as a potential negative externality cumulated in the system that, subject to an unexpected event, may erupt into a crisis, causing the disruption and eventually the collapse of the system, through multiplicative "domino effects", due to financial contagion propagating through interconnectedness, fire sales, rapidly increasing margin requirements, liquidity interest rates spirals, bank runs and herd behavior of financial firms. A high level of systemic risk does not imply per se, however, that a crisis will occur. Yet, the higher systemic risk level, the more vulnerable to a crisis the system is, the higher the cost that a crisis will cause, if it occurs. Derivatives can play a relevant role in price biasing. They are used for hedging and their prices reflect expected values of underlying assets and hence the risk associated by the market to the issuing firms. In case of market bias, instead of reallocating risk among market parties, derivatives may concur to increase prices divergence from their reasonable economic level. Derivatives role may be particularly sensible for systemic risk, because they are often tools of financial speculation, which tends to accentuate rather than mitigate price trends. Also, while standardized derivatives are exchanged through regulated markets (ETDs), which act as clearinghouses for buyers and sellers and match the requirements of transparency and anonymity needed for a correct price determination, OTCDs do not share these essential features. OTCDs markets are therefore main producers of systemic risk. Abad et al. (2016) analyze the set of the 2015 relevant EMIR data. OTCDs market is opaque, involves large volumes of transactions and has a very complex structure. The level and dynamics of systemic risk are affected by the distribution of trades across market entities. The large majority of trades is concentrated in a little number of financial entities, which become the very vulnerabilities of the system in terms of systemic risk. For all the three largest OTCDs sectors (interest rates, foreign exchange and credit) the trade distribution is right-skewed (with a long right tail), and hence strongly asymmetric. This pattern indicates a highly concentrated structure. CCPs are densely linked to each other as well. Several levels of intermediation are present, which connect peripheral counterparty to central dealers. A *complex* system can be defined, in general terms, as a set of many bilaterally interacting elements and their interactions, evolving with time. Each element is connected to (at least one) elements through *bilateral interactions* and to all other elements of the system through *chains of bilateral interactions*. These chains materialise *systemic interactions*. Bilateral interactions are *strong interactions* (results of the elements' choices). Systemic interactions are *weak interactions* (unwanted consequences of many independent bilateral interactions). It is the set of systemic interactions, acting as a connective tissue, that characterizes a system as such and either keeps its elements together or puts them apart. The high number of component elements and the fact that they evolve with time imply that just a fraction of all possible interactions will be in place at any specific time. Which specific fraction is activated and how interactions are distributed among elements (i.e., the pattern of the structure) at a certain time determine the systemic properties of the system. According to network analysis, a system is represented by its *underlying network*, whose N nodes are the system elements and L connections their interactions. The probability distribution $P(k)$ of the variable node degree k_i (number of links of node *i*) determines the *general structure* of the network. $P(k)$ measures the probability that a node has exactly *k* connections. The *small world* character (average path length between two nodes randomly taken) provides an evaluation of the *connectivity* of the network and, therefore, of its sensitivity to shocks. The *clustering* character (nodes propensity to connect in groups, where the nodes belonging to a group are almost all bilaterally connected with each other) provides information about the local structure of the network. Based on the probability distribution of the node degree, it is possible to distinguish two main kinds of network structures with very different properties: the *random networks* and the *scale-free networks*. Assuming the nodes be indistinguishable, each of them will be indifferent between connecting to one partner node or another. Two nodes, taken randomly, will have the same probability to connect to each other as any other arbitrary pair of nodes. There will be no reason to expect that they have a very different number of connections, so that the stochastic variable node degree *k* will approximately follow a Poisson distribution with a small variance. An increase in the number *N* of nodes (network growth) may affect the mean node degree but not at all the network structure pattern. Given that *N* is very high and *k* relatively very small, no single node can affect the *k* distribution of probability and system equilibrium. A network showing these properties is a *random network*. Interactions are distributed randomly among nodes with a certain probability almost equal for all nodes. A random network is characterized by its *scale* (i.e. its mean node degree) and can be described in terms of node connections by a representative node having the mean node degree. A system represented through a random network is a random system whose elements, though having an incentive to interact with each other, do not show any specific auto-organizational principle endogenously generated. When connections cannot be considered statistically equiprobable, the network has biases and shows some level of stratification and clustering, so that individual nodes are not all alike: differences in their degrees *k* are not random any longer, distribution variance depends on node choice and choices are made based on some kind of preferences. A frequent form of structuring in a network is *clustering*. The distribution probability of a clustered network will have the same mean of a corresponding random network, but a larger variance. Random networks – clustered or non-clustered – are *local networks*. Structure at global level reproduces structure at local level, so that the properties of the network can be inferred through a random sample of connection data (inferential statistics). A random network is a good model of a perfect competition market. The *scale-free networks* – typical of many complex information networks – are not characterized by the scale of the variable node degree. The probability distribution of a scale-free network follows a power law and is heavily asymmetric, decreasing for increasing node degrees, with a long right tail. This means there are few nodes, the *hubs* of the network, with a very high number of connections in comparison to all other nodes. Given the big size of the network, the presence of the hubs is significant (low probability x high number of nodes) and shapes the properties of the network. Scale-free networks are *non-local*. From a random data sample properties cannot be inferred. The variance of a scale-free distribution is much higher than that of a random one with the same node degree mean (equivalent dimension). For increasing dimensions, the scale-free network variance tends to diverge from that of the equivalent random network. This means, in general, that inequalities in a scale-free network system increase as the system grows. The scale-free network is a model of an oligopolistic system/market. The *concept of small world* refers to large networks characterised by the property that two randomly selected nodes of the network are separated by a relatively short chain of bilateral connections. Both random and scale-free are small-world networks, though in scale-free networks, due to the hubs presence, this character is much more accentuated (what is important is the distance of a node from the closest hub). The small-world character describes the connectivity of the network, that is how easily information circulates but also how quickly a crisis (contagion) can spread. Empirical analysis and studies show that, *in the real world, large information system underlying networks are scale-free networks*. A random network becomes a scale-free when subject to the dynamics mechanisms of information systems. According to the *growth mechanism*, at any time unit a new node enters the network establishing a constant endowment of *m* connections with *m* nodes of the network. These latter are chosen based on the *mechanism of preferential attachment*: the preferred partner nodes are those with the highest numbers of connections in the network. Entrant connections are attracted with probabilities corresponding to the relative degree of nodes. Such dynamics generates the power law probability distribution of the node degree that characterizes scale-free networks. A small number of giant nodes (the hubs), each with very many connections, ends up dominating the network. Random and scale-free networks have different capacity to resist to endogenous and exogenous shocks (crises) and keep their fundamental properties working (stability: continued network connection of component nodes). If shocks are assumed to strike randomly the nodes, then, since each nodes contributes almost equally to connectivity, random networks are characterized by a threshold of inactivated nodes, beyond which the network collapses. In case of a random selection of the stricken nodes, scale-free networks are more robust, since connectivity is guaranteed by few hubs and the probability that one hub is stricken is very low. However, since shocks do not always hit randomly, as real world system crises often show, and tend to concentrate where some risk factors are more pronounced (the case of speculation in financial system is an example), the scale-free topology makes networks much more sensible to crises: if the shock hits a hub –and the probability that this happen is empirically much higher than that for a regular node– in most cases the network will collapse and lose its connectivity (too-big-to-fail situation). By representing a simple system of financial firms, which exchange assets and liabilities, through its underlying random network, the flow of counterparty risk along a chain of bilateral connections can be traced. If the size of the firms is limited and their number large, the primary condition for free market competition will hold and the market will hardly become biased. Systemic risk will reduce to the sum of counterparty risks. As firms decide to hedge, risk concentrates on the firms selling derivatives, which become potential vulnerabilities of the system. However, if derivatives are traded through a regulated venue (ETDs) and, hence, priced through a transparent market, no significant distortion is introduced. Financial instability tends to reduce, while the underlying network remains a random one. If OTCDs are traded, the market will no longer be a perfect competition one. However, since financial firms are numerous and have modest dimensions, they can still be assimilated to any other financial firm in the market. This situation represents the *scenario of a nascent OTCD market* within a financial system. The system underlying network is a random network with all its properties. The node degree (number of trades per firm) is low and almost the same (the mean node degree) for all firms. Systemic risk remains confined to the sum of counterparty risks –mitigated by the presence of the assets competitive market– apart from externally generated expectations. The system underlying random network will collapse only if a number of firms larger than a high critical threshold defaults. As the financial system grows, its underlying network tends to become a scale-free network. Firms selling derivatives products progressively find out, thanks to knowledge and experience they have acquired on the market, that they can exploit large and apparently easy economies of scale, as they increase their volume of business. The more derivatives they sell, the more advantageous conditions they can offer to buyers, the comparatively less onerous become the margins (own capital) they must keep for covering against risk. Their incentive to grow will turn stronger and stronger. The most competitive of these firms will absorb or throw out of the market the others. After a while, few of them will become the hubs of the OTCDs market. This transition leads to the *scenario of a mature OTCDs market*. The underlying network of the financial system takes now the topology of a scale-free network. The hubs dominate the OTCDs sector. There is no competitive market for these products (no anonymity and poor transparency). Hubs have incentives to select and bias information to feed their business and, in doing so, they increase over and over their market power, not only becoming concentrations of large amounts of the financial system counterparty risk, but also becoming a primary source of endogenous bias of derivatives prices and therefore of systemic risk. As network theory and the experience of real-world crises amply show, it will suffice that just one or two of these hubs default to make the whole financial system and consequently the economic system to collapse. This actual possibility leads directly to the syndrome commonly known as too-big-to-fail, furtherly increasing the level of moral hazard for the hubs and therefore of the amount of systemic risk in the financial system. Speculation furtherly increases the level of systemic risk. If a financial hub makes a bet on the direction of the price fluctuation of an underlying asset issued by a counterparty, the whole amount of the hub's very many trades will be orientated in its bet direction. This will sensibly affect the asset price and its related derivatives in that same direction of the bet as well as the risk attached to the issuing firm, thus strongly biasing the market. This is quite different from a free market assessment, a balanced result of very many bets, maybe of an equivalent volume, but made by independent entities, each pursuing its own interest and hence not necessarily all pointing in the same direction and with identical intensities. In an *EMIR OTC market scenario*, hubs are subject to clearing and have become CMs of the CCP. All trades that were previously bilateral through the hubs with single parties must now be made by CMs through the CCP. The great advantage is that the market function and power are entrusted to the CCP, which has no own interest in the course of prices and can keep under check systemic risk linked to CMs, by appropriate mitigation measures. TRs guarantee necessary transparency of OTC markets by collecting and sharing all data related to trades. The level of moral hazard associated to the hubs (now CMs) and the amount of systemic risk in the system are minimised. Since networks can be mathematically represented through matrices and these allow for quantitative methodologies, network analysis permits calculations of CCPs and CMs financial requirements. Markose (2017) shows an introduction to this kind of application.

In conclusion, systemic risk is a typical situation of market failure where public authorities must intervene in the common interest. Thus, economic doctrine justifies in principle EMIR adoption, though it remains to be seen whether the type and measure of specific rules impose excessive limitation or distortion on market competition. On these grounds, perfectly in line with the stated EMIR aim, financial stability can be defined as the system's capability to reduce and control systemic risk. From the analysis, it seems evident that key provisions of EMIR are those related to the institution of CCPs and TRs. While in a random network financial system there exists a threshold of capitalization below which the system may collapse, the stability of scale-free network financial systems depends solely on CCPs. Therefore, measures to protect the CCPs are absolutely the most important ones. If they default, the system defaults. Despite their robustness, CCPs will not work properly if they cannot rely on complete and reliable information on the OTCDs. So, the supporting functions of TRs are also crucial to ensure an acceptable low level of systemic risk. Finally, the connections and interoperability requirement for different CCPs and TRs are also of great importance in consideration of the global character of the financial system.

***Chapter 6*. <u>Distributed Ledgers Technology (DLT) and financial markets</u>**

Distributed Ledgers Technologies (DLTs) provide users with storage and accessibility of data on a set of assets and their owners in a common database of either trades or account balances (Pinna and

Wiener, 2016), which is disclosed and disseminated among network participants and could be used for the settlement of their trades (e.g. securities and cash), without the need for legitimacy authentication by a central authority. Trade data is protected through *cryptography* and network participants execute trades through pseudonyms. A major feature of DLT is the *decentralised system*, which allows assets to be stored in a network of computers (nodes), being accessible only through the Internet (Pon, 2016). A new trade can be accepted only if there is *consensus* across all nodes, each having to approve it. If validated, it becomes accessible to everyone in the ledger and is integrated in all the nodes' databases. The increasing interest in DLTs has several reasons. (1) the DLT is *reliable*. By giving all participants a share of control of the entire network, the DLT becomes less centralised while at the same time being more secure. In fact, if one of the nodes is subject to an attack or is damaged, all other nodes will still be active, avoiding to lose valuable data. (2) *transparency*. DLT's trade data is available to all participants, thereby ensuring transparency. (3) *convenience*. Executing trades through a DLT is convenient for all participants, since there are fewer intermediaries involved (with respect to traditional trades). (4) *solidity*. Data already stored in the DLT cannot be altered. Therefore, data recorded is more solid and reliable, as it stays unchanged from the moment it is registered (*immutability)*. (5) *irrevocability*. Through the DLT it is possible to realise irrevocable trades. As such, trades are granted to be final, without any possibility to be cancelled. (6) *digitalisation*: with the DLT, the network becomes virtual. Currently, DLTs are applied to crypto-currencies. In the field of trading and post-trading of securities, DLTs are still under development.

The implementation of DLT on post-trading in securities markets could have several benefits. (1) *speed of execution*, making clearing and settlement of trades almost instantaneous (ESMA, 2017). A shorter trading cycle could also result in *collateral savings*, by requiring lower margins and freeing capital faster. Also, counterparty risk could be mitigated, by reducing the timespan in which an entity is exposed to default risk of another party. (2) through a unique common database, data recording on trades would be eased and the automatic update of the records could save expenses. (3) through *smart contracts*, the processing of trades could become automated. (4) *Tracking of securities ownership* would be eased if securities were issued directly in the ledger (ECB, 2016). (5) DLTs could *assist SMEs to have access to funding*: issuing stock directly on the DLT would give access to a larger pool of investors and possibly extend funding opportunities. (7) DLT could make it easier to collect, consolidate and distribute data, that could be used by authorities in their reporting, supervisory and risk management mandates (e.g. systemic risk in OTC derivatives markets), improving *regulatory reporting*. (8) There would be higher security due to encryption and consensus to authenticate trades. The ECB adds that a DLT would be *24/7 processing* all trades, harmonising financial markets.

However, DLTs display some key issues and possible risks. ESMA points to *operational risks* relating to (i) scalability of DLTs: what has been implemented for specific activities could be very complex to be translated at a macro-level comprising several classes of securities and many participants and (ii) interoperability with existing processes (such as CCPs and TRs) and across different networks (distinct databases for different securities' classes). Pinna et al. (2016) argue that DLT application in securities post-trade must deal with the same problems concerning the current framework, i.e. *harmonisation* of technical standards and business rules (*governance issues*). There are also some *privacy issues*. DLTs allow for public access to data stored in the ledgers. ESMA argues that there is the need to balance public disclosure of data with anonymity of the network participants. In theory, DLTs should increase trade traceability and transparency in financial markets. In practice, the difficulty of cryptography could increase the system's complexity. Moreover, moving to a new process always entails risks. ESMA stresses that, although DLTs enhance security, a cyber-attack could gather private sensible data, damaging the whole network. Also, DLTs generally implement similar protocols. Hence, attacks to one network could threaten many other networks.

Securities' market is very complex, as it generates a strong interconnectedness among many market participants and needs many technical and legal provisions. A security's trade goes through multiple stages before it is completed (issuance, trading and post-trading), requiring many intermediaries. DLTs could represent tools for issuing and transferring securities and clearing, settlement and depository services would no longer be needed, fostering disintermediation.

Today, buyers and sellers guide their brokers on the trade to conduct. Their orders are sent to a trading venue for matching and execution. Data is then reported to a CCP that reconciles orders, possibly netting them out to reduce the outstanding exposures of its CMs. CMs tell their brokers the duties they must comply with who then give directions to their settlement agents. The seller's custodian moves securities to the settlement agent of the seller's broker, who credits them to the CCP, which gives guidance to the buyer's settlement agent to move them to the buyer's custodian.

Possible impact on settlement layer. Reliability claims securities face over the underlying assets is crucial to allow both financing in the primary market and hedging in secondary markets. Hence, it would be impractical to introduce settlement between issuing parties and end-users trading in a DLT. Overall, intermediaries' intervention is needed, regardless of the technology applied. If such tasks were delegated to the nodes, issues of confidentiality would arise, as network parties want to keep some data private, including trading strategies. Also, as trade settlement involves security and cash legs (*delivery-vs-payment*), DLTs could work for the transfer of securities, but it is likely that sellers would require real money rather than crypto-currencies. Hence, cash accounts would still be needed.

Possible impact on custody layer. A DLT allows to hold securities directly by end-users or through their intermediary. Also, smart contracts can guarantee automatic execution of trades, by carrying out several tasks, including collecting income from the issuer's cash account to credit automatically calculated dividends/coupons on stakeholders' accounts, splitting or redeeming stocks and overall, any crediting or debiting of accounts in the ledger that is performed following instructions generated from an event that can be authenticated either in the ledger or via a reliable off-ledger entity. When the ledger has been planned to conduct the tasks just mentioned, there are not many more roles remaining to the custodians' chain. Today, identifying end-users and issuers and managing accessibility degree to the ledger are the two remaining operations still requiring human intervention.

Possible impact on clearing layer. When trading platforms are linked to DLTs, end-investors can post orders on the trading venue or OTC, after verifying the securities' disposability in seller's books and cash in buyer's books. The instruments to achieve instantaneous settlements have already been applied to the current traditional processes, but it would not be possible to apply them on a global scale for the colossal volume of trades in financial markets, with business mechanisms and databases staying unchanged. If the DLT has some latency, or the trade concerns OTCDs (not instantaneous), clearing would still be needed for hedging risk until securities and cash are exchanged irrevocably (Platt, 2016). Smart contracts could automatically net out trades and in the event in which collateral management procedures are linked to the DLT, also margin calls. Overall, the effect of DLTs on CCPs is dependent on the level of applied technology, the extent to which authorised entities delegate the clearing function to smart contracts and the type of securities traded on the DLT. However, there are major CCPs' tasks that cannot be replaced (Pirrong, 2016): DLTs neither provide for loss mutualisation nor for defaulted positions, which are two of the main features of a CCP. Overall, DLT do not perform all the tasks carried out by a CCP, especially when dealing with OTCDs.

Pinna et al. (2016) present possible applications of DLTs: (1) *incumbent institutions implement DLT to enhance internal efficiency*. Despite improving internal efficiency, it would be unlikely to link distinct FMIs and market parties to a faster and more interoperable settlement system. The only progress would be the way in which securities change ownership (almost instantaneously). (2) *Core market participants implement market-wide DLTs*. If the post-trade industry moved to a DLT, there would be automatic update of securities' accounts and some layers of the industry could become redundant due to smart contracts, i.e. the settlement would occur in the DLT, data recording would be automatic and almost in real time, entities would be able to track every trade and the application of such contracts could cause custodians and CCPs' functions to become repetitive. Also, for securities traded in OTC markets, the application of market-wide DLTs would enhance transparency. (3) *Issuing and fintech firms and governments govern the application of DLTs for securities trades*. In the extreme event capital markets migrate to a DLT, the whole chain of intermediaries would become redundant: today's post-trade mechanism would be discarded by automatic clearing and settlement systems. However, *know-your-customer* and *Anti-Money Laundering* rules are the main barrier to the achievement of this new revolutionary post-trading framework.

Overall, DLTs will have to be subject to and comply with the regulatory and legal framework in which they are willing to be implemented. This is a characteristic difficulty of DLTs, which would have to perform their functions internationally to achieve their optimal application. Despite pieces of legislation are becoming increasingly harmonised across the Member States of the European Union, currently there is no single regulatory framework for all the EU jurisdictions and, also, there is no general framework for DLTs.

Conclusions

The 2008 financial crisis showed the functional weaknesses that characterised the OTCD market. Since the OTCD market is global in nature, the G20 decided to cooperate and commit to address the weaknesses of such market and to increase financial stability, improve transparency in the derivatives market, mitigate counterparty and systemic risk and protect against market abuse. In the 2009 Pittsburgh Summit, the international leaders conceived five commitments to reform the OTCD market: (i) standardised OTCDs should be cleared through CCPs; (ii) non-cleared derivatives should be subject to higher capital requirements; (iii) non-cleared derivatives should be subject to minimum standards for margin requirements; (iv) OTC derivatives trade information should be reported to TRs and (v) standardised OTCDs should be traded on exchanges or electronic trading platforms. EMIR represents regulators' main tool to achieve these objectives. As of 2017, central clearing frameworks have been, or are being, implemented; interim higher capital requirements for non-centrally cleared derivatives are mostly in force; margin requirements for non-cleared derivatives have begun to be implemented; comprehensive trade reporting requirements for OTCDs are mostly in force; and platform trading frameworks are relatively undeveloped in most jurisdictions. Greater CCPs clearing is a crucial aspect of the reforms that is helping to mitigate systemic risk (which generates from the size of its CMs). Also, increasing the use of CCPs is starting to lower counterparty credit risks in the financial system by substituting complex and opaque networks between counterparties trading in OTC markets with lit and transparent connections between CCPs and the associated CMs. Counterparty and systemic risk mitigation (and hence, financial stability) is achieved through the main activities performed by and the structure of CCPs, namely (i) risk management (ii) promoting liquidity, (iii) enhancing transparency and (iv) reducing costs. Despite their robustness, CCPs will not work properly if they cannot rely on complete and reliable data on the OTCDs. So, TRs' supporting functions are also essential to establish an acceptable low level of systemic risk. Moreover, the central role of a CCP in financial markets and its interconnectedness with other market participants are the main determinants of its systemic importance. The higher the degree of interconnectedness, the greater the impact of a CCP's actions on market participants. In this setting, CCPs' activities could have strong negative externalities or their default could have a domino effect in the financial system. Also, the presence of a CCP clearing individual positions, despite averting the domino effect caused by the default of a single CM, could discourage counterparty reliability monitoring. Becoming the buyer to every seller and the seller to every buyer makes it impossible to make a distinction among the counterparties based on solvency margins. As a result, there is a significant increase in information asymmetry in cleared markets compared to bilaterally-cleared markets, where the FC is more motivated to assess counterparty risk and CCPs are assigned derivative contracts that are riskier to clear bilaterally. Hence, it is crucial that the CCP manages its CMs also from a solvency perspective, evaluating the contracts on a case-by-case basis and not only based on standards.

Introducing to the network analysis of systemic risk in OTCDs markets, Acharya (2016) models systemic risk as an effect of undercapitalization of banks and, hence, of the financial system, affecting the real economy as a negative externality. He shows there exists an empirically measurable critical threshold for the system aggregate capital, below which, at any relevant shock, systemic risk would erupt into a systemic crisis. However, they do not explain why a bank should be feeding systemic risk if it optimizes its position based on market prices. A possible answer is that market prices do not fully reflect risk. Actually, the market "invisible hand" may fail and wrongly estimate risk and consequent prices. The market response is the result of the combination of many *independent* assessments made by firms of the system through the demand/supply process. Should firms' assessments be biased (orientated in the same direction), due to some endogenous or exogenous factor, market prices would be incorrect. The more diverging from (reasonable) economic values are prices, the higher the level of systemic risk, the heavier the impact of a possible systemic crisis on the financial and economic systems. Too high or too low market prices resulting from biased decisions create, in turn, the incentive to freely ride the system and so to furtherly feed price, moral hazard and systemic risk anomalous trends. Systemic risk can thus be interpreted as a potential negative externality cumulated in the system that, subject to an unexpected event, may erupt into a crisis, causing the disruption and eventually the collapse of the system, through multiplicative "domino effects", due to financial contagion propagating through interconnectedness. Derivatives, and especially OTC ones which are not dealt with within a regulated market, can play a relevant role in price biasing. Actually a very critical one, since they are expected to hedge against risks and, even more, because they are often tools of financial speculation. In case of market bias, instead of reallocating risk among market parties, OTCDs may thus strongly amplify wrong price trends and systemic risk. Abad et al. (2016) state that OTCDs market is opaque and involves large volumes of trades and has a very complex structure. The large majority of trades is concentrated in a little number of financial entities, which become the very vulnerabilities of the system in terms of systemic risk. For all the three largest OTCDs sectors the trade distribution is right-skewed and hence strongly asymmetric. This pattern indicates a highly concentrated structure. Such characteristic trade distribution shows that mature OTCDs markets and, more generally, financial systems can be represented by scale-free networks. Actually, according to network analysis, a system is represented by its *underlying network*, whose nodes are the system elements and connections their interactions. The probability distribution of the variable node degree, the small world character, and the clustering character describe the structure of the network and its connectivity properties (sensitivity to shocks). Accordingly, it is possible to distinguish *random networks* from *scale-free networks*, exemplifying respectively systems based on perfect competition markets and systems based on oligopolistic markets. A system represented through a random network is a random system whose elements, though having an incentive to interact with each other, do not show any specific auto-organizational principle. When connections cannot be considered statistically equiprobable, the network has biases and shows some level of stratification, clustering and concentration, so that individual nodes are not any longer all alike. *Scale-free networks* (typical of complex information systems) are characterized by a power law node degree probability distribution, heavily asymmetric, decreasing for increasing node degrees, with a long right tail. This means there are few *hubs* (giant nodes) of the network, with a very high number of connections in comparison to all other nodes, which shape the properties of the network. A process of growth led by the mechanism of *preferential attachment* (entrant nodes connect to existing ones based on their relative degree) inevitably transforms a random network – a nascent OTCD market – into a scale-free network – a mature OTCD market. Hubs have incentives to select and bias information to feed their business and, in doing so, they increase over and over their market power, not only becoming concentrations of large amounts of the financial system counterparty risk, but also becoming a primary source of endogenous bias of prices and hence of systemic risk. While a random network system will collapse only if many firms larger than a high critical threshold defaults, in scale-free network system it will suffice that just one or two hubs default to make the whole financial system and consequently the economic system to collapse. This actual possibility leads directly to the syndrome commonly known as too-big-to-fail, furtherly increasing the level of moral hazard for the hubs and hence of the amount of systemic risk in the financial system. Speculation furtherly increases the level of systemic risk. In a scale-free network system *EMIR OTCDs market scenario*, hubs are subject to CCPs clearing and have become CMs of

CCPs. Moral hazard associated to the hubs (now CMs) is minimized, while systemic risk is concentrated in the CCPs. Since networks can be mathematically represented through matrices and these allow for quantitative methodologies, network analysis permits calculations of the financial requirements for CCPs and CMs. Markose (2017) illustrate an introduction to this kind of application. In conclusion, systemic risk is a typical situation of market failure where public authorities must intervene in the common interest. Thus, economic doctrine justifies in principle EMIR adoption. While in a random network financial system there exists a threshold of capitalization below which the system may collapse, the stability of scale-free network financial systems depends solely on CCPs. Therefore, measures to protect the CCPs are absolutely the most important ones.

DLT represents potentially revolutionary tools that could lead to partial or total disintermediation of securities markets in the post-trading landscape, depending on its degree of implementation. By providing faster, more reliable, transparent, convenient, secure and solid trading platforms, clearing and settlement activities may become redundant. However, there are some major drawbacks linked to DLTs. ESMA points to *operational risks* relating to scalability and interoperability with existing processes and across different networks. Also, there is the need to balance public disclosure with anonymity of network participants and although DLTs enhance security, cyber-attacks could gather private sensible data, damaging the whole network and since DLTs implement similar protocols, attacks to one network may threaten many other networks. Also, as trade settlement involves security and cash legs, DLTs could work for the transfer of securities, but it is likely that sellers would still require real money rather than crypto-currencies. Hence, cash accounts would still be needed. Also, it is highly improbable that central banks will recognize cryptocurrencies as common currencies.

In general, the effect of DLTs on CCPs is dependent on the level of applied technology, the extent to which authorised entities delegate the clearing function to smart contracts and the type of securities traded on the DLT. However, there are major CCPs’ tasks that cannot be replaced: DLTs do not provide for loss mutualisation and do not control for defaulted positions, which are two of the main features of a CCP. Overall, DLTs do not perform all the tasks carried out by a CCP, especially when dealing with OTCDs.