
Decentralized Clearing? An Assessment of the impact of DLTs on CCPs - EACH Forum paper

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Abstract

Recent years have witnessed noticeable expansion of new technologies related to the distributed ledger technology (DLT) and blockchain networks in financial markets. As developments unfold, the key question that emerges is whether these technologies would work to foster traditional services or, conversely, would challenge their existence. Similar reflections exist for specific parts of the financial system. In particular for central counterparties (CCPs), proof-of-concepts and theoretical exercises have been conducted aiming at responding to such questions. While empirical experiences are yet to mature, theoretical exercises have suggested impact to CCPs could be substantial, if not detrimental. The objective of the paper is to contribute to the literature and investigate the impact of DLTs on CCPs. Different than previous exercises, the paper resorts to the economic theory on financial service intermediation to substantiate the assessment. Using functional analysis and good type categorization, the main conclusion of the paper is that under the current offering it seems challenging to foresee a scenario where any of the main services provided by a CCP would disappear or become fully disintermediated. The supporting argumentation is that the core functions of a CCP orbit around risk management, provided either as private or club type of good. To this moment new technologies do not seem able to change the nature of these services and, therefore, render fundamental changes to CCPs less likely.

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1 - Introduction

In recent years financial markets have witnessed the birth, development and expansion of new technologies related to the blockchain network and distributed ledger technology (DLT). These developments have quickly caught the attention of many in financial markets as a potential mechanism to streamline processes and deliver cost reductions, with many having written on the topic.

The literature on DLT is also growing fast for financial market infrastructures (FMI) and central counterparties (CCPs). Initial accounts from proof-of-concepts are being made public, although definitive conclusions are yet to be seen (see Appendix I for a non-exhaustive list). From a more theoretical perspective, reviews and table-top exercises have been executed aiming at forecasting the potential impact of the new technologies. Some studies have claimed that the trade life cycle could be simplified, with reduced costs due to substitution of the manual reconciliation as a natural consequence (see Bheemaiah 2017; Euroclear, Slaughter and May 2016; ESMA 2020). Others went one step further and have suggested that, with trading and clearing becoming more intertwined, it is not clear whether CCPs and CSDs would still be needed (Euroclear and Oliver Wyman 2016). All factors considered, it could well be that the most likely scenario is one of embracing the new technology by the traditional sector, as some DLT providers have suggested (see R3 2017).

The objective of this paper is to contribute to this debate and assess the potential impact of these new technologies to CCPs. The focus is on disintermediation. To the knowledge of the authors there has not been a paper about new technologies solely dedicated to CCPs. Typically, the literature bundles CCPs together with other FMIs, without isolating the nature of the services provided by a CCP. Moreover, limited theoretical background is utilized on these analyses, with the specific focus being on the description of yet-to-mature experiences observed in the markets or the development of hypothetical scenarios simulating the application of DLT features to CCPs. Restricted consideration is given to incentives, costs, market structure, etc. as key elements to support the change from the CCP's perspective.

To analyze the impact of the new technologies in CCPs, the economic theory based on functional approach is used. The theory, which has its roots in the late 1990s as a complement to the New Institutional Economics and Economic Behavior Theory, aims at explaining the existence of financial intermediaries. The main idea is that, due to frictions in the financial markets, there are some functions that are better performed by intermediaries as opposed to end consumers. This approach is extended to the main CCP functions, where incentives for provision and the nature of each service are reviewed against the recent DLT developments.

The main conclusion of the paper is that under the current CCP offering it seems challenging to foresee a scenario where any of the main services provided by a CCP would disappear or become fully disintermediated. The conclusion is not entirely at the odds with an emerging part of the

literature² or some of the more recent developments related to the use of DLT technology³. The core functions of a CCP orbit around risk management, provided either as a private or club type of good. Organized as such, market incentives exist for CCPs to centralize their offering. CCPs enable counterparties to transfer risks, such as credit risk, liquidity risk and counterparty credit risk. The nature and type of those functions are not substantially impacted by the new technologies, i.e. they are limited to a point that is far from leading to their oblivion.

The above argumentation falls short of saying that the new technologies can and will not be used by CCPs. For particular securities markets, where settlement cycle may be substantially reduced and the future value of contract can be determined entirely by current market prices, the role of CCPs may be transformed⁴. Similarly, collateral and treasury functions performed by CCPs could be enhanced with streamlined updates to databases and automated reconciliation processes being enabled by the new technologies. However, deferred settlement creates credit risk, and derivatives contracts cannot be disassociated from counterparty credit risk.⁵ Therefore, while efficient allocation of risks is a demand from counterparties, the CCPs' vital role will remain.

2 - Market frictions and financial intermediation

2.1 - A digression on risk, consensus and trust

In the traditional Arrow-Debreu model of resource allocation, where markets are perfect, complete and frictionless, firms and households would interact through markets and financial intermediaries would play no role (see Allen et al 1998). To accommodate the fact that such conclusions are at the odds with empirical evidence, intermediation theory introduces the idea of transaction costs and asymmetric information.⁶ Transaction costs would imply that intermediaries have an advantage when compared to single individuals, as they can share and diversify risks more efficiently. Similarly, intermediaries would overcome asymmetric information due to better capacity to monitor markets and counterparties. See early propositions in Diamond (1984). In summary, intermediaries arise within financial systems as an endogenous response to market frictions.

² The European Commission (2020) states that “[...] after early promises of muscled revolutions in a multitude of sectors, DLTs have not fully delivered what was frequently forecasted and announced. In this, they are not as unique or disruptive, considering the pace and adoption of other emerging technologies, as some of its most devoted supporters preach” (page 7). See also a number of other references quoted in the study.

³ Accenture (2022) reports on the challenges leading to the ASX's cancellation of the years-long blockchain settlement and clearing system project. In particular, issues with the latency and concurrency in the use of the Daml ledger are highlighted.

⁴ German Banking Industry Committee (2016), Priem (2020), and ISSA (2022) argue that DLT and legacy system would still coexist in the future, i.e. at least for the next 20 to 30 years.

⁵ Deferred settlement also alter the way liquidity risk is managed. While it alleviates liquidity pressures on counterparties, it does engender greater responsibility at the CCP level, almost as if a core part of the liquidity management were transferred from counterparties to the CCP.

⁶ Transaction costs has its foundation on the New Institutional Economics and asymmetric information on Behaviour Economics. See respectively Williamson (1998) and Barbaris and Thaler (2003) for early accounts of the literature.

Fast forwarding a few years, the development of the blockchain technology in late 2000 has reopened the debate on the role of financial intermediaries. According to Yaga et al (2018), the core idea behind blockchain emerged in late 1980s and early 1990, under a proposal of a consensus model for reaching agreement on a result in a network of computers where the computers or network itself may be unreliable. After 2000, the blockchain concept starts to be applied to electronic cash, giving rise to the Bitcoin (see Nakamoto 2008). Even though electronic cash existed before, it was the trust on the technological framework, i.e. the fact that no single user controlled the network and no single point of failure existed, that promoted the use and proliferation of Bitcoin.

More specifically, the blockchain network enabled trust to be built amongst counterparties, even though these had no prior relationship to one another. Firstly, the use of ledger permitted that the full history of a state or result of the network (i.e. a transaction in the electronic cash dimension) to be stored. Secondly, the cryptographical element in the network helped to ensure that network cannot be inadvertently modified. Third, being network shared across all participants, the blockchain or network result would be distributed to all users without no additional costs. Lastly, the automated mechanism of payment to miners (i.e. network contributors) enabled an endogenous administration of the network, without the need for a centralized governance.

While the blockchain network created the means for counterparties to interact, financial services are structured around contracts that go way beyond the simple electronic cash movement. Therefore, it was the development of smart contracts, i.e. contracts which governing clauses would be automated and programmed in the blockchain, that created the means for financial services to be provided within the network. Under such a configuration, the question of whether financial intermediaries were necessary was once again opened.

2.2 - The disintermediation push

Although a unique definition of decentralized finance (DeFi) might not exist at this moment in time, the concept broadly refers to technological frameworks that, when deployed fully, would enable the execution of financial services without the need for financial intermediaries (see Carter and Jeng 2021, or Meyer 2022 for a comprehensive account of the literature). To some extent, the blockchain network development around smart contracts, the use of permissionless solutions (i.e. open to the public), and trustless services (i.e. not requiring the provision by an intermediary) seems to tackle the frictions that the economic theory enumerated to justify the existence of financial intermediaries. The additional marginal costs related to asymmetric information and fixed transactional costs appears to be significantly reduced under the blockchain solutions.

There is little doubt that innovation has been a central force driving financial systems toward greater economic efficiency.⁷ However, it is a different question whether these innovations are able to render the role of financial intermediaries void, i.e. in the sense that equilibrium prices and the allocation of resources are unaffected by specific organizational structures. To try to assess the above question, this paper focuses on financial market infrastructures, particularly on central counterparties and how the functions they provide as financial intermediaries coexist with the new technologies.

Even though the evolution of blockchain technology to this date might be marked by episodes of success and failure, it is notable that after 2014/2015 the use of blockchains starts to expand its range of application, from its origins on electronic cash to a number of different services provided by the traditional financial intermediaries.⁸ Due to their outreach and systemic importance, financial market infrastructures, or post-trading intermediation, is one area that has gained relevant attention (see ESMA 2017). It has been proposed that post-trading is a fertile area for the new technologies as inefficiencies in the current offering of services would abound (see Priem 2020).

While a full operationalization of DLTs into the post-trade environment is yet to be realized, early literature has suggested that the impact and transformation push would exist in all 4 categories of post-trading services, i.e. notary, custody, clearing, and settlement.⁹ One initial proposition was that trading and post-trading would all get merged into a single cycle (see Peters and Panayi 2015; Malinova and Park 2017; Platt 2017; European Commission 2020). Under instantaneous liquidation in the DLT, trading, clearing and settlement would be combined into a single step. In a more specific perspective, it has been suggested that record-keeping of asset/contract ownership could also be managed in the DLT, refreshed to participants of the network in real-time. All in all, DLTs would enhance netting effects and, in the case of security markets, the certainty around the availability of assets (see ECB 2016).

To accommodate these distinct perspectives on the potential effects of DLT, disintermediation could be broadly classified into two categories as described in the following. For the purposes of this paper, the analysis will reside mainly on the first one, i.e. the CCP.

⁷ As presented in Demirgüç-Kunt et al (2017), financial services can help drive development, in particular when these services facilitate financial inclusion. Moreover, even though digital technology alone is not enough to increase financial inclusion, the technology does potentialize it.

⁸ During this rapid evolutionary process the blockchain technology gets also rebranded to distributed ledger technology (DLTs) probably reflecting, to some extent, the scope expansion. The terms 'blockchain' and 'distributed ledger' are often used interchangeably by business practitioners and scholars. Blockchain technology can be described as the process of adding blocks of cryptographically signed data yielding immutable records, while distributed ledgers are databases where several users collaborate to reach a consensus on the correct state of the data. Not all distributed ledgers use blocks, while most blockchains use a consensus mechanism (see Euroclear and Oliver Wyman 2016).

⁹ The concept of clearing in this section is being used loosely. See Section 4 for a precise characterization.

- **Disintermediation of the CCP or some of its features in their current form:** In this case, the CCP or part of its functions as they stand today may be made redundant.¹⁰ A partial disintermediation of a CCP could occur in case the CCP clears different asset classes some of which require longer-term risk management functions, such as derivatives. These need to be risk-managed during the duration of the contract, which can last up to some months or years.
- **Disintermediation of other elements of the CCP clearing ecosystem:** In this case, some actors in the CCP clearing ecosystem other than the CCP itself are disintermediated. For instance, the CCP could clear products for retail participants based on a non-intermediated model (i.e. clear derivative products without involving intermediaries).^{11 12}

3 - Functional approach and public goods: the assessment framework

To assess the potential impact of DLTs on central counterparties the functional approach, as developed by Merton and Bodie (1995), is considered. The authors added to the financial intermediation literature proposing that market frictions would create intrinsic functions in the financial markets that are best performed by intermediaries.¹³ More specifically, this set of functions would exist as “anchors” or “givens” of such systems, and any potential changes would be explained from that theoretical framework. Under the notion of economic equilibrium, prices equal marginal costs. In perfect functioning markets marginal costs tend to zero as quantities increase and, therefore, these anchor functions can be easily performed by any economic agent. However, when frictions exist, convergence does not occur, and incentives for intermediaries to benefit from this source of revenue would be in place. See Merton and Bodie (2004) for further details.

Amongst these, one core function is risk management. The idea is that the value added of intermediaries resides in allowing risk to be allocated efficiently at minimum cost. In more explicit terms, intermediaries are dedicated economic agents and, as such, are able to minimize the effects of market frictions. In full operation, these agents face much lower transaction costs (e.g. credit

¹⁰ A total disintermediation of a CCP could materialise if the CCP only clears assets that can be exchanged instantly and that do not require longer-term CCP risk management features. This could be the case for example in the event that an IT system is developed that allows ‘atomic settlement’, or instantaneous settlement by which the securities and cash leg of a transaction are exchanged instantly and simultaneously. This is what SDX is aiming for, where the typical Exchange-CCP-CSD/Custodian system could be replaced by an Exchange-Custodian system.

¹¹ FTX, an exchange operating in the crypto space, is one of these examples. Although following its bankruptcy in November 2022 the company withdrew its request (i.e. LedgerX LLC) to amend registration as a derivatives clearing organization with CFTC. See original details in <https://www.cftc.gov/PressRoom/PressReleases/8499-22>

¹² FIA (2022) argues that disintermediation of clearing members could lead to investors not benefitting from the clearing members’ high degree of prudential regulation such as capital requirements, audit or reporting.

¹³ According to Merton and Bodie (1995), the primary function of any financial system is to facilitate the allocation and deployment of economic resources. From this most aggregated level, one would be able to distinguish other basic functions performed by the financial system, such as risk management, clearing and settlement, amongst others.

quality, operational efficiencies, etc.), making them the ideal mechanism for shifting risks according to the appetite of counterparties. Individuals, while having high trading costs and subject to information asymmetries, would be less competitive in the risk allocation process.

The concept of non-perfect equilibrium can be coupled with the economic theory around the different types of goods.¹⁴ The nature of the good would affect the incentives of how, and by whom, the good would be provided. There are some goods for which the cost of the initial offering as a whole might be substantial and, once provided, the marginal cost of an additional unit tends very quickly to zero. This feature creates an inability to determine the value attributed by a consumer to each additional unit and, consequently, makes them hard to be priced. Put differently, any entity considering being a provider for this type of good is subject to a lost revenue. This is the case of public goods, which are defined as being non-rivalrous (i.e. the consumption by one individual does not reduce the ability of others to consume the good as well) and non-excludable (i.e. the access to the good is not limited to paying consumer only). See Table 1.

Due to their nature, public goods are typically offered by the public sector. However, exceptions might exist. In some instances, alternative mechanisms might be in place to protect at least part of the revenues (e.g. patent in the case of a software). There is also the possibility for the public good to be slightly modified in a manner that the value-added helps to ensure a stream of revenue to its provider (e.g. a tailored application of an open-source software), rendering it with the characteristics of a private or a club good. In other cases, the role of a centralizing party is simply inexistent, and organization around supply and demand is determined by the market (e.g. knowledge).

	Excludable Only paying participants can have access to the good.	Non-excludable Non-paying market participants can have access to the good.
Rivalrous Consumption by one consumer prevents simultaneous consumption by other consumers.	Private goods	Common-pool goods
Non-rivalrous Consumption by one consumer does not prevent simultaneous consumption by other consumers.	Club goods	Public goods

Table 1: Classification of goods

¹⁴ Please see Mankiw (2012) or other book on microeconomics for a discussion on types of goods.

The combination of the functional approach with the economic theory of goods provides a robust assessment framework of the potential impact of DLTs to central counterparties. On the one hand, traditional CCP services are non-rivalrous but exclusive, making them club goods.¹⁵ On the other hand, digital goods like open-source softwares or technological architectures (e.g. the world wide web) are typically deemed to be public goods (see Rayna 2008). As such, the nature of the good is a suitable proxy for the type of offering expected to a service. In particular, under the current assessment framework, CCP services would become fully disintermediated if the new technologies are able to either:

- render null all competitive advantages of CCPs when compared with self-provided services; or
- be able to change the nature of the service provided by the CCP to resemble a public good.

It is, however, important to note that the form of application of DLT to financial market infrastructures is not unique and is currently evolving. Therefore, in this review, it is also relevant to consider how the core defining principles of the early blockchain network will remain when the technology is transposed to the traditional financial services.

4 - Clearing, CCPs, and core functions

There are a number of papers describing the key functions performed by central counterparties. See Gregory (2014), and references therein, for a comprehensive discussion. However, few of them analyze these functions under the perspective of the type of good offered by central counterparties. Cerezetti et al (2019) perform this analysis, discussing how each type of good provides, and is provided, under a different set of incentives by the CCP.¹⁶ A functional analysis of central counterparties would reveal that the offering can be categorized on five main sets: 1) risk management; 2) interface with/for market participants; 3) default management; 4) trading counterparty; and 5) collateral and treasury management. Respectively, these functions would have predominantly a private good nature for category 1, a club good nature for categories 2 and 3, and a public good nature for categories 4 and 5. Below we review these functions in more details.

¹⁵ The non-rivalrous nature of traditional CCP services comes from the fact that, operationally, the marginal cost of clearing an additional trade is very low, and in cases where trades reduce risk in the cleared portfolio, the marginal cost could be negative.

¹⁶ Anecdotaly, it is noted that while central counterparties may help deliver financial stability, i.e. a “public good”, in most case those entities actually offer a “club good”, where only a limited set of member firms cooperate for the prosperity of the business.

4.1 - Risk management

It is not uncommon to observe the use of the words clearing and central counterparty interchangeably. While it is true that CCPs rely on clearing techniques to net and manage exposures to each one of the participants that operate in their markets, the obligation to ensure contract continuity in the event of a default is unique to CCPs. Therefore, to appropriately understand the importance of DLTs in the post-trade services, a differentiation of these two is necessary.

In general terms, clearing is the process of transmitting, reconciling and, in some cases, confirming transfer orders prior to settlement, potentially including the netting of orders and the establishment of final positions for settlement.¹⁷ The process typically starts when financial institutions send transfer messages to the network. These messages are then processed and communicated back to network participants and can, sometimes, include other related information for the participating financial institutions to correctly process the transfer instructions.

Conversely, and complementarily, CCPs are entities that interpose themselves between counterparties, becoming the buyer to every seller and the seller to every buyer. In doing so CCPs assume the legal responsibility for contract continuity, even when one of the parties does not perform as expected. To support this legal responsibility, CCPs develop extensive and comprehensive risk management frameworks, capable of identifying, monitoring, and mitigating potential threats.¹⁸ Amongst these, credit risk, liquidity risk, and counterparty credit risk are of fundamental importance.

The transition from clearing to CCPs, while a historical phenomenon (see Norman 2011 for an elegant description), has amongst its main foundations the need for market participants to better manage their risks. When operating under a CCP framework, market participants need to focus only on solvency of the CCP. Because the CCP becomes the solely counterparty, market participants have a reduced need to monitor and spend resources measuring the quality of other counterparties. The CCP, instead, performs and centralize the management of this risk.

Furthermore, CCPs facilitate netting of positions and cash flows, enabling settlement to be consolidated and performed via a deferred approach. Deferred settlement is typically associated with lower liquidity pressures on counterparties as needs are net and concentrated in one point in time. However, while likely making easier the liquidity risk management for each counterparty,

¹⁷ Please see <https://www.ecb.europa.eu/pub/pdf/other/glossaryrelatedtopaymentclearingandsettlementsystems.en.pdf>

¹⁸ In some instances, one could further differentiate CCPs and clearing houses, in the sense that while both guarantee the fulfilment of contract obligations, for the latter case the institution performs an agency function between the counterparties. For the purposes of this paper, these terms are being used interchangeably.

deferred settlement increases the requirements at the CCP level. Therefore, liquidity risk management becomes a key function to be performed by CCPs.¹⁹

Lastly is the management of counterparty credit risk. This process is intrinsically related to the advance of derivatives contracts. In a similar manner that deferring settlement in time creates credit risk, the potential future exposure of a derivatives contract generates counterparty credit risk. CCPs are able to streamline the risk management of these contracts not only due to the fact that netting of risk exposures exist, but also because the closeout of positions is similar to all contracts for non-performing members (i.e. netting of risk exposures is dependent, but also enforces, netting of payments during the closeout process).

Over history risk management became a fully marketable service and CCPs a good candidate for offering it. In fact, most CCPs nowadays operate as private enterprises with fees charged to pay for the costs of the service provision. Although with differences across entities, for the risks discussed above, CCPs centralize and assume responsibility for their management. In addition to regulatory incentives, presented later in the paper, there are other market-related aspects that favor the provision and centralization at CCPs. Complementarily to netting of exposures discussed previously, well-defined and integrated margining frameworks, mutualization of tail losses, legal jurisdiction based on private law as opposed to public law, and transparency are some of these features. Under such setting, risk management is viewed as a private good, with CCPs displaying competitive advantages when compared with other alternatives.

While it is prudent to argue that DLTs may help with a more efficient organization of some of these services, it seems that the private nature of the risk management is not passive of change with the introduction of the new technologies. To a large extent credit risk can be eliminated under the DLT, but at the expense increased liquidity needs, i.e. instantaneous settlement, and circumvented only to cash markets. For derivatives contracts and counterparty credit risk, it is not yet entirely clear how the introduction and development of DLTs can alter the need for risk managing the potential future exposure of derivatives contracts. There would need to exist in the DLT a mechanism responsible for calculating risk, issuing margin calls, and managing any asset received as part of the clearing process.

4.2 - Participant interface and default management

The second category of services provided by the CCP is that encompassing activities supporting, enabling, and maintaining central clearing by the member firms. These include, for instance, trade capture, trade compression, position management, reporting, amongst others. A key service

¹⁹ The trade-offs between deferred and gross settlement, or also called instantaneous settlement, is neither unique to the CCP space nor is a past debate. Payment systems and, in particular the systemically important ones, are a good example of such trade-offs. While it is true that most payment systems operated by central banks are based on gross settlement, it is also true that central banks offer liquidity support for participating entities to mitigate liquidity risks arising from the non-netting of positions.

within that set is default management, the focus of this section. For the purposes of the paper, default management represents all procedures implemented by a CCP to deal with the default of a clearing member. Typically, these procedures include identification of a non-performing member, notification to stakeholders, porting of client accounts, hedging and liquidation of the defaulter's portfolio.

Under the proposed assessment framework default management is viewed as a club good, in the sense that it is excludable, i.e. only members of the CCP are serviced when those procedures are executed. Nonetheless, it is non-rivalrous, implying that all members of the CCP benefit when the default management procedures are successfully implemented and concluded by the CCP.

More generally, either due to transaction costs or asymmetric information, it is important to note that club goods, or club services in the case of a CCP, are the creation of its members, where rules are set jointly. Membership to the club is voluntary and, once members have joined, they adhere to the club's rules of their own creation. Economies of scale and network externalities tend to drive the market structure to one or a few CCPs per asset class (see Padoa-Schioppa 2007), and participants choose to which of these clubs they will become members.

Specifically for the default management, when market participants decide to become clearing members, they are implicitly committing to support the CCP in liquidating the defaulter's portfolio (i.e. most CCP require nowadays clearing members to bid in the auction process). When other layers of the waterfall are considered, similar commitments from clearing members exist via, for instance, recovery tools such as variation margin gains haircutting or forced allocation. These obligations and structure of incentives, designed around the club nature of the CCP, are a strong competitive advantage of CCPs when compared with other alternatives for this service provision.

Anecdotally, in the recent past there have been several entities that started, or announced that they have plans to start, clearing crypto-related contracts. Typically, CCPs offering to clear these contracts rely on a direct clearing model, as opposed to the traditional model based on tiered participation. While the proposal represents a landmark in how the default management of a participant could be organized, the CCP itself still performs a central role in the design and execution of the default management procedures. Moreover, dependency on intermediaries to support the liquidation process when market becomes illiquid is also a key feature.

Based on the above rationale, the introduction of DLTs does not seem to be able to alter the characteristics and incentives of members to form the club. This is not to say that the technology cannot enhance the execution of default management procedures. Updating the position inventory of defaulting and non-defaulting members, for instance, could be done almost instantaneously as positions are liquidated under the use of a DLTs framework for record keeping. However, it seems challenging to imagine that these technological enhancements will change the club nature of the service and, consequently, eliminate the need for the CCP to be the key executor of each stage of the default management process.

4.3 - Clearing, collateral and treasury management

The third category of services provided by a CCP are those that, in the event of a failure, would impose systemic consequences to the market. This is the case of the clearing services, as described previously. The provision of this type of service has a number of implications not only to the CCP itself, but also to the market as a whole, ranging from operational features to legal provisions. Netting of positions and cash-flows, for instance, is enabled and executed by the clearing mechanisms. These reduce the amount of exposures to and from members and, consequently, affect the amount of risk borne by counterparties.

The two other services included in this category are collateral management and treasury. The former refers to all activities performed by the CCP in order to ensure that cash and non-cash collateral posted with the CCP have the appropriate custody, value adjustment for market events, and return to owner when requested. Complementarily, the treasury functions, sometimes called or combined with the banking services, encompass the activities related to the movement of money in and out of the CCP. This includes, payment/receipt of variation margin, investment of cash collateral, liquidity management, amongst others.

Because of the interlinkages under which CCPs operate, a failure on the provision of any of these services, if not appropriately managed, would destabilize markets. While CCPs do not normally carry market risk, for instance, following the default of a member the clearing book will become unbalanced and trades unmatched. In the event that the CCP is unable to deliver contract continuity and restore the matched book, the non-performance of the CCP to its members will most likely cascade to the market, triggering the non-performance of its counterparties. Similar systemic effects are to be observed when failures occur at the collateral or treasury management.

Even though the benefits of these services are directly consumed by each participating member (e.g. exposure reduction in the case of clearing), the range and size of the externalities generated in their provision can be large to the point that they would closely resemble those of a public good. Therefore, for the purposes of this paper, the natural question is whether such characteristics would enable the new DLT technology to alter the nature of such services, rendering them a true candidate for disintermediation. Put differently, is the new technology able to alter the structure of incentives in the market (i.e. CCP and other participants) such that these services are ripped off from the CCPs and begin to be provided via disintermediated mechanisms?

The general answer seems to be the same as that of the other functions of the CCP discussed previously (i.e. while the DLT technology may make the offering of the service more efficient, it seems challenging to picture a scenario where they are provided without the CCP or an intermediary). The main argument is that these functions orbit around the risk and default management provided by CCPs. As such, any disintermediation on clearing, collateral and treasury

functions needs to be accompanied by the disintermediation of the other core services provided by the CCP.

In particular, when clearing is conceived, disentangling it from the central counterparty role would go in the opposite direction of that observed in history. While complementary services may exist, e.g. compression, in the CCP space they are designed to facilitate the functioning of the central counterparty role, but not to replace it. A similar argument can be made for collateral management. Collateral management exists as a solely result of the central counterparty role performed by the CCP. One could argue that triparty collateral services have grown in the past decades in an allusion that it is already being removed from the CCP. However, even if the DLT enables that all collateral management be performed outside the CCP, it by no means imply that it would be without an intermediary or associated to the CCP's processes.

5. DLT network and its externalities

While the core functions of a CCP might be less susceptible to any type of disintermediation, as discussed above, there could exist other positive and negative externalities arising from the use of a DLT. Risk management factors analysed above aside, these externalities could relate to:

- **Efficiency** - By definition, a technology that aims, amongst others, to reduce friction in a multi-process system would have efficiency as a potential benefit. Investors and users could, for instance, benefit from an increase in the speed of transactions settlement. In particular, instruments with short-dated settlement, such as cash equities or FX could potentially be more impacted, and also see a higher risk of a diminished CCP role than others. Similarly, the novel clearing technologies could result in reduced costs in the short-term by a reduced need for the process of trade reconciliation and confirmation (see BIS 2020), as this would happen in an automated, immutable, transparent and near-immediate way (see OECD 2020). As a side-effect, the costs could however increase in case there is a need for public authorities to intervene if the disintermediated system is under threat.²⁰
- **Transparency** – A DLT system could increase transparency since all information will be seen by all participants via duplication in their ledgers (see Priem 2020). However, this transparency would need to address confidentiality and competition issues as all the users of a DLT network would be aware of all transactions (see ESMA 2017; Goldman Sachs 2016). While solutions are being considered (see Bheemaiah 2017), it should be considered what the impact of these solutions on the clearing environment would be, and whether a new decentralised environment that also includes those transparency-remedying measures may overall be more optimal than the current set up.

²⁰ <https://www.risk.net/risk-management/7949131/ftxs-easy-access-clearing-stokes-fears-over-runaway-risk>

- **Operational risk** - On the one hand, it could be argued that operational risk may be diminished because of the fewer number of intermediaries involved in a disintermediated system as well as the shorter timeframes that the process entails. On the other hand, the large multiplication of trades expected in a gross rather than net environment could make operational risk increase. In addition, a decentralised system where transactions are instantaneous would lead to the inability to rectify errors. A central institution to manage these risks would be adequate. Operational risk should also be considered as it would be the case today in case two decentralised operating system interoperate.
- **Legal risk** – Due to the investor and the nominee no longer needing to be separately recorded as beneficial owner and legal owner, legal risk would decrease. Legal risk would however increase during the transition phase due to the absence of settlement finality protection awarded to DLT systems or digital assets.

6 - Regulation and its effects

CCP specific factors considered, whether and how DLTs may be integrated into central counterparty clearing, or even potentially replace them, is also dependent on the current and forthcoming regulatory landscape. Since the seminal publication by Stigler (1971) on the theory of economic regulation, much has been written about the incentives and barriers brought by different legal regimes. There is not much debate, however, around the fact that regulation, in the form of taxes and subsidies, is a market friction that alters the marginal cost of a service. Similarly, regulation can create barriers of entry or, conversely, foster competition. See Mankiw et al (2009).

In particular for the European Union (EU), regulations such as EMIR²¹, MiFID²² and MiFIR²³ play key roles in determining the cleared and uncleared space, and assessing these may highlight how the DLT technology can work within the current financial system. The first point of consideration is that these regulations were not written with DLTs as part of their initial conception – in fact, a question that emerges is whether these regulations are the best fit to properly promote and regulate DLT in the world of clearing. Consequently, it may be the case that an entirely new regulation, or at least substantial amendments to the existing framework, would be advisable to ensure its proper development and use in European financial markets.

²¹ 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.

²² Directive 2014/65/EU of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments and amending Directive 2002/92/EC and Directive 2011/61/EU.

²³ Regulation (EU) No 600/2014 of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments and amending Regulation (EU) No 648/2012.

6.1 - The EU regulatory landscape

Clearing activities in the EU are supported by basically four regulatory pillars, i.e. EMIR, MiFID/MiFIR, the Settlement Finality Directive²⁴ and the Financial Collateral Directive²⁵, as well as guidance by global institutions on which regional legislation is largely based, such as the Principles for Financial Market Infrastructures²⁶. Notwithstanding the above, provisions in other regulations such as, for instance CSDR²⁷ and CCP Recovery and Resolution²⁸, also help to define a robust legal framework for the operation of CCPs in the EU. Specifically:

- EMIR provides that certain classes of over-the-counter (OTC) derivatives transactions have to be cleared through CCPs. Similarly, it establishes prudential and organizational requirements for CCPs, ranging from authorization and organizational procedures to margin, guaranty fund and default management practices expected from each entity.
- MiFID/MiFIR, in general terms, define the regulatory framework for trading venues and investment firms in the EU. In particular, these regulations extend the clearing obligation by CCPs to regulated markets for exchange-traded derivatives. In addition, clearing may be used for other types of transactions (e.g., transactions of shares or bonds), depending on market practices.
- The Settlement Finality Directive (SFD) stipulates protections for the irrevocability and finality of transfer orders entered into a SFD system.²⁹ As such, it prevents transfer orders from being interfered with insolvency proceedings. It also provides for the enforceability of the netting of transfer orders from the effects of the insolvency of a participant.
- The Financial Collateral Directive (FCD) is a form of security arrangement designed to simplify the process of having recourse to financial collateral across the EU.³⁰ In particular, it extends SFD in protecting collateral takers by ensuring that financial collateral arrangements can be mobilised and realisable without delay due to national formalities and providing for close-out netting to be enforceable should one of the parties become insolvent.

²⁴ Directive 98/26/EC of the European Parliament and of the Council of 19 May 1998 on settlement finality in payment and securities settlement systems.

²⁵ Directive 2002/47/EC of the European Parliament and of the Council of 6 June 2002 on financial collateral arrangements.

²⁶ See <https://www.bis.org/cpmi/publ/d101a.pdf>

²⁷ Regulation (EU) No 909/2014 of the European Parliament and of the Council of 23 July 2014 on improving securities settlement in the European Union and on central securities depositories.

²⁸ Regulation (EU) 2021/23 of the European Parliament and of the Council of 16 December 2020 on a framework for the recovery and resolution of central counterparties.

²⁹ Note that the SFD has been subject to review starting in 2021. Please see details in https://finance.ec.europa.eu/regulation-and-supervision/consultations/2021-settlement-finality-review_en.

³⁰ Note that the FCA has been subject to review starting in 2021. Please see details in https://ec.europa.eu/info/sites/default/files/business_economy_euro/banking_and_finance/documents/2021-financial-collateral-review-consultation-document_en.pdf.

6.2 - Incentives and barriers

The assessment of the effects of the regulation in the DLT developments permeates the establishment of the regulatory perimeter, i.e. whether or not a specific activity, object or agent is subject to the scope of the regulation, and the consideration of how existing rules promote or constrain those developments. In principle, the technology used to provide central counterparty clearing is not the focus of the existing regulations. Therefore, these regulations should only create incentives or barriers as long they alter the legal object subject to the law, the way activities are established, or the form agents organized.³¹ Against the above background, the following paragraphs review the pillar regulations using product type as categorization.

As discussed in ESMA (2017), cash transactions are not in scope of the clearing obligation under EMIR and MiFID/MiFIR and any DLT initiative seeking to combine the clearing and the settlement steps would fall outside their perimeter. If these assets are cleared by entities other than CCPs, there is no rule at EU level defining how these entities should be organized and governed. Equally, such alternative clearing entities would very unlikely fall under the scope of SFD and, therefore, would not benefit from the regulatory protection or requirements. This is because SFD constitutes an exception to the equal treatment of creditors upon the opening of insolvency proceedings, and overriding public interest would be only justified if systemic risks were associated to the provision of those services. For FCD, consistent conclusions with those of SFD would apply due to the interconnections of both directives.

When derivatives transactions are considered, a first categorization that needs to be made is between exchange-trade derivatives (ETD) and over-the-counter derivatives (OTC). MiFIR Article 29 establishes that all transactions in derivatives that are concluded on a regulated market should be cleared by a CCP. However, the regulation does not preclude derivatives to be traded in multilateral trading facilities (MTFs), organized trading facilities (OTFs), or third-country trading venues. While these facilities fall under the scope of MiFID/MiFIR, transactions conducted through them are not subject to the clearing obligation and could be performed via alternative clearing entities. Therefore, although trading would be subject to more stringent regulation in MiFID/MiFIR, clearing would not be governed by EMIR. Similar to the case of cash transactions, these alternative clearing entities would also fall outside the SFD and FCD protection.

A second important categorization for OTC derivatives is the distinction between transactions subject to the clearing obligation by CCPs and those not captured by the mandate.³² Under the

³¹ In June 2022 'Regulation (EU) 2022/858 of the European Parliament and of the Council of 30 May 2022 on a pilot regime for market infrastructures based on distributed ledger technology was published in the Official Journal of the European Union. The regulation created a pilot regime to allow for certain DLT market infrastructures to be temporarily exempted from some of the specific requirements of Union financial services legislation.

³² Please note that due to benefits associated to clearing, e.g. netting of exposures, it is not uncommon for OTC derivatives transactions not subject to the clearing mandate to be also cleared by a CCP.

clearing obligation, if market participants were to set up a DLT technology to clear these transactions, the network would need to comply with requirements set by EMIR. This means that a CCP would be necessary, i.e., the network would need to meet the definition of a CCP under EMIR and obtain a CCP authorization, or an existing CCP would need to join the network. Complementarily, as CCPs are typically classified as systemically important infrastructures, a SFD recognition by the relevant competent authority would be required.

For OTC derivatives transactions outside the mandate and non-centrally cleared, bilateral exchange of margin could possibly be accommodated via DLT, also in a disintermediated manner and not involving a CCP. Indeed, for OTC derivative transactions not cleared by a CCP, EMIR requires a range of risk mitigation techniques but does not prescribe the type of technology to be used for these prudential requirements. This implies that DLT would have the capacity to accommodate those risk mitigation techniques.

The categorization presented previously illustrates that, depending on the form assumed by the DLT application, the clearing of transactions under the DLT technology would fall inside or outside one or more regulatory perimeters. As expected, the more complex, sizeable and interconnected these applications are, i.e. the more systemically important, the larger is the amount of regulatory requirements. While on the one hand the more stringent requirements may function as a barrier for entry, on the other they help to create public trust on clearing framework and offering. This general assessment is complemented by a more detailed one in Appendix II, with similar conclusions holding.

7 - Concluding remarks

In recent years financial markets have witness the birth, development and expansion of new technologies related to the blockchain network and distributed ledger technology (DLT). The literature on DLT is also fast growing for financial market infrastructures (FMI) and central counterparties (CCPs). The objective of this paper is to contribute to this debate and assess the potential impact of these new technologies to CCPs. The particular focus is on disintermediation, and the aim is to expand the current restricted consideration given to incentives, costs, market structure, etc. as key elements to support the change from the CCP's perspective.

To analyze the impact of the new technologies in CCPs, the economic theory based on functional approach is used. The main idea is that due to frictions in the financial markets, there are some functions that are better performed by intermediaries as opposed to end consumers. This approach is extended to the main CCP functions, where incentives for provision and the nature of each service are reviewed against the recent DLT developments. Under this assessment framework, the main conclusion of the paper is that, for the current CCP offering, it seems challenging to foresee a scenario where any of the main services provided by a CCP would be entirely replaced or fully disintermediated by DLT or novel clearing models in a mutually exclusive

manner. The core functions of a CCP orbit around risk management, provided either as a private or club type of good. Organized as such, market incentives exist for CCPs to continue to centralize their offering.

When regulation is considered as an additional market feature capable of creating barriers and incentives to entry, it is noticeable that depending on the form assumed by the DLT application, the clearing of transactions under the DLT technology would fall inside or outside one or more regulatory perimeters. The more systemically important the application, the larger the requirements for entry. It may be the case in the future that regulators choose to promote more harmonized regulation on DLT and novel clearing models, making it clearer how a DLT application does or does not fall under the scope of the various regulation. Whether this falls after the role of DLT in clearing has become clear, or during the process, remains to be seen.

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Appendix I - List of Empirical Implementations

Project	Asset class	Impact on				Status
		Trading	Clearing	Settlement	Custody	
ASX	<ul style="list-style-type: none"> Cash equities 					Not live - In December 2017, ASX announced that CHES would be replaced with distributed ledger technology developed by Digital Asset. In November 2022 it announced the closure of the project.
Börse Stuttgart's digital-asset exchange	<ul style="list-style-type: none"> Crypto currencies 					Live
DBAG/Bundesbank 'trigger solution'	<ul style="list-style-type: none"> Electronic securities 					Tested - Settlement interface for electronic securities
DBAG D7 platform	<ul style="list-style-type: none"> Electronic securities 					Live (first phase: central register launched in December 2021)
DTCC Project Ion	<ul style="list-style-type: none"> Equities 					Live in a parallel production environment (For bilateral equity transaction)
FTX	<ul style="list-style-type: none"> Cryptocurrency futures and options 					Permission requested to CFTC withdrawn
JSCC/Japan Exchange Group Inc.	<ul style="list-style-type: none"> Settlement by delivery of rubber futures 					Live from January 2023
KRX Startup Market Exchange	<ul style="list-style-type: none"> Equity (start-up) 					Latest news on 2016 – Not live?
TMX Natural Gas Exchange (NGX)	<ul style="list-style-type: none"> Natural gas 					Latest news in 2017 - TBC
SDX***	<ul style="list-style-type: none"> Equity (SME focus for the moment) 					Live – Tokenization of equity shares; Issuance of limited assets for the moment.
Nasdaq Linq	<ul style="list-style-type: none"> Equity (private) 					In operation?

Appendix II – EMIR Titles & possible reasons for adaptation

EMIR Titles and Articles	Reason for adaptation (e.g., barrier to DLT inclusion, regulatory coverage, etc.)
<p>Title I: Subject Matter, Scope and Definitions</p> <ul style="list-style-type: none"> Articles 1, 2 <p>Title II: Clearing, Reporting and Risk Mitigation of OTC Derivatives:</p> <ul style="list-style-type: none"> Articles 4, 5, 6, 7, 8, 9, 12 <p>Title IV: Requirements for CCPs</p> <ul style="list-style-type: none"> <i>Ch1. Organisational Requirements: Articles 31 – 38:</i> <i>Ch3. Prudential Requirements: Articles 40, 41, 42, 44, 45, 46, 47, 48, 49</i> 	<p>Possible expansion of scope? Several EMIR articles may require a change to include, subject to regulators' will³³, new DLT-based disintermediated clearing models, such as:</p> <ol style="list-style-type: none"> Clearing obligation – Allowing disintermediated clearing models to handle standardised OTC derivatives, would require an expansion of scope of EMIR Articles 4-12 which cover the clearing obligation. Depending on the disintermediated model in question, the regulators may or may not choose to grant such a possibility via EMIR. If yes, this would be overcoming a barrier. General expansion of EMIR's scope – Whilst this is not overcoming a barrier to operating DLT in clearing as such, it is noted that regulators may at some point decide to update regulation to be 'in synch' with new technology and novel clearing models. Such a change would concern the articles as categorised in the first column, but not necessarily by expanding the clearing obligation.
<p>Articles 14 – 26:</p> <ul style="list-style-type: none"> Title III: Authorisation and supervision of CCPs Title IV: Requirements for CCPs – Ch1. Organisational Requirements: 	<p>General expansion of EMIR's scope – In the situation described in point 2 above, Regulators may decide they want disintermediated clearing models to adhere to rules on "<i>conditions and procedures for authorisation</i>" as is done under Articles 14 – 26 for CCPs.</p>
<p>Articles 27 and 28</p> <ul style="list-style-type: none"> Title IV: Requirements for CCPs – Ch1. Organisational Requirements: 	<p>Boards & Committees structure – Currently, CCPs Board and Risk Committee are obliged to have clearing member and client representation. Under a DLT-based clearing model handling OTC derivatives that disintermediates CMs, EMIR may require change to mandate higher client representation in boards and committees.</p>
<p>Article 29:</p> <ul style="list-style-type: none"> Title IV: Requirements for CCPs – Ch1. Organisational Requirements 	<p>Record keeping – EMIR may require change to accommodate for the workings of DLT recording keeping.</p>
<p>Article 43</p> <ul style="list-style-type: none"> Title IV: Requirements for CCPs – Ch3. Prudential Requirements 	<p>Skin in the game – As is currently for CCPs, in the case of any DLT-based/disintermediated clearing model, it may be desirable/necessary for them to adhere to the same pre-funded resources requirements.</p>

³³ **Whether** this would happen would depend on the will of regulators to oblige DLT clearing models to adhere to EMIR rules. **When** this would happen would depend on whether regulators want to amend regulation to include novel clearing models prior to their role in FMIs becoming clearer, while its role is more clearly established or after it has already become so. **How** this would done may depend on whether the model is disintermediating CCPs or Clearing Members.

<p>Article 50</p> <ul style="list-style-type: none">• Title IV: Requirements for CCPs – Ch3. Prudential Requirements	<p>Settlement – A possible barrier may be using Central Bank Money to settle transactions. Similar to the CSD cash leg issue, any DLT based clearing model may struggle to settle in Central Bank Money until CBDC is established. This considered the terms “where practical and available” may mean such a system may settle transactions via DLT via other means.</p>
<p>Article 51</p> <ul style="list-style-type: none">• Title V: Interoperability Arrangements	<p>Interoperability arrangements – In a transaction where two different DLT clearing models handle the cash and securities leg respectively, this would be considered an interoperable system (BIS 2020), so coverage of such a novel model under EMIR may be decided as necessary by regulators in the future.</p>