CHAPTER 17

Preventing risks in financial market infrastructures

Update 14 December 2018

As described in Chapter 5, financial market infrastructures play a key role in the financial ecosystem and the financing of the real economy. Their effectiveness was demonstrated in particular during the 2008 crisis, when central counterparties (CCPs) contributed significantly to limiting contagion. Regulators have entrusted them with an increasingly wide remit, particularly with regard to implementing the obligation to centrally clear standardised derivatives. This development, combined with a natural concentration (which is due to these entities' high entry and structural costs), has resulted in a concentration of risks within these infrastructures.

This chapter focuses on identifying and illustrating the risks borne by financial market infrastructures, as set out in the CPMI-IOSCO '*Principles for Financial Market Infrastructures*', and also on these infrastructures' risk management role. It looks in detail at the concept of interdependency and the various forms that this can take, as well as systemic risk. Finally, it addresses the very specific risks associated with offshore infrastructures, in particular those that process one or more currencies other than that of their operating region's central bank of issue.

1. Risk types associated with financial market infrastructures

1.1. Financial market infrastructures: risk carriers

The global financial system has known very few financial market infrastructure failures, but the handful that have occurred have been noteworthy. The last quarter of the 20th century was punctuated by three central counterparties (CCPs) failures, two of them in Asia. In 1974, France's *Caisse de Liquidation des Affaires en Marchandises* (CLAM) collapsed following the default of a market participant, while in 1983 the Kuala Lumpur Clearing House went bankrupt after only three years of existence, following multiple defaults of its members. Lastly, the Hong Kong Futures Exchange Clearing Corporation defaulted in 1987 following a stock market crash and the depletion of its default fund. These CCPs' failures resulted in extreme disruptions to the functioning of the markets that they served and drew attention to the risks contained in financial market infrastructures.

Financial market infrastructures are an essential link in the financial system, and play a very specific role. They streamline and simplify financial flows and – in the case of CCPs – even replace bilateral relations between market players. Beyond their operational processing of transactions and flows, most of them play a key role in managing and redistributing risks by limiting contagion from a defaulting participant to the financial system as a whole, thanks to default management and loss allocation mechanisms. Financial market infrastructures such as CCPs notably came into their own in the financial crisis that followed Lehman Brothers' collapse, when they prevented contagion to other financial players.

The corollary of this transformation or reallocation of risks, however, is the concentration of risks within the infrastructures themselves, some of which are considered 'systemic', or even 'supersystemic'.

This systemic characteristic is mainly due to the high number of links that these infrastructures are required to develop – both between each other and with market participants such as banks –, which create interdependencies. Consequently, the failure of an infrastructure could result in the failure of other entities and cause serious disruptions to the financial markets – what is known as 'systemic risk'.

The systemic nature of financial market infrastructures means that they are monitored by supervisory authorities, central banks and financial market regulators, because their proper functioning is essential for both financial stability and market efficiency and security. To this end, the risks associated with financial market infrastructures must be identified, the main difficulty here being that the nature and extent of these risks are closely linked to these systems' architecture and operating method.

Financial market infrastructure-related risk can be studied from two angles: the risks that participants pose to financial market infrastructures, and the risks to which infrastructures expose their participants. Several types of financial market infrastructure risk have been identified, the most comprehensive listing being in the CPMI-IOSCO *Principles for Financial Market Infrastructures (PFMI)* report of April 2012.[1] This report tackles risk holistically, defining a market infrastructure as a system made up of both its participants and its operator (see Chapter 5), as these different players are exposed to potentially interlinked risks. It is these specific risks that the PFMI aim to control and mitigate.

1.2. The different types of financial market infrastructure risk

The main financial market infrastructure risks are legal, liquidity, credit, business, custody, investment and operational risk.

1.2.1. Legal risk (PFMI Principle 1)

Legal risk is the risk of ill-planned or poorly defined implementation of legal or regulatory provisions, leading to a potential loss. It can notably occur in the case of the application of a legal regime that makes contracts illegal or unenforceable. Such would be the case, for example, if a procedure for dealing with a participant's insolvency contradicted an infrastructure's operating rules (in terms of payment terms, formalities for accepting obligations, protection of a bankrupt participant by freezing positions, etc.). For so-called global infrastructures, which have significant cross-border activity and multiple foreign members, it is vital that application of the rules of participants' jurisdictions does not create legal conflict with the systems' rules; otherwise the infrastructure's functioning could be disrupted. Financial market infrastructures have to protect themselves against this legal risk by obtaining external legal opinions and analysing the legal and regulatory framework of the participants' jurisdictions, both before they allow participants to join the system and on a continuous basis, by carrying out legislative and regulatory monitoring.

For example, within the European Union, provisions relating to the irrevocability of payments in the systems, as laid down in the so-called Settlement Finality Directive (SFD: see Chapter 5), and provisions covering a banking participant's failure, as set out in the BRRD Directive,[2] must be applied consistently between EU Member States; however, this does not apply to participants from third countries, which can have different rules. Consequently, operators must obtain legal opinions on the third country's rules, in particular to ensure that there is no conflict with the bankruptcy law of the participant's jurisdiction, which could run counter to the system's irrevocability rules. In this respect, it is absolutely crucial to avoid a situation in which a third country's bankruptcy court could have a participant's assets seized when the related procedures have reached the point of irrevocability and payments must be made.

Settlement risk, which is the risk that a settlement will not proceed as planned,[3] is a major risk for financial market infrastructures. If such a risk materialises, it calls into question certain transfer orders and can create both credit and liquidity pressure for an infrastructure's participants. It can also lead to systemic risk.[4] It is therefore essential for the smooth functioning of financial market infrastructures that any settlement, transfer (of securities or cash) or offsetting (between two obligations), or any other obligation that is settled in a system, is 'permanent'. To that end, the transfer of securities or cash must not be subject to any condition that could prevent its

1 English version: *https://www.bis.org/cpmi/publ/d101a.pdf* French version: *https://www.bis.org/cpmi/publ/d101_fr.pdf*

2 Directive 2014/59/EU of the European Parliament and of the Council of 15 May 2014 establishing a framework for the recovery and resolution of credit institutions and investment firms.

3 *https://www.bis.org/cpmi/publ/d101a.pdf*, see Principle 8, p.64 et seq.

4 For example, in the case of net settlement systems, a participant with unsettled transactions to its credit could see its initial creditor position turn into a debtor position, leading to its inability to pay and in turn putting other financial players in difficulty.

execution: the transfer must be 'irrevocable' and universally 'enforceable' for it to be permanent. The objective is to establish a legal mechanism to protect against the default of a participant in a payment or securities settlement system. This question is considered in greater depth in Section 3.3 of Chapter 5.

1.2.2. Liquidity risk (PFMI Principle 7)

There are two types of liquidity risk: one linked to a system participant's default risk and the other linked to the system operator's activity and the state of the associated market. This risk differs depending on the type of infrastructure in question.

Liquidity risk in the event of a participant's default

This is the risk that a counterparty, whether an infrastructure participant or another entity,[5] does not have sufficient funds to settle its financial obligations in a timely manner, regardless of whether it may be able to do so in the future.CCPs are subject to liquidity risk, as are, generally, deferred net settlement payment systems.

This risk arises, for example, when a participant in a payment system operating in deferred net settlement mode cannot settle its net debit balance at the required time, such as at the end of the day, despite doing so subsequently (the next day, for example). The participants expecting payment do not receive their funds when required, and may then have to borrow, for example on the interbank market, to meet their own obligations. At the end of the day, when the markets close, these participants could have difficulties obtaining sufficient liquidity and refinancing in the markets.

In the case of a sale of securities, this risk can arise when the seller of a financial asset who does not receive payment at term needs to borrow on the market or sell another asset to make other payments. It could also be the risk that the buyer of an asset that has not been delivered at maturity will be forced to borrow that asset (or even buy it again, after the initial transaction has been cancelled) in order to comply with its own delivery obligation. Both parties to the financial transaction may therefore be exposed to liquidity risk at the settlement date.

For CCPs, this liquidity risk is particularly high for contracts such as repurchase agreements (repos), which are accompanied by significant cash flows. When the transaction is executed, cash is paid to the borrower providing the securities as collateral. If at maturity the borrower does not repay the borrowed cash, the lender can sell the securities in order to recover its funds. The CCP must at all times have enough liquid resources to ensure settlement, even if one of the members is unable to settle the repo. This exposes it to significant liquidity risk.

In extreme cases, liquidity risk can turn into credit risk (see below), i.e. a permanent loss if the defaulting participant cannot obtain the liquidity needed to meet its obligations. However, even in the absence of credit risk, liquidity risk can hamper the smooth functioning of financial markets. This was notably the case when Lehman Brothers collapsed in 2008. Before the central banks intervened, market liquidity dried up due to the lack of trust prevailing among banks and market players.

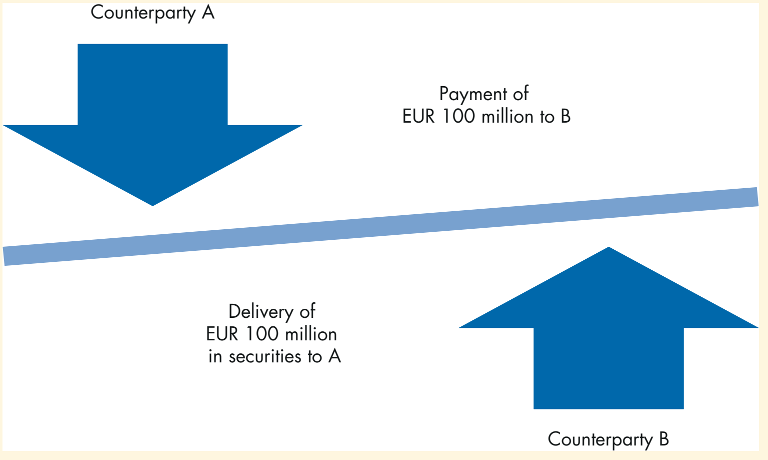
Liquidity risk and credit risk are therefore not necessarily linked: liquidity risk can materialise in a pressure situation without necessarily leading to credit risk (permanent loss). Nevertheless, distinguishing between liquidity risk and credit risk can be complex; sometimes the distinction can only be made after the event, i.e. when the loss has already occurred or the risk disappeared. By contrast, as regards securities transactions in settlement and delivery systems (securities settlement systems - SSSs), liquidity risk is in fact a replacement risk (as defined above) and is completely disconnected from credit risk (see below).

5 For example, a system liquidity provider such as in the CLS multi-currency payment system (see Chapter 9).

Box 1: Cleared repo liquidity risk compared with uncleared repo liquidity risk

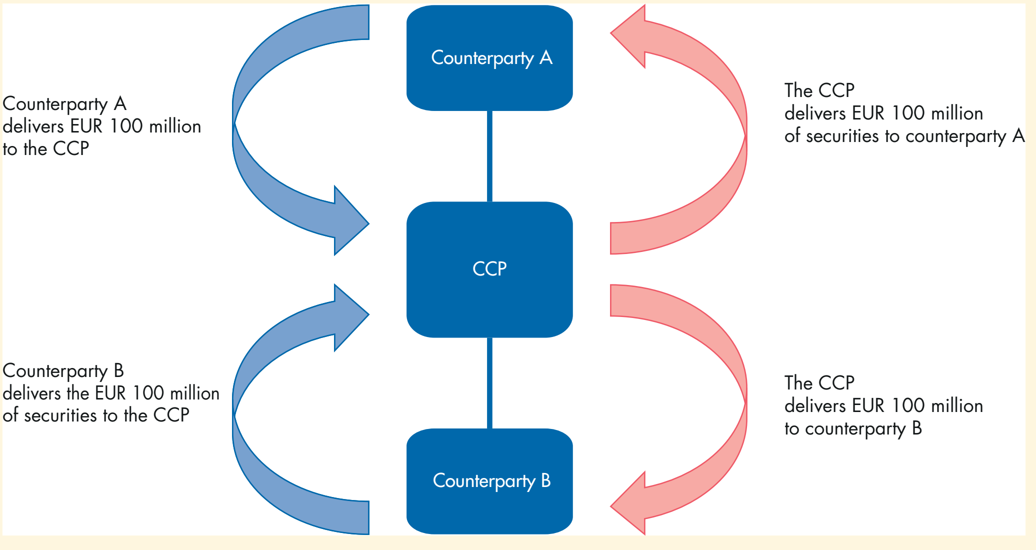
Consider the example of a repo in respect of which counterparty A undertakes to pay EUR 100 million in cash to counterparty B, while counterparty B must deliver to A the equivalent of EUR 100 million in securities as collateral. In this case each counterparty's settlement will take place in delivery versus payment (DvP) mode, in which each counterparty is released from its obligation (e.g. cash payment) if and only if it simultaneously receives from the other counterparty the opposing leg that is the subject of the exchange (e.g. delivery of securities).

In a bilateral, uncleared transaction the flows linked to a repo can be summed up as follows:



In the case of a transaction cleared by a central counterparty (CCP), which replaces the initial counterparties, the flows can be summed up as follows:

The CCP bears the liquidity risk. For example, if B does not provide it with the securities when the transaction is settled, the CCP will have to buy them on the market and thereby incur a replacement cost:



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The CCP must at all times have enough liquidity in euros to ensure settlement, even if one of the members is unable to pay.

Another type of instrument that can typically generate significant liquidity needs for a CCP in the case of centralised clearing is a currency forward. For example, if counterparty C has to deliver EUR 100 million to counterparty D at term and counterparty D has to deliver USD 120 million to C in exchange, if D defaults the CCP is at risk of having to pay C the USD 120 million on D's behalf. The CCP may have to buy dollars in the market, which can be both costly and difficult – particularly at the end of the day, in crisis situations or at times of market stress. This risk is significant because it concerns the transaction's principal amount.

A counterparty's liquidity risk may also have other sources, such as the impossibility or inability of settlement banks, nostro agents, custodian banks, liquidity providers or related infrastructures to meet their commitments.

Liquidity risk not linked to a default

Liquidity risk can also materialise independently of a default, for example in a real-time gross settlement (RTGS) system, which processes and settles payment instructions as they enter the system: if a participant makes a succession of large-value payments without at the same time receiving credit amounts, it is likely to face liquidity pressure. Indeed, RTGS payment systems consume liquidity as they do not offset amounts payable against amounts receivable, unlike deferred net settlement payment systems. System participants therefore need to have quick and easy access to liquidity (via interbank refinancing or a central bank, for example). For a CCP, liquidity risk could arise in connection with collateral management, if for example the collateral received (as cash margin, for instance) has been invested in infrequently traded, illiquid securities. When the time comes for it to return the corresponding cash to the clearing member (for example as a result of a reduction in the latter's position vis-à-vis the CCP), the CCP may find itself unable to sell the securities on the market in order to return the cash.

Liquidity risk may also generate systemic risk, particularly if a participant's inability to meet its obligations due to liquidity problems materialises when markets are closed or illiquid, if asset prices are rapidly fluctuating or if the participant's situation raises concerns about its solvency.

1.2.3. Credit risk (PFMI Principle 4)

Credit risk is the risk that a counterparty, whether a system participant or another entity such as the settlement bank, will be unable to fully meet its financial obligations at term and subsequently. Like liquidity risk, this risk is specific, being determined by the infrastructure's type and modus operandi.

This risk may be borne by the infrastructure (such as the CCP in the event of the default of one of its participants, by the creditors of a participant that is no longer able to meet its financial obligations, or by the other participants. The counterparty(ies) that bear(s) this risk may then incur a principal risk and a replacement cost risk. Principal risk is the risk of losing the entire amount of a transaction, for example when the seller of a financial asset irrevocably delivers it without receiving payment (theoretical risk in a settlement and delivery system but actually eliminated by the settlement and delivery technique – see below). Replacement cost risk arises from a change in market value compared to the transaction's initial terms likely to lead to a higher replacement transaction execution cost for the buyer.

Credit risk can, however, be reduced or even eliminated. For example, for payment systems, the real-time gross settlement method eliminates any delay between the time when the instructions are entered into the system and the time they are settled; credit risk is nil in such systems. The deferred net settlement model, meanwhile, makes it possible to reduce credit risk by implementing a hedging mechanism (guarantee fund, individual guarantees, pre-funding, etc.: see Chapters 8 and 10). In the case of deferred net settlement systems, another possible protection mechanism is the implementation of bilateral limits between participants. This is notably the case with the EURO1 large-value payment system (see Chapter 10). This system does not entirely eliminate credit risk but allows it to be reduced to a level deemed acceptable by system participants and supervisory authorities.

Credit risk can also be reduced or even eliminated in foreign exchange settlement systems and securities settlement and delivery systems. The main protection method is the implementation of a payment-versus-payment (PvP) mechanism[6] (see Chapter 9) for foreign exchange transactions and a delivery-versus-payment (DvP) mechanism[7] (see Chapter 13) for the settlement and delivery of securities. These mechanisms ensure the simultaneous settlement of the transaction's two 'legs'.

1.2.4. General business risk (PFMI Principle 15)

Like any company, an infrastructure is exposed to the risk of damage to its sustainability as a business. This risk arises from a variety of sources other than a participant's default: it can involve the loss of one or more major clients, depriving the infrastructure of a substantial source of income and resulting in an inability to recover its costs, for example, or errors in the company's strategy resulting in ill-suited or insufficient investments, or losses incurred in other business sectors by the infrastructure's parent company or that company's other subsidiaries.

Most financial market infrastructures, particularly CCPs, operate in a competitive environment, exposing their operating conditions to sudden change.

Certain risks dealt with in other PFMI principles – such as legal risk or operational risk – can generate business risk. For example, with regard to legal risk, if a payment system's rules were identified as conflicting with a country's legislation, all participants in that country would have to leave the system, leading to a loss of activity and income for the infrastructure. Similarly, the detection of a significant operational risk within a system, such as the impossibility of confirming participants' positions, complying with cut-off times or accessing the backup site could result in participants leaving the system for that of a competitor, deemed more secure. Reputation risk can also result in business risk, for example in the event of negligence or an error resulting in the loss of clients.

To cover these risks, international standards require infrastructures to hold liquidity 'reserves' to deal with such events (see Chapter 18).

1.2.5. Custody risk and investment risk (PFMI Principle 16)

Custody risk is the risk of incurring losses on assets held in custody, as a result of the insolvency of a custodian (or sub-custodian). Insofar as the securities that the custodian agent holds are not its own, and are therefore not part of the pool to be distributed among creditors in the event of said agent's default, this risk will materialise solely in connection with negligence, fraud, maladministration or inadequate account keeping.

Investment risk, meanwhile, is the risk of loss incurred by an infrastructure when it invests its own resources (for example its capital) or those of its participants (guarantee

6 The PFMI define PvP as a cash settlement mechanism under which final settlement of one leg in a currency can only be made if, and only if, final settlement in the other currency (or other currencies) has actually been made.

7 The PFMI define DvP as a settlement mechanism that links the transfer of a financial instrument to the corresponding transfer of cash intended to settle it, such that the delivery of the financial instrument can only be carried out if, and only if, the cash payment has actually been made.

funds, deposits or margins paid) in assets that subsequently lose value.

As part of their activity, some financial market infrastructures hold financial instruments (e.g. securities provided as collateral or to guarantee transaction execution) or cash collateral entrusted to them by their participants. The recipient infrastructure is required to return said securities or cash at the transaction's term. These financial instruments are exposed to the risk of a loss of value in the event of market pressure or a deterioration in a counterparty's credit situation or even its default.

The loss of value of financial instruments or cash exposes the infrastructure to principal risk, i.e. the obligation to reconstitute the cash or financial instruments, at its own expense, by charging the related costs to its own funds or calling for contributions from its participants. For example, certain CCPs, considering that their clearing members are stakeholders in the CCP's investment decision-making process, only bear part of the losses linked to these investments, and to that end have put in place a mechanism for sharing and allocating investment losses with their participants.

The return of assets to participants may also involve ancillary costs such as fees, commissions or an increase in the price of the securities concerned. Infrastructures that receive financial assets from their clients under an arrangement to return them at a later date are exposed to custody risk. This risk may arise in the event of fraud or negligence (lack of control or reconciliation, for example, between the amount of an issue and the amount of securities subject to centralised account keeping). Because of their role in the processing of financial operations, infrastructures have a key responsibility in this area. Custody risk is therefore particularly high at central securities depositories (CSDs) and CCPs.

This is because for their part, CSDs act as a securities centralised account keeper, guaranteeing that the total amount of securities held by investors is equal to the amount of securities issued (no creation or loss of securities: see Chapter 12).

CCPs, meanwhile, receive margin payments (in securities or cash) from their clearing members, which they must be able to return to them as soon as the position decreases (partial return) or is closed (total return). As such, they must have in place a secure asset custody system. In the European Union, for example, CCPs must wherever possible deposit financial instruments received as margins, and default fund contributions, with settlement systems that provide full protection for these instruments; similarly, cash deposits must be made within a highly secure framework such as a central bank.

1.2.6. Operational risk (PFMI Principle 17)

All FMIs face operational risk, which is the risk that deficiencies in information systems or internal processes, human errors, management failures, or disruptions from external events will result in the reduction, deterioration, or breakdown of services that they provide. These operational failures may lead to delays, losses, liquidity problems, and in some cases systemic risks. Operational deficiencies also can reduce the effectiveness of measures that FMIs may take to manage risk, for example, by impairing their ability to complete settlement or to monitor and manage their credit exposures. In the case of trade repositories (TRs), operational deficiencies could limit the usefulness of the transaction data they hold (see Chapter 16).

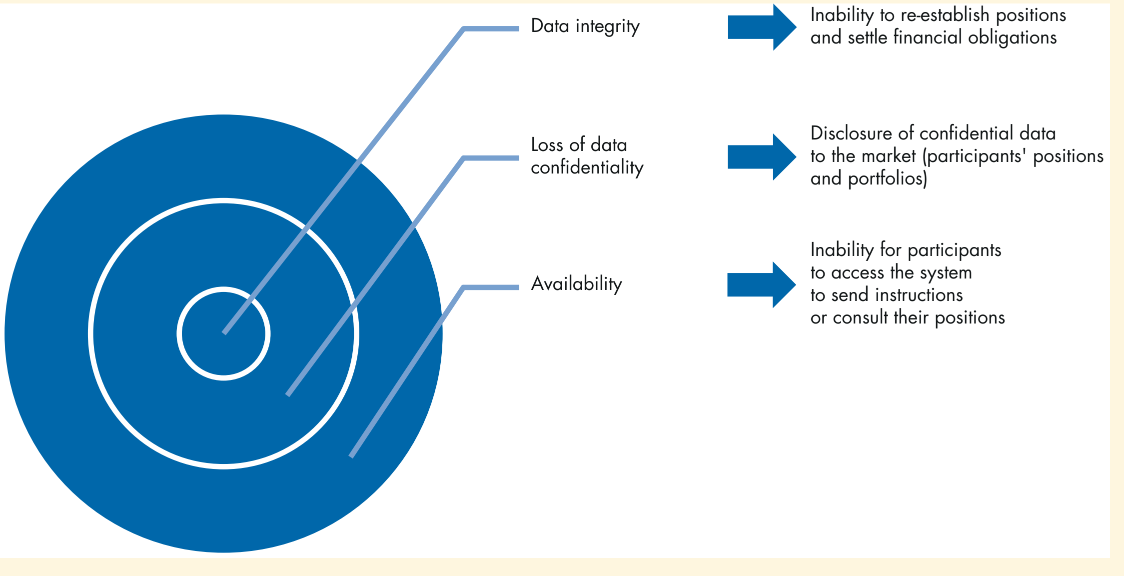
Possible operational failures include errors or delays in processing, system outages, insufficient capacity, fraud, and data loss or corruption. Operational risk can stem from both internal and external sources. For example, participants can generate operational risk for FMIs and other participants, which could result in liquidity or operational problems within the broader financial system.

Cyber risk is also a source of operational risk that is receiving increasing attention from regulators given its potentially very debilitating consequences for FMIs. According to the CPMI report published in November 2014 on cyber-resilience in financial market infrastructures, a cyber threat is a "circumstance or event with the potential to intentionally or unintentionally exploit one or more vulnerabilities in an FMI's systems resulting in a loss of confidentiality, integrity or availability".[8] Cyber attacks involving extreme risk such as data corruption or prevention of system access – known as distributed denial-of-service (DDoS) – can force the infrastructure to stop all activity and thus prevent it from performing its critical function. Cyber-attacks of this kind present a real challenge for infrastructures, insofar as they make it difficult to achieve the objective of a two-hour return to operations (RTO) – generally the time frame worked to in such cases – which in the case of data corruption, for example, takes into account the need to identify the attack point, restore sound data before this point and reprocess all affected transactions in the system.

Another major source of operational risk is outsourcing. Like other business entities, financial market infrastructures may choose to partially subcontract management of their activities, chiefly for areas that are not part of their core business such as legal tasks, real estate management or human resources management, but in some cases for more core activities (hosting or operation of technical platform, software development and maintenance, IT management, website management, risk model and algorithm maintenance, etc.), so as to benefit from pooling-related economies of scale.

8 *www.bis.org/cpmi/publ/d122.pdf*

Box 2: Cyber attacks: targets and consequences



However, this outsourcing potentially exposes an infrastructure to additional risks, which costs may far exceed the savings expected from outsourcing. These risks include:

- the risk of default (contractual, operational or financial) by the service provider which, in the absence of a fall-back solution, could prevent the infrastructure from being able to ensure business continuity and provide critical services (calculating net positions for a CCP, for example);
- the risk of not being able to meet the maximum two-hour RTO deadline, a firm PFMI objective (see Chapter 18), which is likely to result in a very high risk of reputational damage and loss of clients;
- the risk of loss of ownership or control of the technology associated with out-sourced services, particularly in the case of core business components such as netting algorithms for payment systems or margin calculation models for CCPs.

To combat these risks, the PFMI require infrastructures to monitor activities delegated to critical service providers (PFMI Annex F: see Chapter 18). For EU CCPs, EMIR imposes strict regulatory requirements for outsourcing. A European Union CCP cannot, for example, outsource its main risk management-related activities unless it obtains the explicit agreement of the competent national authority (or authorities if a Member State has designated several competent authorities under EMIR).

Financial market infrastructure risks are not only highly diverse but also interdependent. Investment risk may lead to liquidity risk, for example; operational risk may lead to custody or even liquidity risk (particularly if it is technically impossible to make payments) and liquidity risk may develop into credit risk, for example if a CCP clearing member's one-off non-payment of a margin call is not subsequently regularised – which exposes the CCP not only to potential liquidity problems because it does not receive its expected margin but also to the risk of losing the principal of its receivable due from that member.

An infrastructure's degree of exposure to a given risk depends on its type and design. For example, CCPs are exposed to credit risk (see Chapter 11), but this risk does not affect securities settlement systems operating on a delivery versus payment (DvP) basis (see Chapter 12). SSSs are exposed to very specific risks. A payment system will be exposed to different risks depending on whether it operates in real-time gross settlement or deferred net settlement (DNS) mode (see Chapters 7 and 8), but also on the rules it adopts with regard to participants. According to the PFMI, a system includes the central body, i.e. the infrastructure itself, and its participants. An infrastructure's risk profile therefore depends not only on the function it performs, but also on how it operates and the rules it sets for its members.

1.3. Financial market infrastructures' key risk management role

While carrying risks, financial market infrastructures are also a means of managing risks by mitigating or transforming them for their participants. They played a crucial role in managing the 2008 financial crisis, for example, when they acted as mitigators and 'circuit-breakers', thus containing market contagion. CCPs typically play a key role in managing a participant's default, both through their loss allocation and default management mechanism and the calibration of their resources that in Europe, pursuant to EMIR 'Cover 2' requirements, is designed to enable them to cope with the failure of the two clearing members to which they have the highest exposure (see Chapter 11). When Lehman Brothers collapsed, for example, the initial margins that the bank had deposited with the CCPs enabled them to absorb the losses arising from its default. Similarly, securities settlement and delivery systems operating in DvP mode make it possible to eliminate credit risk for their participants by ensuring the simultaneous payment of cash for securities and delivery of securities for cash.

2. Interdependencies and systemic risk

2.1. Types of interdependency

Market infrastructure-related interdependencies must be considered from several angles. Firstly, financial market infrastructures are essential elements of the post-market transaction processing chain (securities clearing, settlement and delivery, and cash leg settlement), which automatically creates operational interdependencies between them. In addition to these operational interdependencies, interactions between market participants and financial market infrastructures lead to the creation of other, system-to-system interdependencies.

Systemic risk has several dimensions.[9] France's High Council for Financial Stability (*Haut Conseil de Stabilité Financière*) defines it as "disruption to the provision of financial services caused by an impairment of all (or a large part) of the financial system, and which has the potential to have serious negative consequences for the real economy". In the context of interbank clearing systems, the Lamfalussy Report[10] defines it as "the risk that the illiquidity or default of an institution, resulting in the latter's inability to honour its obligations, leads to the illiquidity or default of other institutions". As such, infrastructures can also be vectors for the propagation of risks because they can very quickly transfer exposures from one participant to another, or even from one market to another, resulting in a contagion within the financial system. Certain market infrastructures are therefore considered 'systemically important' because of the volume of financial flows that they settle and the possible chain reaction across the financial sector as a whole that could result from a financial or technical shock that is not properly controlled. While interdependencies have significantly improved the security and efficiency of infrastructures' activities and processes, for example through integrated flow transmission, they increase the likelihood of increased and widespread market disruption. Thus, if an infrastructure depends on the proper functioning of one or more other infrastructures for its payment, clearing, settlement and registration processes, a disruption in any one of these entities may have a simultaneous impact on the others. These interdependent relationships can therefore spread disruption beyond a single infrastructure and its participants to impact the economy as a whole. The objective of limiting and controlling systemic risk – a fundamental goal for central banks – must be taken into account in the design of financial market infrastructures and the establishment of their operating rules.

While they can propagate systemic risk, financial market infrastructures play a central role in mitigating this risk, and that is their ultimate purpose. The PFMI accordingly specify that certain infrastructures are critical for central banks' monetary policy management operations and financial stability roles. As we saw above, when Lehman Brothers collapsed in September 2008, the CCPs were able to settle that counterparty's transactions, under extreme market conditions, thanks to the initial margins[11] that they had collected. This enabled them to play the role of circuit breaker, settling transactions with other counterparties without having to call for contributions from other clearing members. The liquidity of the other market players was thus preserved thanks to the CCPs' interposition.

FMI interdependencies were the subject of a CPMI working group report[12] published in June 2008 (before the crisis, therefore). That report identified three types of interdependency: those arising from common participants, those between infrastructures and those linked

9 See Rocher-Tirole "Controlling risks in payment systems" in *Journal of Money, Credit and Banking* (1996).

10 *http://www.bis.org/cpmi/publ/d04_fr.pdf*

11 See Chapter 11 on CCPs.

12 *http://www.bis.org/cpmi/publ/d84.pdf*

to the environment, for example in the case of a service provider common to several infrastructures.

2.1.1. Interdependencies linked to common participants

Interdependencies linked to common participants result from the participation of the same market players, often the largest banks, in the transaction processing chain of various infrastructures: for example, bank A is a clearing member of CCP A and CCP B, but also a participant in the CSD and the payment system responsible for cash leg settlements. Bank A's default would therefore impact CCP A, CCP B, the CSD and the payment system. This example is illustrated in the box 3 below. These interdependencies create externalities. For example, the fact that participant C does not receive the expected settlement from participant D due to D's failure within the system has negative consequences for participant C, which will have to borrow in the interbank market for refinancing purposes, leading to costs or even stress situations in periods of market pressure and if interbank lending is tight. Interdependencies also arise when direct participants represent indirect participants in the systems. This happens when market players that do not meet the access criteria or do not have the operational capacity to be direct participants in infrastructures are represented by direct participants – in the case of CCPs this is the role of clearing members which offer client clearing services. As a result, in a CCP for example, the default or bankruptcy of a clearing member would have significant repercussions on that clearing member's clients or indirect participants.

In terms of risk management, interdependencies can result in an infrastructure participant or a major credit institution providing liquidity to the infrastructure. By way of illustration, as regards the functioning of the CLS foreign currency settlement system, if a participant cannot settle its debit position in a given currency such as the euro, CLS may call on euro liquidity provider banks to settle the euros against another currency held by said participant (see Chapter 9) within the limit of the amount to which the liquidity provider is contractually committed. This link creates dependency between the system and the liquidity provider, insofar as settlement in the currency concerned will necessarily depend on the liquidity provider's capacity to supply this currency.

The organisation of relations between participants is also a risk factor. For example, an infrastructure with few direct participants but a large number of indirect participants, representing a significant volume of activity, presents risks: the default of a direct participant may cause difficulties for its indirect participating clients, who therefore no longer have access to the infrastructure and are forced to rapidly find an alternative access solution.

2.1.2. Interdependencies arising from links between infrastructures

The second type of interdependency arises from links between infrastructures that make one system's functioning closely correlated to another's. This is typical of links between CCPs, CSDs and large-value payment systems (LVPS) for the settlement of the cash portion of transactions (see box 3). It also applies to retail payment system flows channelled into a large-value payment system.

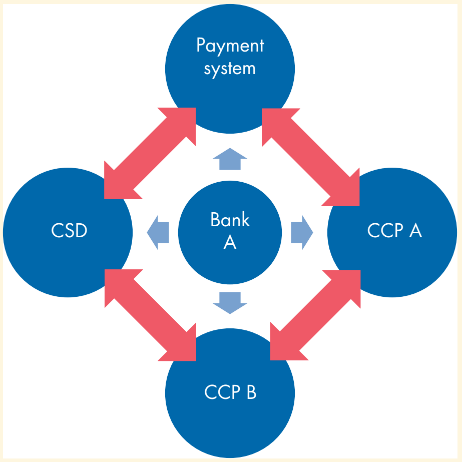
Interoperability links between infrastructures such as CCPs (see Chapter 11, Section 2.2) also create new interdependencies, which require appropriate risk management systems.

2.1.3. Environmental interdependencies

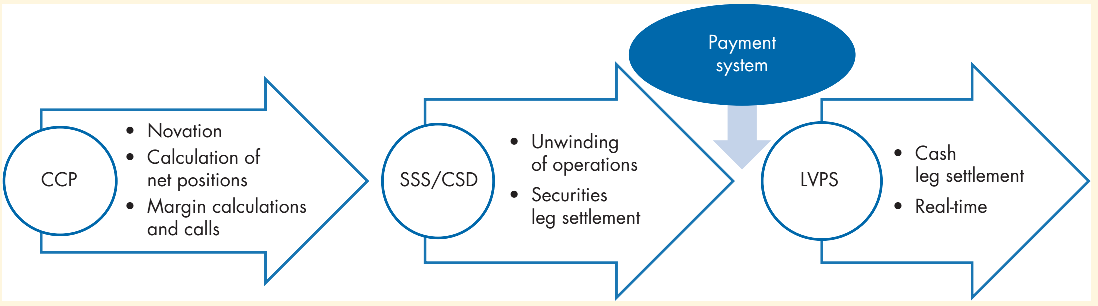
Several factors contribute to the creation or deepening of interdependencies. Market globalisation and regional integration naturally foster interdependencies. The consolidation of market players themselves can deepen interdependencies,

Box 3 : Interdependencies

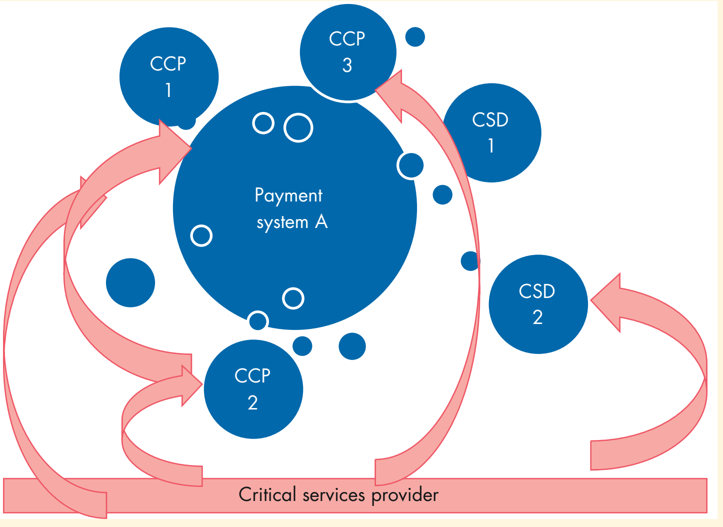
1. Interdependencies linked to common participation



2. Interdependencies between infrastructures



3. Interdependencies linked to a shared critical services provider



for example via a common shareholder structure, or the establishment of shared platforms to pool technical resources and thus reduce costs. Technological innovations can also lead to interdependencies, when identical technology such as financial messaging is used to facilitate exchanges and adopt common standards.

This is the third type of interdependency – environmental. It concerns indirect relationships arising from more general factors – several infrastructures' use of the same service provider such as a network or messaging provider, for instance. Joint platform sharing schemes can also create interdependencies; for example, the use of SWIFT by most infrastructures creates interdependencies that contribute to the 'systemic' nature of SWIFT's financial messaging service.

The box 3 illustrates how risk transmission takes place in the post-market processing chain, with examples of interdependencies:

2.2. Systemic risk: 'supersystemic' CCPs

The network of interdependencies between clearing member banks and CCPs tends to create a major systemic risk by allowing very strong interconnections to develop between these players. This has been illustrated in particular by the work on interdependencies carried out by the Financial Stability Board (FSB).

For example, based on data on derivative positions in 26 CCPs worldwide collected in 2016 by the Financial Stability Board's Study Group on Central Clearing Interdependencies, it was found that global systemically important banks (G-SIBs) are very closely linked to each other, in particular through their participation in the same CCPs. In this study, interdependencies were measured notably based on the amount of the CCPs' main G-SIBs' contributions to initial margins and default funds. It transpired that as few as 20 or so clearing members out of more than 300 contribute more than 75% of the financial resources provided to these CCPs. The default of the two largest clearing members of any given CCP would have an impact in more than 20 other CCPs to which they participate. In addition, around ten CCPs account for nearly 88% of the resources contributed by these G-SIBs. Some CCPs thus appear to be 'supersystemic', in that they represent a significant proportion of overall risks.

Risks associated with market structure

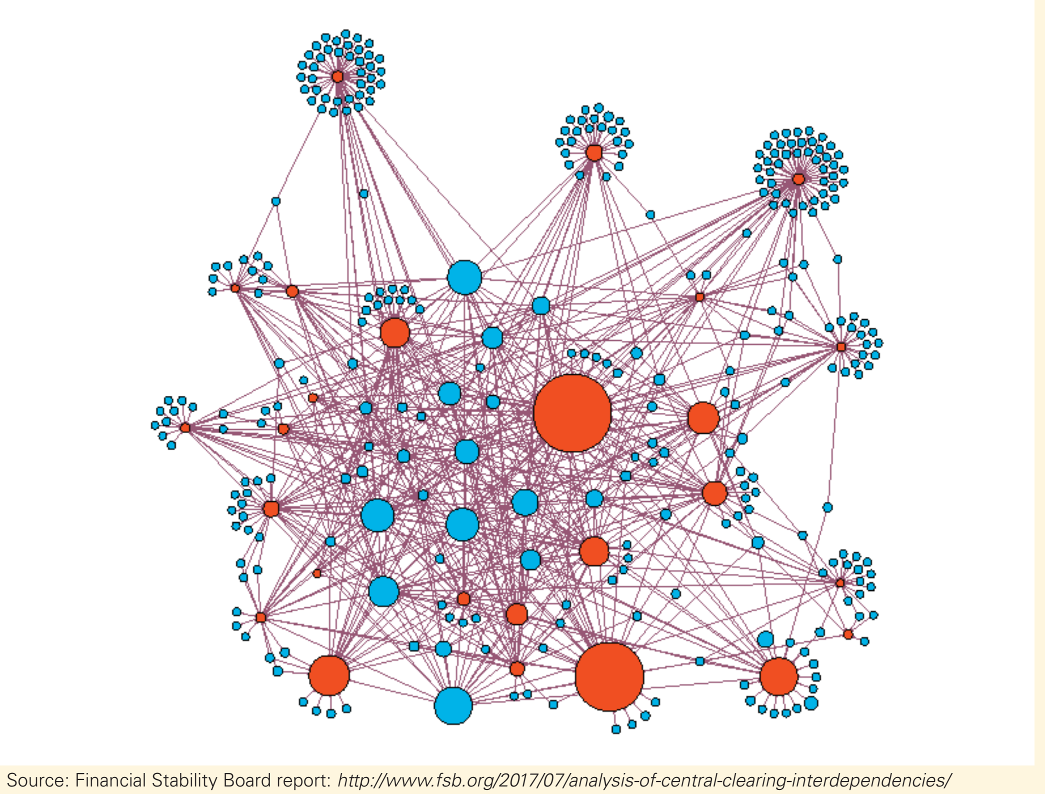
Risks in the systems may also be compounded by market structure issues. The high fixed costs and technical resources needed to set up an infrastructure naturally result in high concentration and specialisation among these players; many jurisdictions have just a single CCP and a single settlement and delivery system or a single large-value payment system. This concentration makes the infrastructures difficult to replace and increases interdependencies.

For example, a market structure that includes multiple CCPs may have fewer vulnerabilities than an organisation with a global CCP, which would concentrate all exposures and thus become 'supersystemic' because its failure (to return securities or deliver cash, for example) could trigger the failure of its clearing members. A silo-type, vertical integration of an infrastructure with other entities could further increase the risk that the default of one of the chain's links (such as the trading platform) will cause the other infrastructures (the CCP and the settlement and delivery system) to default, by complicating or even making impossible such infrastructure's resolution. The difficulty of replacing an infrastructure and its systemic nature can therefore lead its oversight bodies to impose additional requirements (coverage of financial risks, capital requirements, etc.) in order to reduce its risk of failing.

Box 4: Interdependencies linked to participants.

Illustration from the work of the Study Group on Central Clearing Interdependencies, 2017

The chart below illustrates the network made up of 26 CCPs (in red) and each of their 25 largest clearing members (in blue), based on pre-funded financial resources paid by clearing members to these CCPs. The size of each circle represents the total amount of pre-funded financial resources that have been collected by a CCP or paid by a clearing member to all CCPs of which it is a member. The lines connecting the CCPs and the members show the relationships between the clearing members and CCPs that make up the network.



Source: Financial Stability Board report: *http://www.fsb.org/2017/07/analysis-of-central-clearing-interdependencies/*

CCPs and members in the middle tend to be larger than those on the periphery. Meanwhile, outlying CCPs tend to have a large number of members that belong to only one CCP. This graph thus illustrates the high concentration within a few CCPs of pre-funded resources paid by members.

3. Offshore infrastructure risks

3.1. Different types of offshore infrastructure

To properly understand the risks associated with these infrastructures, the concept of so-called offshore infrastructures must be defined, as it covers various scenarios. Offshore[13] infrastructures are (i) infrastructures that allow their participants to connect indirectly – i.e. from a jurisdiction other than that of the central bank of issue – to an infrastructure in the issuing currency zone, and (ii) infrastructures that, in their territory, process instruments or payments denominated in a currency other than that of

13 In the context of market infrastructures, the term 'offshore' is normal and in no way refers to prohibited activities.

Box 5: euroSIC, example of an indirect connection by the Swiss banking community to TARGET2

Despite Switzerland not being a member of the euro area, SIX Interbank Clearing (SIC) was instructed by the Swiss financial market to develop a real-time gross settlement system for euro transactions, known as euroSIC and operated by a German settlement bank (SECB - Swiss Euro Clearing Bank). This system has been used since January 1999 to enable Swiss banks to rapidly clear euro-denominated payments between each other, without having to keep euro-denominated accounts in TARGET2. In its capacity as a Frankfurt-registered German universal bank and a participant in the Bundesbank's TARGET2 system, the SEBC settlement bank has access via TARGET 2 to all euro area member countries, and processes euroSIC participants' payments from Switzerland to the euro area and vice versa in real time.

As regards the terms of participation, any institution subject to Swiss banking supervision can legally participate in euroSIC. Financial institutions, common institutions, clearing organisations and their members outside Switzerland also receive access, provided they are subject in their country of origin to banking supervision of at least equivalent legal and operational standards to those governing participants in Switzerland as regards banking oversight, anti-money laundering and telecommunications infrastructures. SIX-SIS, the group's CSD, is directly connected to the European TARGET2 Securities (T2S) platform, enabling the settlement in euros of securities from Switzerland and Liechtenstein.

the central bank of issue of their operating jurisdiction,[14] being typically multi-currency CCPs, which clear financial instruments in multiple currencies (EUR, USD, GBP, CAD, etc.) or multi-currency settlement systems such as CLS (see Chapter 9).

The first scenario, described in the box 5, gives the example of euroSIC, a payment system located in Switzerland that makes it possible to indirectly connect a banking community outside the euro area, in this case Switzerland, to the TARGET2 payment system via a German commercial bank acting as a settlement agent.

The second scenario concerns offshore CCPs in the UK, which clear a substantial portion of transactions in euro-denominated financial instruments (see Box 6).

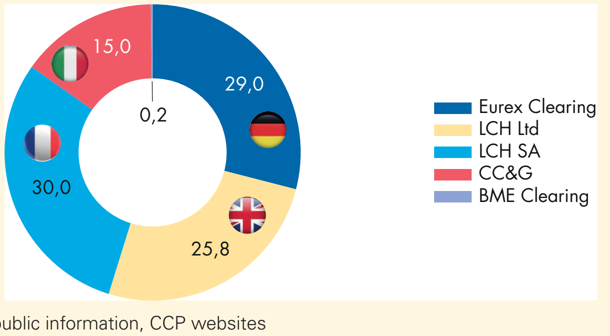
The European repo market is cleared almost exclusively by four CCPs. Outside

14 See CPMI glossary: *https://www.bis.org/cpmi/publ*

Box 6: Offshore CCPs: the case of UK CCPs

In Europe, certain CCPs located outside the euro area, in particular in the United Kingdom, process a very substantial portion of transactions in euro-denominated financial instruments; this is the case, for example, of LCH Ltd, whose SwapClear euro interest rate derivative clearing service represented, at the end of March 2017, EUR 84 trillion of open positions and 99% of the euro interest rate derivative clearing market.

C1: EUR repo clearing in the European Union



Source: public information, CCP websites

T1: Annual EUR sovereign debt clearing volumes (2016)

CCP	Volume cleared, 2016 (EUR billion)	% market
LCH Ltd	59,000 [a)]	25.8
LCH SA	67,534	30.0
Eurex Clearing	65,293	29.0
CC&G	33,448	15.0
BME Clearing	410	0.2

a) Estimated value, the EUR/non-EUR ratio in this segment being around 80%.

Source: CPMI-IOSCO quantitative disclosure, LCH Ltd.

T2: European CCP open interest – EUR OTC interest rate derivatives – March 2017

(EUR trillion)

CCP	Open interest	% market share
LCH Ltd SwapClear	84.3	99
EurexOTC	0.9	1
BME Clearing	0.001	0

Source: public information, CCP websites.

the euro area, and in the UK specifically, the LCH Ltd CCP's RepoClear service clears approximately EUR 75 trillion of repo transactions every year, most of which (around 80%) on euro-denominated German, Belgian, Austrian and Dutch sovereign debt.

3.2. Advantages of offshore infrastructures

Offshore infrastructures are used to settle international transactions, and as such facilitate the development of international trade. These infrastructures are adapted to the settlement of regular rather than one-off transactions, benefiting from significant volumes and generating economies of scale (by spreading development and structural costs over a large number of transactions and thus reducing the unit processing cost) and liquidity gains (through the offsetting of participants' opposing positions held in the same currency). This makes these offshore infrastructures more suitable for handling the currencies commonly used in payment transactions, at a lower cost than that associated with the use of correspondent banks.

They thus contribute to improving systems' efficiency and effectiveness. Lastly, in certain cases, such as multi-currency CCPs or multi-currency payment systems, they allow the netting of positions between different currencies (see calculation of the Aggregate Short Position Limit for CLS, Chapter 9, Section 2.3). For the CCPs' clearing of financial instruments, this netting can reduce margin call-related collateral requirements (see Chapter 11, Section 3).

3.3. Specific risks of offshore infrastructures

Offshore infrastructures, however, have their own specific risks, linked to their remoteness from the central bank of issue with which they deal.

An offshore infrastructure that processes a very large amount of foreign currency-denominated transactions is a source of risk for the currency zone in question, particularly in terms of liquidity. For example, some participants in domestic payment systems may rely on euro liquidity from offshore systems to settle their end-of-day debit positions in domestic systems. Similarly, because offshore infrastructures generally have no direct links with the central bank of issue, liquidity management could prove ineffective in the event of stress. The misalignment of interests between an offshore infrastructure and the central bank of issue is itself a source of risk: experience shows that, for example, a euro-processing CCP established outside the euro area that is not regulated primarily by one or more euro area supervisors is likely to take measures contrary to the interests of and with a potentially systemic impact on the euro area, with no possibility of intervention by the euro area authorities. The euro area experienced this situation during the sovereign debt crisis that affected certain euro area countries between late 2011 and early 2012 through summer 2012, when a UK CCP took pro-cyclical decisions to increase initial margins and collateral haircuts, that were potentially detrimental to the euro area's financial stability without first consulting the Eurosystem, the body responsible for said financial stability.

These financial stability issues are also crucial for market players, who need a secure framework for the processing and clearing of their transactions.

Offshore infrastructures must not threaten the financial stability of the markets or currencies of the central banks of issue concerned. As such, they must be governed by a risk control system. There are various ways of controlling the related risks, in particular (i) limiting volumes by implementing a location policy, and (ii) subjecting the infrastructures in question to enhanced oversight, with the central banks of issue playing the main role.

3.3.1. Example: the Eurosystem payment system location policy

Monetary authorities use location policies to help preserve financial stability and control their currencies, insofar as the implementation of monetary policy and the processing of payments in the issuing currency are intrinsically linked.

The Eurosystem oversight framework, published in July 2011 and revised in July 2016,[15] includes a policy for locating payment systems that handle euros. It is based on the principle that payment systems that handle a significant amount of euro-denominated transactions must be legally domiciled in the euro area and settle these transactions in a central bank currency. In addition, operational control and responsibility for all these transactions' critical functions must be carried out in the euro area. According to the principles set out in this location policy, euro-denominated transactions in offshore payment systems must be repatriated to the euro area if these systems settle more than EUR 5 billion daily or individually account for more than 0.2% of the total value of euro-denominated transactions settled by euro area interbank payment systems.

Currently, there are very few payment systems handling euro-denominated transactions outside the euro area. They are: euroSIC in Switzerland, CHATS EUR (HK) in Hong Kong, whose activity in euros remains very limited (beneath the location policy activation threshold) and CLS, which handles significant amounts far in excess of the specified ceilings but benefits from an exemption to the location policy, a concession that the Eurosystem can grant in very specific cases. The CLS exemption is currently the only one granted. CLS is a PvP multi-currency settlement system (see Chapter 9), which by definition is an offshore system for all but one of the currencies it handles, the US dollar (since CLS Bank is located in the US). The Eurosystem granted an exemption to CLS, for PvP payments only, on the basis that it reduces settlement risk on foreign exchange transactions. In return, the Eurosystem is closely involved in monitoring CLS under a cooperative oversight arrangement between the G10's central banks (and those whose currencies the system handles), under the aegis of the US Federal Reserve (see Chapter 9, Section 3).

15 *https://www.ecb.europa.eu/pub/pdf/other/*

3.3.2. The case of offshore CCPs

CCPs that clear transactions in euros are critical to both financial stability and the implementation of monetary policy; in this regard, a CGFS report in 1994[16] highlighted the importance of derivative mandate.

A CCP that handles transactions in a given currency and which, being located outside the central bank of issue's currency zone, is not primarily supervised by an authority in that zone, can take measures or have measures imposed on it by its national supervisor that conflict with the interests of the currency zone, without that zone's authorities being able to intervene (see above).

In this context, locating financial instrument clearing activities in the currency zone itself is the safest way of ensuring these infrastructures' security, as the central bank's proximity allows it to monitor the relevant CCP's liquidity management system. In cases of extreme market pressure, the central bank may, on a discretionary basis and within the limit of the eligible collateral that the CCP can provide, supply emergency liquidity.

3.3.3. Enhanced oversight mechanisms involving central banks of issue

In addition to implementing a location policy, another way to preserve financial stability with regard to offshore infrastructures, although less effective than the location policy, is to put in place an oversight system in which the central banks of issue of the currencies of the processed financial instruments wield real power alongside the competent national authorities, with prior approval of any extension or change to the risk management framework, as well as a right of veto and the imposition of emergency measures in the event of a threat to the financial stability of the issuing zone in question. To date, such effective enhanced oversight systems do not exist; oversight authorities apply either a location policy or direct, so-called extra-territorial oversight (in the United States, for instance – see Chapter 18). Necessarily, only a location policy allows the central bank of issue to intervene quickly and effectively. Direct oversight and offshore CCP cooperation arrangements allow no such intervention, since they are not binding and based on the goodwill of the home country's authorities, both in terms of the transmission of information and the decision-making needed to preserve financial stability.

It is thus perfectly conceivable that a CCP be subject to contradictory requirements from regulators of different jurisdictions, particularly in times of crisis, with each pursuing its own mandate to defend its currency zone's financial and monetary stability or preserve its clearing members' financial solidity. If this tool was used on CCPs, it could make crisis management even more problematic.

Lastly, there is no mechanism for resolving conflicts between regulators, and the uncertainty resulting from this could further exacerbate financial destabilisation, especially in times of crisis. Ultimately, the extra-territorial oversight method could prove ineffective in such situations.

The European Commission took these risks into account in its proposed EMIR revision concerning third-country CCP oversight, published on 13 June 2017.[17] They suggest a graduated approach based on the risks posed by these CCP which clear European Union currency-denominated financial instruments, and define three categories of CCPs, the last of which is subject to an obligation to relocate to the European Union:

- third-country CCPs considered non-systemic, which can continue to be supervised according to the current equivalence regime, i.e. 'deference' to the local regulator(with a few adjustments);

16 *https://www.bis.org/publ/ecsc04.pdf*

17 *http://eur-lex.europa.eu*

- third-country CCPs considered systemic, which must be subject to enhanced extra-territorial supervision by the home authorities;
- third-country CCPs considered of supersystemic importance, whose activities must ultimately be relocated to the European Union.

According to these proposals, the concept of systemic importance is assessed based on various criteria, in particular the aggregate value, in each European Union currency, of the CCP's cleared transactions, the potential impact of the CCP's default on the financial markets or on the financial stability of the European Union's currency zone or that of one of its Member States, and the interdependencies between the CCP and other infrastructures, clearing members and the financial system as a whole.

While the relocation of the activities of CCPs of substantial systemic importance is recognised in principle, when this document was drafted the European Commission's proposed EMIR revisions had yet to be ratified by the European Parliament and the Council. Furthermore, on 22 July 2017 the European Central Bank's Governing Council issued[18] a recommendation to amend Article 22 of the ECB's Statute to give it powers in the area of financial instrument clearing.

The primary responsibility for risk management lies with financial market infrastructure operators. Given the risks they face and their key role in the financial sphere, financial market infrastructures must comply with security and risk management rules on the one hand, and be supervised by the authorities on the other. Central banks in particular have a crucial role to play in preventing systemic risk.

18 *http://www.ecb.europa.eu/press*