

# Legal Constrains of Smart Contracts in the Context of the Article 104 CRR

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## Abstract

The 2007 Global Financial Crisis revealed material weakness in the boundary between trading and banking books. Consequently, this boundary was revised by the Basel Committee, leading to an amendment to the Capital Requirement Regulation. Smart contracts can be applied diversely, including to assign positions to a trading or banking book. However, legal constraints could limit the smart contract utilization for this purpose.

Assuming a European standalone institution, two main legal constraints can be identified in the application of smart contracts. First, legal definitions and requirements are mostly qualitative in nature. This means that a smart contract cannot perform a certain justification, as it requires a quantitative interpretation. Second, certain governance processes and risk management reviews are complex and highly economic, demanding a high cognitive ability. A smart contract is therefore limited in its ability to tackle the required exercises, being able to only support these processes and reviews.

## Catchwords

Capital Requirement Regulation, Fundamental Review of the Trading Book, Trading Book, Banking Book, Boundary, Smart Contract, Distribution Ledger Technology

## Regulations

Regulation (EU) No 575/2013, Proposal for a regulation amending Regulation (EU) No 575/2013 on requirements for credit risk, credit valuation adjustment risk, operational risk, market risk and the output floor

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## I. Introduction

An institution such as a bank is mandatorily required to allocate each financial instrument to a banking or trading book. The main allocation criterion is the business purpose of a financial instrument. The assignment of a financial instrument to either book sets out several requirements for prudent valuation, risk management, governance, own fund requirements, etc. The Global Financial Crisis that began in 2007 revealed that trading book positions accumulated significant losses due to which own fund requirements became inappropriate and institutions had to be bailed out.

Therefore, to increase the overall financial stability, the Basel Committee reviewed the boundary between trading and banking book and concluded that the objective boundary between the two was just one aspect of the financial weaknesses, as institutions optimized their own fund requirement by regulatory arbitrage. All the findings and a revised boundary were summarized in the Fundamental Review of the Trading Book (FRTB).

Capital requirements of institutions domiciled under the European Union are subject to Capital Requirement Regulation (CRR), that is, Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012 (Text with EEA relevance), OJ L. 2013/176, 1. The European regulator utilized the FRTB findings to amend the CRR. With respect to the boundary between trading and banking book, Regulation (EU) No 2019/876 of the European Parliament and of the Council of 20 May 2019 amending Regulation (EU) No 575/2013 as regards the leverage ratio, the net stable funding ratio, requirements for own funds and eligible liabilities, counterparty credit risk, market risk, exposures to central counterparties, exposures to collective investment undertakings, large exposures, reporting and disclosure requirements, and Regulation (EU) No 648/2012 (Text with EEA relevance.), OJ L. 2019/150, 1. implements an objective boundary and introduce requirements for the management, reclassification, and valuation of trading book positions. Proposal for a regulation amending Regulation (EU) No 575/2013 of the European Parliament and of the Council of 27 October 2021 on requirements for credit risk, credit valuation adjustment risk, operational risk, market risk and the output floor (Text with EEA relevance) adds several exceptions for the general position assignments to the trading or banking book. Comments related to this proposal refer to the version published on 27 October 2021. Further, CRR will henceforth refer to the valid version of Regulation (EU) No 575/2013 including amending Regulation (EU) No 2019/876.

Along with the revised regulatory framework, the financial industry is influenced by technological innovation. In particular, the increasingly popular distributed ledger technology can be utilized instead of existing instruments or processes. Two good examples of such technology are crypto assets and smart contracts. Smart contracts have become an alternative for traditional contracts as they provide advantages such as automated contractual performance, resulting in, for example, more efficient post-trade processes<sup>1</sup>.

Whether smart contracts be utilized to support the position assignment process to a trading or banking book is debatable. Addressing this, the central question of this research is,

What are the legal constraints of smart contracts in the context of Article 104 CRR?

The fundamental motivation behind this research question is that a smart contract can assign financial instruments to a banking or trading book. It can also review all the necessary requirements to comply with Art 104 CRR. From an economic perspective, a smart contract is used because it needs to be implemented only once for the institution to capture the related economies of scale. Additionally, it can reduce institutions' regulatory uncertainty. Assuming a smart contract is updated and fully compliant with CRR, the assignment of financial instruments to a banking or trading book is consistent and in line with the capital regulation. This means that an institution cannot breach a regulatory requirement.

From a technical perspective, a smart contract is integrated into a distributed ledger technology. It is a unique feature that it can not be modified. The contract can be updated though an add-on, which is »visible« on the distributed ledger. This creates an additional certainty for institutions as they are restricted from amending the smart contract and changing the assignment of positions to a trading or banking book.

As a smart contract follows a certain logic, the assignment process is completely transparent and can be examined under certain conditions. Users of the distributed ledger technology can review, investigate and test the smart contract. If a competent authority is interested in an assignment under certain circumstances, with access to the smart contract, they could independently review the implemented boundary between the trading and banking book and draw conclusions.

However, whether a smart contract can maintain and perform all the requirements and necessary actions remains questionabale. A potential area of conflict is the fulfillment of legal requirements, as a smart contract

<sup>1</sup> Cf *European Securities and Market Authority*, The Distributed Ledger Technology Applied to Securities Markets.

is a sequence of logical commands and decisions. The larger the room for legal interpretation, the more challenging it is for a smart contract to review the requirement. Therefore, the research question points to the legal limitations in Art 104 CRR when applied to a smart contract. This study's purpose is to provide a list of such legal constraints. However, it is noteworthy that the legal limitations reduce the scope of applications but do not suggest that such applications are impossible.

This legal investigation is organized as follows: Section 2 introduces the general framework, describes the considered institution and the applied accounting treatment, and discusses smart contracts. Section 3 examines the legal limitations of smart contracts with respect to the legal definition of trading intent. Section 4 provides an overview of the legal constraints in the inclusion and reclassification of trading book positions. As a practical guideline, Section 5 details a decision tree, that is the logic behind how positions are assigned to a trading or banking book. Section 6 introduces the legal constraints in prudent valuation. Finally, Section 7 provides the concluding remarks.

## II. Framework

### A. The institution

This chapter will first introduce the considered institution and then the related regulatory and technical framework related to the research question, which aims to describe the basis of the financial company and the smart contract. The considered institution, in compliance with Art 4 (2) No 3 CRR is either a credit institution<sup>2</sup> or an investment firm<sup>3</sup>. It is domiciled under the European Union (EU) and does not have any branches<sup>4</sup> or subsidiaries<sup>5</sup> within or outside of the EU; therefore, it is subject to European regulation only and is under the supervision of a European authority. The institution, which can be described as a European and standalone institution, is assumed to be fully licensed and headquartered in an EU member state.

Furthermore, it is supervised by the national competent authority of the headquarter location<sup>6</sup>. Thus, the

<sup>2</sup> Cf Art 4 (2) No 1 CRR.

<sup>3</sup> Cf Art 4 (2) No 2 CRR.

<sup>4</sup> Cf Art 4 (2) No 17 CRR.

<sup>5</sup> Cf Art 4 (2) No 16 CRR.

<sup>6</sup> In case, the institution is classified as a systemic relevant institution, the competent authority is the European Central Bank (ECB). In accordance with *Regulation (EU) No 1024/2013* of the European Parliament and of the Council of 15 October 2013 conferring specific tasks on the European Central Bank concerning policies relating to the prudential supervision of credit institutions, OJ L. 2013/287, 1., the governing law remains CRR. Due to the economic importance of a systemic relevant institution, an enhanced supervisory could be the result.

institution must meet Art 11 CRR requirements and the application of these requirements is considered on a consolidated basis.

With respect to its accounting treatment of this institution follows the International Financial Reporting Standard (IFRS) 9<sup>7</sup>. This accounting standard has a broad and general application in the financial industry and is specifically designed for financial assets and instruments. However, IFRS 9 is used as an accounting standard for consolidation purposes. Therefore, IFRS 9 may not be the appropriate accounting standard. In a standalone institution, a consolidation would have the same results as an individual treatment. As consolidated and individual treatment for this institution is similar and due to its practical relevance, it is assumed that the institution follows IFRS 9.

Finally, the scope of this legal assessment is solely from a regulatory perspective. Any other legal considerations, for example, an examination under civil law, are not performed. Therefore, the lack of legal considerations is a limitation of this assessment.

### B. International Financial Reporting Standard 9

The object of IFRS 9 is to introduce accounting principles for financial assets and liabilities and provide relevant information such that a financial statement can be verified from various dimensions<sup>8</sup>. In general, all financial instruments are subject to IFRS 9<sup>9</sup> except for the rights and obligations under leases according to IFRS 16, employee benefit plans as under IAS 19, equity instruments subject to IAS 32, insurance contracts defined in IFRS 17, agreements subject to IFRS 3, and share-based payment as per IFRS 2<sup>10</sup>. The fundamental logic behind IFRS 9 is that classifying positions to certain accounting treatments follows the business model of the institution<sup>11</sup> and the characteristics of the contractual cash flows of the financial instrument<sup>12</sup>. Therefore, financial products are not classified based on individual aspects such as the position or trade level but instead on a higher, aggregated level considering the (sub) business model. This means that a particular accounting treatment for an entire business segment or function is considered. Additionally, each financial instrument is classified at initial recognition and the assigned accounting treatment is irrevocable. The accounting treat-

<sup>7</sup> IFRS 9 is the »successor« of IAS 39.

<sup>8</sup> Cf IFRS 9.1.1.

<sup>9</sup> Cf IFRS 9.2.1.

<sup>10</sup> The list of exception is not complete. The entire list is observable under IFRS 9.2.1.

<sup>11</sup> IFRS 9 considers the business model of a specific entity. As the considered institution is standalone, entity and institutions are synonyms.

<sup>12</sup> Cf IFRS 9.B4.1.1.

ment during the lifetime of a financial instrument can be amended only if the business model of the institution changes. However, an updated business model does not necessarily lead to an adjustment in the accounting treatment, as the accounting flags are reviewed under the new circumstances. Further, when a re-considering the accounting treatments, only the financial assets can be modified, as the treatment of financial liabilities are irrevocable.

IFRS 9 introduces three different treatments: Amortised cost (AC)<sup>13</sup>, Fair Value through Other Comprehensive Income (FVtOCI)<sup>14</sup>, and Fair Value through Profit and Loss (FVtPnL). AC and FVtOCI have the common condition that *»cash flows [...] are solely payments of principal and interest on the principal amount outstanding«*<sup>15</sup>. The fundamental difference between AC and FVtOCI is that the financial instruments under the former are held till maturity to collect contractual cash flows while it is possible to sell the asset during its lifetime under FVtOCI. Thus, the main purpose of a financial instrument under AC is to collect contractual cash flows, that is the principal and interest; the management of the overall returns is less relevant. To determine whether a financial instrument is held to collect contractual cash flows, the business behavior of the business segment should be examined. This investigation captures the frequency, value, and timing of sales in previous periods. These historical observations are used as an indicator for future activity, and the sales activities can be used to undermine the business model and thus justify the selection of the accounting treatment. If the business model suggests that AC or FVtOCI is not appropriate, then FVtPnL becomes the default category.

It is noteworthy that the classification is performed under the assumption of an absence of financial stress. This is because an institution might have to sell its assets in a stressed period, resulting in the selection of a different accounting treatment. Moreover, an institution could deviate from its normal business behavior to realize cash flow under stress, for example, by selling the assets booked under AC<sup>16</sup>. Therefore, a financial asset may not be held till maturity and still be accessed at AC, if its business objective is to collect contractual cash flows<sup>17</sup>.

For example, a business model of a segment could be the institution's duration management of the assets

and liabilities. It is essential for an institution to manage the duration gap between assets and liabilities as it represents a large risk. The liabilities of an institution are exemplarily fixed-rate mortgages. To mimic these liabilities, the institution buys fixed-rate bonds with the same duration. As fixed-rate mortgages are less price sensitive, the institution aims to consume the contractual cash flows of the purchased bonds, thus reducing the interest rate risk and the duration gap. Therefore, it is justifiable that the bond positions, that is, financial assets of an institution, are held under AC as fixed-rate mortgages are held till maturity, as well. Nevertheless, this assessment also considers external aspects such as the credit risk with respect to the issuer of the financial instrument<sup>18</sup>. This means that the classification of a financial instrument to a certain accounting treatment must consider the internal and external aspects and perform an overall assessment.

Fixed-rate bonds can be held under any accounting treatment; therefore, the main reason for a different classification is the business model. However, not all financial instruments have such a freedom. A floating rate note (FRN) is a bond with a periodic reset of coupon payment. It includes the element of modification and is therefore called imperfect. Due to the reset in interest rates of a FRN, its time value of money (TVM) is modified. Hence, it is questionable whether holding an FRN satisfies the pure consumption of contractual cash flows, that is whether FRN is allowed to hold under AC or FVtOCI. It is therefore necessary to determine how the contractual cash flows of the FRN differ from a reasonable benchmark, that is, a financial instrument without the element of a modified TVM. If the contractual cash flows differ significantly from each other, the financial asset does not meet the condition that the contractual cash flows consist of interest on the principal amount and sole payments of the principal. Consequently, the financial asset must be FVtPnL. In addition, typical examples of financial instruments classified as FVtPnL are derivatives or swaps.

### C. Smart contracts

All financial instruments are set up using civil law contracts between two or more counterparties. Over the last decade, crypto currencies have become increasingly popular and resulted in the introduction of smart contracts. Nick Szabo<sup>19</sup>, a crypto asset researcher, was the first to introduce the idea of a smart contract. Heuristically, a smart contract is a self-executable computer pro-

13 Cf IFRS 9.B4.1.2.

14 Cf IFRS 9.B4.1.2A.

15 Cf IFRS 9.B4.1.2B.

16 Generally, an asset under amortised costs should be held till maturity. Under specific circumstances, an institution is allowed to sell these assets prior their maturity, for example, if the creditworthiness of the issuer declines.

17 Cf IFRS 9.B4.1.3.

18 Cf IFRS 9.B4.1.3A.

19 Cf Szabo, Smart contracts: Building blocks for digital markets, The Journal of Transhumanist Thought (1996), 16.



gram that can »fulfill« an agreement between various counterparties. The term contract has various meanings depending on the context. A legal contract is agreed under a certain law with rights and duties for the counterparties. However, in a programming context, a contract represents a specification for system implementation.

Following the idea of Lessig<sup>20</sup>, we assume that the code and, hence, a smart contract is »law«. Additionally, as mentioned earlier, a smart contract is implemented on a distributed ledger, from which the smart contract receives an input and provides an output. An output is, for example, an executable transaction or command, whereas an input can be observed transactions or other parameters. Along with a smart contract, any transactions are integrated into the underlying distributed ledger. This means that all transactions and smart contracts are saved on the distributed ledger and thus reconcilable. To compute executable commands, a smart contract receives and uses different input parameters to apply a pre-defined algorithm or logic. Based on this logic, an outcome or executable command is computed. The counterparties of the smart contract trust the computation accuracy of the algorithm which is why the code is »law«.

An essential difference between a legal and a smart contract is that the latter can automatically detect a breach and trigger certain actions. For example, in a loan between an institution and a company the conditional terms are laid out through a smart contract, that is, the contract monitors the terms. If the smart contract detects a violation of the agreement, it triggers additional measures such as an increase in the interest rate or sending out a notification. A smart contract is deployed on a blockchain such as Ethereum, which is distribution ledger technology. From a technical viewpoint, a blockchain consists of various blocks originating from the genesis block. Each block is chained via a reference to its previous block, thus forming the blockchain. It is worth mentioning that every additional block is attached to the existing blockchain only if a computational puzzle is solved, which proves and simultaneously validates the additional block. This verification process enhances the security and protects the blockchain against forgery, as invalid blocks with malicious content are detected and flagged. This feature increases the security and correctness of the blockchain resulting that users can be confident about the soundness of a blockchain and, consequently, in the commands of the smart contract. Since a blockchain is decentralized, there are various copies of the blockchain and the verification process can be performed independently. This is an additional layer of security, and the blockchain is thus deemed unforgeable.

20 Cf Lessig, Code: And other laws of cyberspace.

However, this high degree of security implies that the blockchain content can not be changed as it is appendonly. This means that data added to the blockchain can not be deleted later<sup>21</sup>. Thus, smart contract is deployed on a blockchain, it can neither be deleted nor amended, thus making it irrevocable. However, smart contracts can receive add-ons, that is, the contract's logic can be adjusted, if necessary. Once a smart contract is deployed on the blockchain, it receives a unique identifier, an address, through which it can communicate with the network. Additionally, the smart contract validates input parameters autonomously and constantly reviews whether a command or transaction must be triggered. Such services of a smart contract are free of charge but the blockchain charges with a fee called gas.

In the assessment the smart contract is considered from a technical viewpoint as an auxiliary instrument. That is, the smart contract receives input parameters and computes an outcome or executable command based on a certain logic. In the current case, the output of the smart contract is the assignment of a financial instrument to a banking or trading book. An interpretation of a smart contract as a legal contract, from the perspective of civil law or any other legal interpretation should not be drawn. The constraint in interpretation represents a limitation of this research as the research object is the regulatory assessment of the boundary between trading and banking book.

In addition, the relevant European capital requirements are technologically neutral. As the considered institution is compliant with the national law and the European and national regulatory requirements, it is assumed that the application of the smart contract within the member state is not prohibited. However, the institution's management shall perform a risk assessment for the usage of the smart contract.

#### D. Basic principles

According to CRR a financial instrument shall be assigned to two books: trading and banking book. This regulation has been amended by Regulation (EU) No 2019/876. As a convention CRR always refers to the current valid version of Regulation (EU) No 575/2013, including amending Regulation (EU) No 2019/876. A motivation behind differentiating between trading and banking book is the appropriate calculation of own funds such that the amount of own funds adequately represents the related risk<sup>22</sup>. Here, a precise accounting

21 This feature could lead to concerns regarding data security. However, aspects of data security and protection are not within the scope of this research paper.

22 Cf CRR Recital 39.

technique is required. The valuation of assets and off-balance sheet items is described in Art 24 CRR, which belongs to the section on the scope of prudential consolidation. Such institutions are particularly affected by Art 24 CRR, which needs them to satisfy the requirements on a consolidated or a partially consolidated basis in accordance with Art 11 CRR. As discussed in Section 2.1, the considered institution is assumed to meet the Art 11 CRR requirements. These requirements are indirectly applicable to all members of an institution or financial holding as the valuation needs to be in accordance with the applicable accounting standard with exemplarily an obligation to transmit the relevant data for consolidation. Although Art 24 CRR sets out the requirements for the supervisory consolidation, all the requirements need to be fulfilled on an individual basis. As the valuation of own funds relies on these inputs, there is an indirect relationship with external accounting. Additionally, the legal definition of »applicable accounting framework«<sup>23</sup> also creates a link between external accounting and prudential data. The importance of accounting is illustrated in Recital 39: the accounting technique should »be used for the calculation of own funds, their adequacy for the risk to which an institution is exposed, and for the assessment of the concentration of exposures«<sup>24</sup>.

Art 24 (2) CRR contains an option for the competent authority to require institution to value assets and off-balance sheet items according to International Accounting Standards (IAS)<sup>25</sup>. This is a derogation of paragraph 1. However, the wording in paragraph 2, »in derogation of paragraph 1« highlights that this is only an option for the institutions that are not required to carry out the valuation in line with paragraph 1. Overall, the option seems feasible only if the current accounting framework in accordance with Art 4 (1) No 77 CRR is not fully compliant with IFRS<sup>26</sup>. This strengthens the assumption that the considered institution follows IFRS 9.

With respect to the material scope of application, Art 24 (1) CRR refers to the valuation of assets and off-balance sheet items. Art 24 CRR is consistent with Art 111 and 166 CRR in terms of asset valuation, with the book value as the general starting point. Regarding the off-balance sheet item, capital regulation provides deviating valuation concepts, for example, in accordance with Art 111 CRR<sup>27</sup>. Additionally, Art 24 CRR addresses

the »valuation« of various balance sheet items. In this context, valuation needs to be understood in a broader context, that is, not limited to the valuation in mathematical terms but also considering the valuation standard and its method, unless the supervisory law specifies differently. The reason for this broader understanding is that assets and/or liabilities can consist of different components, requiring various methods and measurements to obtain a prudent valuation.

Art 24 CRR integrates the accounting standard into the regulation. As the accounting standards and regulation provide various definitions, it is uncertain whether the term »asset« can be compared in both frameworks. CRR does not introduce a legal definition for assets, but utilizes it in several instances. For example,

- ▷ Assets in compliance with Art 4 (1) No 50 lit a CRR describe financial contracts. This definition is inline with IAS 32.11<sup>28</sup>.
- ▷ In Art 4 (1) No 109 CRR, assets are used to describe »calculated after they have been reduced by the amount of obligations under the same fund or plana defined pension fund or plan, as applicable,«<sup>29</sup>.
- ▷ Art 4 (1) No 115 CRR introduces intangible assets in line with the applied accounting framework including goodwill.
- ▷ Art 34 CRR sets out additional requirements for prudent valuation with respect to fair valued assets.

In the absence of a legal definition of »assets« and since the accounting framework is used as a basis for measurement, it must be assumed that the chosen accounting framework is utilized as a basis for defining assets – unless CRR introduces deviating requirements or treatments. A similar conclusion can be drawn for »liabilities« as CRR does not provide a corresponding legal definition. CRR introduces exemplarily a deviating treatment for derivatives in line with Annex II, as these financial contracts are considered as derivative risk positions and valued as in Art 271 CRR.

Since the accounting treatments determine the valuation method for the assets and off-balance sheet items, their direct impact on the supervisory risk position valuation is noticeable. Indirectly, the valuation affects the requirement and amount of institutional own fund. This is because own funds predominately function as loss absorbing assets, as mentioned in Recital 39<sup>30</sup> and Basel III<sup>31</sup>. However, whether the valuation of own fund instruments will follow the applicable accounting framework remains debatable. This is especially relevant

23 Cf Art 4 (1) No 77 CRR.

24 Cf CRR Recital 39.

25 The International Accounting Standards are set out in *Regulation (EU) No 1606/2002* of the European Parliament and of the Council of 19 July 2002 on the application of international accounting standards, OJ L. 243, 1.

26 Cf Grünberger/Sopp in Dellinger/Blume, Regulation (EU) 575/2013 Recital 8.

27 Section 6 discusses further valuation adjustments.

28 Cf IAS 32.11.

29 Cf Art 4(1) No 109 CRR.

30 Cf Regulation (EU) No 2019/876 Recital 39.

31 Cf Grant, Mitchell. Tier 1 capital, Investopedia [Internet Page].

to additional tier 1 (AT1) and supplementary capital (Tier 2). Instruments of common equity Tier 1 (CET1) capital according to Art 28 (1) lit c No ii CRR are required to be classified as balance sheet items. In general, CET1 includes common shares or retained earnings, etc. AT1 enhances the institutional loss absorbing capacity and consists of nonredeemable preferred stocks or qualifying minority interest, etc. Tier 2 and AT1<sup>32</sup> financial instruments are classified as debt capital and treated accordingly. Therefore, there might be a difference between a carrying and a nominal amount, which is in particular noticeable in the scope of the fair value option. If IFRS 9 finds application, AT1 and Tier 2 instruments are considered at their carrying amount.

### III. Legal definition of the trading book

Each institution contains two different types of books: the banking and the trading book. As per Art 6 (1) CRR positions need to be classified to a banking or trading book on an individual basis. That is, each position needs to be reviewed separately and assigned case-by-case. CRR provides a legal definition of a trading book in Art 4 (1) No 86 CRR. The legal definition of a trading book includes »*all positions in financial instruments and commodities held by an institution either with trading intent or to hedge positions held with trading intent in accordance with Article 104*«<sup>33</sup>. Implicitly, it can be assumed that the corresponding residual, the non-trading book, refers to the banking book.

The material scope of the application of a trading book includes financial instruments in accordance with Art 4(1) No 50 CRR and commodities. A financial instrument is, by definition, a contract between at least two counterparties, with financial assets and liabilities, an instrument in compliance with Section C of Annex I of Directive 2004/39/EC<sup>34</sup>, a derivative<sup>35</sup>, a primary<sup>36</sup> financial instrument, or a cash instrument<sup>37</sup>. A contract involves financial assets and liabilities between counterparties. Instruments according to Section C of Annex I of Directive 2004/39/EC<sup>38</sup> and derivative financial instruments are

classified as financial only, if their value can be derived from the underlying instrument, item, rate, or index. A typical example for a financial derivative is a stock option. If such a valuation is not possible, the instrument can not be classified as a financial instrument. An example of a non-financial instrument is intellectual property.

Due to the 2007 Global Financial Crisis, the Basel Committee began a review process of the boundary between trading and banking book which resulted in the Fundamental Review of the Trading Book (FRTB)<sup>39</sup>. A key outcome of FRTB was that the boundary was not made sharp enough giving institutions a certain degree of freedom. The subjective boundary allowed institutions to optimize the assignment of trading and banking book positions to minimize their own fund requirements. This was a structural weakness of the boundary introduced in 2013 and revised by Regulation (EU) No 2019/876<sup>40</sup>.

The designation of risk positions to a trading or banking book was expected to satisfy the different risk profiles, positions requiring distinct risk management and own fund requirements<sup>41</sup>. In general, the boundary is characterized by endogenous variables, such as trading strategy, and exogenous variables, such as the static data of a financial instrument.

The legal definition of a trading book requires that the financial instruments and commodities be held with trading intent. »Positions held with trading intent« is the legal definition according to Art 4 (1) No 85 CRR.

Trading intent is assumed if at least one of the following requirements are met: The position is held to serve clients arises from market making activity or is proprietary driven; the position is purchased with an intent to resell over a short term; the position is held to profit from the expected and actual short-term price differences between the ask and bid prices. This short-term price difference can be caused by any price or interest rate variations or differentials. As this legal definition is a key component of the boundary between a trading and a banking book, various aspects of this definition will be discussed in detail.

#### A. Market making

The first part of the legal definition focuses on the business model of market making, serving client needs, and

32 The classification of AT1 financial instruments are dependent on their contractual design.

33 Cf Art 4 (1) 86 CRR.

34 Cf Directive 2004/39/EC of the European Parliament and of the Council of 21 April 2004 on markets in financial instruments amending Council Directives 85/611/EEC and 93/6/EEC and Directive 2000/12/EC of the European Parliament and of the Council and repealing Council Directive 93/22/EEC, OJ L. 145, 1.

35 An example for a derivative is an interest rate swap.

36 Exemplarily, a primary financial instrument is a stock, a bond, or a currency.

37 Cash instruments are, for example, a money market paper.

38 Cf Directive 2004/39/EC.

39 Cf Basel Committee on Banking Supervision, Fundamental review of the trading book: A revised market risk framework – Consultative document (Basel; Bank for International Settlements, 31 January 2014).

40 Cf Regulation (EU) No 2019/876 Recital 39.

41 Cf Schiwietz in Becker/Christ/Denter, CRR-Handbuch zur Solvabilität: Ansätze für Prozessverbesserungen und Prüfung der neuen Vorschriften.



proprietary positions. Market making is defined as a business activity of a market participant, an individual or a firm, who actively quotes on a two-sided market in a particular security<sup>42</sup>. The key task of a market maker is to provide liquidity. Thus, their main source of income is the bid-ask spread. Furthermore, a market maker is market neutral meaning they have no directional exposure<sup>43</sup>.

Client servicing refers to a business activity that is focused on satisfying the needs of a client. If a client aims to buy a directional exposure in a security, the institutions satisfy the demand by purchasing the corresponding financial instruments. Subsequently, the institution acts as an »intermediary« and sells the instrument to the client, thus remaining market neutral.

Proprietary positions refer to the positions an institution possesses for a self-motivated trading purpose, expecting, for example, the valuation of equity markets to increase<sup>44</sup>.

Whether a financial transaction was made for market making, serving client needs, or proprietary trading can be verified through a smart contract. In a common institution, business activities are separated into segments, establishing trading desks in accordance with Art 4 (1) No 144 CRR. Typical features of these desks are that a high average daily trading volume and a short lifetime of positions<sup>45</sup>. It therefore can be assumed that the intention of each position of a desk is market making. Thus, a smart contract can directly flag any new position of this desk as »position with trading intent«.

## B. Short term

The second part of the definition refers to positions that are intended to be resold on a short term basis<sup>46</sup>. The phrase »short term« is not legally defined by CRR. Therefore, the duration that the term refers to is debatable, and a smart contract can work only if the period is well defined. Overall, the phrase short term has been used 51 times in this capital regulation. It has also been used in the legal definition of trade finance pursuant to Art 4 (1) No 80 CRR, where trade finance services have a fixed short-term maturity of less than one year. This definition shows that a possible upper limit of short term is

one year. Further, Art 162 CRR refers to short-term trade finance, but it does not define the term further.

Short term is also used in credit assessment in accordance with Art 112, 140, and 195 CRR. All these articles do not provide additional insights into the interpretation of short term. Under Basel II<sup>47</sup>, short term is mainly applied to characterize short- and long-term credit assessment. Basel II utilizes the rating P-1, P-2, and P-3, which follows the method of Standard & Poor and Moody's. Here, this short-term credit assessment refers to a period up to 365 days<sup>48</sup>.

Basel II introduces a credit risk standardized approach, that considers risk weights of short-term claims in banks. According to this section, short-term claims have an initial maturity of three months or less. However, Basel III replaces the term short-term claims with short-term exposure and discusses various maturities within this section. The change from Basel II to III indicates that the utilization of short-term should be considered in a broader context. Further under Basel III<sup>49</sup>, the standardized credit assessment approach is revised and introduces a sovereign floor: »The sovereign floor will not apply to short term (ie with a maturity below one year) self-liquidating, trade-related contingent items that arise from the movement of goods«<sup>50</sup>. Therefore, according to the Basel Committee, short term within the credit rating assessment appears to refer to a period of one year.

In terms of liquidity, short term is mentioned in Art 103 (1) lit e CRR, stating that an institution should be able to liquidate or hedge a trading book position in a short term. Art 103 CRR discusses trading book management with respect to policies and procedures and shows that it should be considered from a general management perspective. Practically, hedging or the liquidation of a position should be achieved within a short period, typically within days or in exotic cases within a couple of weeks<sup>51</sup>. However, whether short term in Art 103 CRR is comparable with the usage in Art 4 (1) No 86 CRR is debatable. An institution generally has a high demand to hedge or, if needed, liquidate a position quickly to reduce an observed risk. Therefore, the period to hedge or liquidate in comparison with resell is reduced and the usage of short term within Art 103 CRR represents a specific application.

42 Cf *Bloomenthal, Andrew*. Market maker, Investopedia [Internet Page].

43 If an individual purchases, for example, a stock, the individual has a directional exposure, as he gains or losses if the stock price raises or declines, respectively.

44 Cf *Garvey/Murphy*, Entry, exit and trading profits: A look at the trading strategies of a proprietary trading team.

45 Lifetime of a position refers to the time period of a position between purchase and disposal.

46 The differences between short term and short-term is that the former is a singular, while the latter refers to an adjective. However, both terms point content-wise to the same direction. The analysis of this term considers both versions.

47 Cf *Basel Committee on Banking Supervision*, International convergence of capital measurement and capital standards: A revised framework.

48 Cf *S&P Global Ratings*. Issue credit ratings [Internet Page].

49 Cf *Basel Committee on Banking Supervision*, Basel III: Finalising post-crisis reforms.

50 Cf *Basel Committee on Banking Supervision*, Basel III: Finalising post-crisis reforms Recital 31.

51 Cf *Schweizer*, Risk-minimizing hedging strategies under restricted information.

A similar logic can be found in the usage of short term at Recital 49 and 50 of Regulation (EU) No 2019/876. Both recitals examine issues related to the liquidity cost ratio (LCR)<sup>52</sup> and net stable funding ratio (NSFR)<sup>53</sup> as there is an asymmetry between short-term funding and lending. Both regulatory measures aim to compare the cash-out and cash-in flows over 30 or 90 days. At first glance, this indicates that short-term funding and lending also refers to a period of up to 90 days. However, the regulatory measure computes only the related cash flows within the next 30 or 90 days; this refers to the remaining maturity of financial instruments. Since an institution can have longer tenures for its funding and lending, 30 or 90 days seems to be only an indication of the short-term assets and liabilities being considered for computation. From an institution's funding perspective, deposits are a key component and classified as liabilities. Client deposits, for example, are specified as non-eligible liabilities pursuant to Art 72a (2) lit d CRR. However, these short-term deposits have a maximum maturity of one year.

Overall, there is a strong indication that short term refers to a period up to one year, unless it is otherwise specified. This means that a smart contract can classify a financial instrument with a remaining maturity of one year as short term. However, a list of exceptions needs to be implemented, for example, if a financial instrument represents an exposure to banks.

The phrase short term has also been adopted in the definition of short-term resale. Thus, an investigation into the scope of resale is required. There is no legal definition of resale in CRR or a general description in FRTB<sup>54</sup>. Therefore, it can be assumed that resale follows the general (market) definition and convention. In the financial context, resale means that a financial instrument is purchased and sold later<sup>55</sup>.

From a theoretical or legal viewpoint, a position with a short-term resale purpose can be characterized as a buy and sell transaction, where the maximal period between the two financial transactions is one year. However, a financial instrument may be bought with the purpose of holding for several years. After a short period, for example six months, if business needs to sell the financial asset, the short-term resale requirement would be fulfilled. This raises the question whether the requirement of short-term resale needs to be reviewed at the initial or long-lasting state.

To answer this question, first, the constant evaluation of short-term resale requires the ability reassigning positions between the trading and banking book because if the short-term resale is not fulfilled, a reclassification would be required, and vice versa. However, Art 104a CRR allows a reclassification only under exceptional circumstances. A revaluation of business needs cannot be classified as such<sup>56</sup>.

Second, a reclassification from a banking to a trading book, or vice versa, could also trigger an amendment to the accounting treatment. The reason for such an accounting change can be that the business had initially decided to hold the financial instrument under AC. As Art 105 (3) CRR requires that trading book positions be fair valued daily, a reclassification between trading and banking book would cause an amendment of the accounting treatment. However, IFRS 9<sup>57</sup> prohibits a reclassification in accounting treatment. The only reason allowing a reclassification is a change in the business model, resulting in a general review of the accounting treatment. If the position is initially considered at fair value, from an accounting perspective, a reassignment between the trading and banking book would not affect the accounting treatment.

Third, a fundamental review of the trading book requires that the classification of a position to a trading or banking book be made at the initial stage<sup>58</sup>. Considering these arguments, the requirement of a short-term resale, or in more general terms, the trading intent must be fulfilled at the first recognition of the position. The assignment of a position to a trading or banking book is also consistent with the classification to an accounting treatment at initial recognition<sup>59</sup>. Therefore, to apply a smart contract, the trading intent must be reviewed at the initial stage. Once a financial instrument is classified under a trading or banking book position, it can not be amended, unless there exists exceptional circumstances<sup>60</sup>.

### C. Price variation

The difference between the buying and selling prices is highly time sensitive<sup>61</sup>. If a position is held to profit from an expected or actual difference between the buying and selling price or any other price or interest rate variation,

52 Cf *Basel Committee on Banking Supervision*, Basel III: The liquidity coverage ratio and liquidity risk monitoring tools.

53 Cf *Basel Committee on Banking Supervision*, Basel III: The net stable funding ratio.

54 Cf *Basel Committee on Banking Supervision*, Minimum capital requirements for market risk.

55 Cf *Collins*. Resale. Dictionary [Internet Page].

56 Art 104a CRR will be discussed in Section 4.3 in more details.

57 Cf IFRS 9.4.4.1.

58 Cf *Basel Committee on Banking Supervision*, Boundary between the banking book and the trading book (Risk-Based Capital Requirements (RBC)) Recital 25.13.

59 Cf IFRS 9.3.1.1.

60 Whether exceptional circumstances create any constraints regarding the application of a smart contract will be discussed in Section 4.3.

61 Cf *Kozhan/Tham*, Execution risk in high-frequency arbitrage.

the position belongs to the trading book<sup>62</sup>. Economically, the legal definition of »trading intent« is aimed to allocating arbitrage or statistical arbitrage positions to a trading book. The difference between arbitrage and statistical arbitrage is that the former is observable through market prices while the latter is stochastically computed. A typical example of arbitrage is a market participant buying a financial asset at exchange A and immediately selling it at exchange B for a higher price. The difference between the prices is the arbitrage gain. Statistical arbitrage refers to strategies that systematically screen the entire financial market for statistical differences between various financial instruments<sup>63</sup>. For example, a market participant observes that one company is statistically overvalued than another. Due to the statistical difference between the two companies' stock prices, the participant expects to capture this delta. However, this price difference is expected to decline gradually. Therefore, the lawmaker added the requirement that the actual and expected price differences remain on a short-term basis with respect to the definition of trading intent. As earlier discussed, short term means that the actual and expected price variation can remain for up to one year.

Whether a new position is intended to benefit from the expected or actual short-term price difference is mathematically challenging for a smart contract. To illustrate a potential review process of a smart contract with respect to the expected short-term price difference, consider a financial instrument bought with the intention of holding for several years. As the smart contract computes an expected short-term price difference for an existing position<sup>64</sup>, it is unsure whether the new position should be allocated to a trading or a banking book. In contrast to the holding period suggesting a banking book position, the expected short-term price difference indicates a trading book position. Based on the three criteria for »positions held with trading intent«<sup>65</sup>, the expected short-term price difference allows the position to be assigned to a trading book.

Nevertheless, whether the general intent to hold for a position long term has a higher priority than the estimated expected short-term price differences must be assessed. For this purpose, several cases of expected

short-term price differences<sup>66</sup> must be calculated. A smart contract has the ability to compute a huge variety of expected price differences using different mathematical models. Theoretically, such a contract must review all possible combinations of new and existing positions, which require enormous computational power<sup>67</sup>. Various financial mathematical models should be used in order to scan for the expected price differences in any dimension. The more combinations and models reviewed, the more likely the expected or actual short-term price differences are found. Consequently, a smart contract can find an expected short-term price difference for any position being allocated to a trading book.

However, the fundamental question is, under which circumstances would an institution enter a position given the expected short-term price difference. Economically, such a position would be justified only if the institution is confident about the expected price difference. An institution typically has several mathematical models to determine such price differences. Therefore, it can be assumed that the number of expected short-term price differences is finite and small. Nonetheless, the expected price differences that are reviewed will be in line with the related policies and procedures in accordance with Art 103 CRR, as otherwise, a rule might be violated. Thus, a countable set of expected short-term price differences seems to be sufficient to consider.

Next, assume that a smaller set of observations comprises expected short-term price differences. It still does not seem plausible that these short-term price differences have a larger significance than the business intent. This is driven by the intent to keep the position for a longer period. Consequently, even if there is a short-term price difference, the intent of the position is not to capture the market imbalance; therefore, the price difference is not consumable.

In summary, such a position should be assigned to a banking book as the overall intention points to a non-trading book. To support the long term intent, it could be useful to consider assigning the position to an AC portfolio so that the short-term price differences is out of range, as the financial instrument will be held till maturity.

#### IV. Inclusion and reclassification

In the revised regulatory framework the legal definition of the trading book refers to Art 104 CRR. In the version

62 Cf Art 4 (1) No 85 lit c CRR.

63 Cf *Chen, James*. Statistical arbitrage, Investopedia [Internet Page].

64 For simplicity, it is assumed that the position exists twice, i.e. in a trading and banking book.

65 The German version of Art 4 (1) No 85 CRR is not absolutely clear whether at least one criterium needs to be fulfilled. However, an instrument, which is held for at least one trading purpose, it can be concluded that the English version of the legal definition represents the lawmaker's intension. This interpretation is also in line with *Basel Committee on Banking Supervision*, Minimum capital requirements for market risk.

66 Expected short-term differences is mathematically a result of a certain quantitative model.

67 The computational power is a technical issue, which will not be discussed further, as technical constraints are not within the scope of this research paper.

of Regulation (EU) No 575/2013, Art 104 consists of two paragraphs. In the revision, the second paragraph was removed and assigned to Art 103 CRR. Art 104 CRR states which positions belong to a trading book to calculate capital requirements. For this purpose, institutions should have clearly defined policies and procedures in place that satisfy the requirements of Art 102 CRR and the legal definition of the trading book, that is, Art 4 (1) No 86 CRR. Their risk management capacities and practices should also be considered. It is also mandatory that the policies and procedures should be subject to a periodic internal audit review and the related compliance be documented.

### A. Policies and procedures

Policies and procedures are key elements of this article. The fundamental review of the trading book states that policies and procedures act as a vehicle to determine which position should be assigned to a trading or banking book. Policies and procedures ensure that governance and compliance criteria are fulfilled. This means, for example, that there will be a process among the institution's internal control functions that regularly reviews all the instruments at initial stage and determine whether the trading book criteria are fulfilled and no position is wrongly classified<sup>68</sup>.

The material scope of policies and procedures is described in Art 103 (1) CRR while the related governance is discussed in paragraph 2 of the same article. Policies and procedures should therefore be considered an essential and integral part of the overall management of the trading book. The following paragraphs describes the material scope of policies and procedures.

First, policies and procedures shall include activities with respect to the trading business for own fund requirements. As the material scope of Art 103 (1) lit a CRR is described as »activities which institution considers to be trading business«<sup>69</sup>, the institution has a certain degree of freedom as the term »trading business« is not further clarified. Thus, policies and procedures need to clearly define the scope of the trading business. Generally, trading business refers to day-to-day activities such as proprietary purchases, sales or hedging and trading of commodities, etc<sup>70</sup>. Additionally, these trading activities belong to the trading book and are considered »as constituting part of the trading book for own funds requirement purposes«<sup>71</sup>. Therefore, the range of financial instru-

ments subject to own fund requirements in line with Art 92 CRR, which consists exemplarily of CET1 and AT1 instruments, should be clearly defined.

Second, lit b and c of Art 103 (1) CRR set out the requirement that trading book positions must be marked-to-market daily. This is in line with the fair value accounting treatment requirement<sup>72</sup>. The difference between lit b and c is that the daily market values can either be determined directly from the market prices or indirectly from observable market factors<sup>73</sup>. However, both valuation techniques require a liquid two-way market. The second subparagraph of Article 325 (6) CRR defines that a two-way market is where »independent bona fide offers to buy and sell, so that a price that is reasonably related to the last sales price or current bona fide competitive bid and offer quotations can be determined within one day and settled at that price within a relatively short time conforming to trade custom«<sup>74</sup>. This definition of a two-way market also exists in the second subparagraph of Art 338 (1) CRR and is thus assumed to be generally applicable. A two-way market requires tradable ask and bid quotes so that financial transactions can be executed promptly and prices can be determined within a day, including a market's conventional settlement process. This definition is consistent with the relevant accounting treatment as fair value trading book positions must be calibrated daily, and hence, there is a demand for daily market prices. Further, as paragraph 8 of Art 325 CRR states »a liquid two-way market as described in the second subparagraph of paragraph 6«, it can be presumed that »liquid two-way market« and »two-way market« refer to the same object.

With respect to a smart contract, the definition of a liquid two-way market is not crucial. A smart contract must review three different aspects concerning a liquid two-way market: whether there are bona fide offers to buy and sell, the bona fide offers are independent from each other, and the settlement of a financial transaction can be achieved within a relatively short time period.

Bona fide offers are observable as various market makers provide offers that are directly tradable. Such bona fide offers are independent as various market markers provide them. Finally, the settlement process with market makers is fulfilled within a relatively short period, typically within one or two days<sup>75</sup>. This means that a smart contract, under normal conditions, can certify whether a financial instrument has a liquid two-way market.

68 Cf *Basel Committee on Banking Supervision*, Boundary between the banking book and the trading book (Risk-Based Capital Requirements (RBC)) Recital 25.13.

69 Cf Art 103 (1) lit a CRR.

70 Cf *Law Insider*. Trading business [Internet Page].

71 Cf Art 103 (1) lit a CRR.

72 Cf IFRS 9.4.1.1.

73 If a price is observable in the market, the valuation is called marked-to-market. Otherwise, if the price is calculated and modeled by factors, the valuation is known as marked-to-model.

74 Cf Art 325 (6) CRR.

75 Cf *Kagan, Julia*. Settlement date, Investopedia [Internet Page].



However, under volatile market conditions, such as the 2007 Global Financial Crisis or the financial turmoil at the beginning of 2020 due to the COVID-19 pandemic, market makers or other participants stop providing quotes<sup>76</sup>. Even if quotes are observable, a financial transaction will not be possible due to the risk aversion of market makers<sup>77</sup>. These market conditions can be classified as exceptional circumstances and an exemption from daily market prices is justifiable. However, it is also possible that exchanges suspend certain financial instruments from trading due to high volatility while the other financial markets function normally<sup>78</sup>. All these examples point whether a liquid two-way market will last long or several exemptions are »acceptable«. It is therefore highly challenging to conduct a practical review of a two-way liquid market. Additionally, a liquid two-way market is specific for each institution, because, for example, a large institution will generally require a much larger tradable volume in comparison to a smaller institution. Another challenge is related to certain financial products, that is, each institution will have a specific demand for tradable volumes depending on its business model. All these aspects prevent a liquid two-way market from being systematically reviewed by a smart contract. However, an institution can include a precise definition in its policies and procedure pursuant to Art 325 (8) CRR, making smart contracts feasible.

Even if an institution formulates a precise technical executable definition of a liquid two-way market, the smart contract could compute several violations of the liquid two-way market. Such »frequent« violations would not necessarily lead to a reclassification between trading and banking book positions, as Art 103 (1) lit b and c CRR only requires the daily valuation of a position with reference to a liquid two-way market. This means that violations of a liquid two-way market need to be an integral part of policies and procedures to describe the impact on valuation and how the lack of information on the incident or price can be resolved. Thus, the smart contract has two tasks. First, it must review whether the financial instrument has a liquid two-way market. If so, no further investigation is required. Second, if a liquid two-way market can not be confirmed, the smart contract must review

the necessary actions described in the policies and procedures. Whether a smart contract can also perform this review depends on the formulation of the related policies and procedures. Generally, the more technically a review process is described, the more likely it is that a smart contract executes the subsequent review.

The previous paragraphs focused on Art 103 (1) lit b CRR as the daily price observation, that is, the marked-to-market price, refers to a certain liquid two-way market. In contrast, lit c of Art 103 (1) CRR examines marked-to-model positions. In this case, a liquid two-way market is necessary for all material risks of the considered position. However, these material risks must first be identified. Therefore, policies and procedures includes a description of material risks and how they can be identified. »Material risk« is not a legally defined or standalone term in CRR. However, there exist a strong indication caused by Art 277 CRR that material risks refer to interest rate, foreign exchange, credit, equity, or commodity risks. Once the material risks are identified, Art 103 (1) lit c No ii CRR requires that the hedge instruments with respect to the material risks belong to a liquid two-way market. That is, the main difference between lit b and c of Art 103 (1) CRR is that the liquid two-way market is desired for either the financial instrument or its hedges for material risks. Nevertheless, the key issues of a smart contract regarding a liquid two-way market remain the same.

Third, lit d of Art 103 (1) CRR requires that the a position be externally and consistently valued. Therefore, policies and procedures need to capture the extent to which an external party can review the valuations and ensure that suitable data is provided.

The main exercise of a smart contract is to review the data flow and determine whether a valuation can be conducted using the data. Thus, the smart contract needs to know how certain positions are valued mathematically. Under such circumstances, the smart contract can review whether the necessary data points have been delivered to the external party and thus fulfill an audit requirement. A smart contract can monitor this process such that the requirement does not cause a limitation.

Providing necessary data to an external party does not ensure that a valuation of the positions can be conducted as the data quality must be reviewed. However, it can be assumed that the data quality is sufficient as, according to Art 106 CRR, the institution must ensure a prudent valuation. This means that insufficient data quality would represent a violation of Art 106 CRR, in turn, and a breach of Art 103 (1) lit d CRR. The discussion on data quality is therefore unnecessary at this stage and is subject to Art 106 CRR.

Fourth, the focus of Art 103 (1) lit e CRR is the extent of legal restrictions on institutions' ability to liqui-

76 Cf *Kubiczek/Tuskiewicz*, Intraday patterns of liquidity on the Warsaw stock exchange before and after the outbreak of the COVID-19 pandemic.

77 Cf *Subrahmanyam*, Risk aversion, market liquidity, and price efficiency.

78 For example, in February 2022, the London Stock Exchange suspended trading for a couple of days for the commodity nickel. The reason was a disfunction of this commodity market due to a short squeeze. For more details see *London Metal Exchange*. Disruption event – nickel closing prices [Internet Page]. It can be argued that the halt in trading seems to be a limitation of the constraint that a trading book position has to be free of restriction. This aspect will be discussed later within this section.



date or hedge a position in the short term. Legal restriction is not a legal term and must be understood in the general context. From a regulatory viewpoint, legal restrictions can refer to a license, concession, or bilateral agreement for trading a certain financial instrument at a designated platform. Additionally, there can be legal limitations on trading due to a) insider knowledge, for example, in accordance with Art 14 MAR<sup>79</sup> or Art 2 REMIT<sup>80</sup>; b) blackout periods; c) trading ban; or d) sanctions on counterparties. However, the listed legal limitation is not complete and should only illustrate the broad range of possible legal restrictions. Subsequently, Art 103 (1) lit e CRR also refers to other operational requirements that lead to a derogation in liquidation and hedging behavior. This could be bilateral agreements to prohibit a liquidation for a certain period, clearing or settlement failures, or accounting requirements, etc. Clearing and settlement failures can lead to a limitation as a financial instrument can be successfully liquidated only if the clearing and settlement process is successful<sup>81</sup>. If such a process regarding a position interacts with failures, the tradability of a product is reduced or even limited and further liquidation or hedging becomes more difficult. Accounting requirements must be considered as only fair valued financial instruments are free of any requirements to sell. If an instrument is held under AC, it should be held until maturity, because the financial instrument is held to collect the contractual cash flows.

Under exceptional circumstances, financial instruments can be sold prior to maturity, for example, if the creditworthiness of an issuer worsens and consequently the credit risk increases<sup>82</sup>. However, sufficient and reasonable information documenting the increasing credit risk is required. From a practical perspective, the accounting department must be involved in the assessment and so the decision-making process becomes time consuming. Nevertheless, frequent selling a financial instrument prior to maturity under such an accounting treatment must be avoided<sup>83</sup>.

Moreover, it is worth mentioning that a financial instrument can become encumbered and it can thus not be liquidated. A financial instrument is encumbered if

it is utilized for a different financial transaction. For illustrative purpose, consider the following example to highlight the limitation of encumbered assets. An institution purchases a financial instrument, such as a bond. This purchased bond is unencumbered in line with Art 411 (5) CRR. If the bond is used in a repurchase agreement, that is, exchanged for cash with an external counterparty, then it becomes encumbered. Consequently, the financial instrument can only be sold once the second order transaction is matured or reversed, that is, in this example, once the repurchase agreement is matured or terminated.

The abovementioned limitations and restrictions must be considered for the position, if the position is marked-to-market, or all of its hedges assuming the position is marked-to-model. As a marked-to-model position must be hedged against all material risks, all the hedges must be reviewed with respect to legal restrictions and other operational limiting requirements. Due to the broad range of possible legal restrictions and operational limitations, a smart contract may not be able to review this requirement properly and revise the policy extent. To demonstrate the difficulty, the following example illustrates how a smart contract determines whether a restriction on insider knowledge should be reviewed. Art 7 MAR defines inside information as non-public and precise information that is directly or indirectly related to one or more issuers or financial instruments. This information contains content that has a significant effect on the price of a financial instrument or derivative. The classification of insider knowledge requires a high degree of cognitive interpretation or experience. Moreover, each case has its own individual characteristics. The difficulty in classifying insider information is also highlighted in various court cases<sup>84</sup>. These challenges in interpretation and the large range of restrictions and requirements are a clear limitation for a smart contract.

Fifth, lit f of Art 103 (1) CRR requires institutions to actively monitor and manage the risk related to their positions within a trading operation. According to Federal Reserve guideline on risk management<sup>85</sup>, trading operations are highly dependent on the relevant external providers being driven by their organizational size and structure, computer systems, and strategy of the institution as well as its trading activity, etc. Therefore, an independent risk management function that allows autonomous reviews of risk positions by both trading and risk staff is necessary. Risk staff perform their risk as-

79 Cf *Regulation (EU) No 596/2014* of the European Parliament and of the Council of 16 April 2014 on market abuse (market abuse regulation) and repealing Directive 2003/6/EC of the European Parliament and of the Council and Commission Directives 2003/124/EC, 2003/125/EC and 2004/72/EC (Text with EEA relevance.), OJ L. 2014/173, 1. – henceforth called MAR.

80 Cf *Regulation (EU) No 1227/2011* of the European Parliament and of the Council of 25 October 2011 on wholesale energy market integrity and transparency (Text with EEA relevance.).

81 Cf *Fleming/Garbade*, Explaining Settlement Fails.

82 Cf IFRS 9.B4.1.3A.

83 Cf IFRS 9.B4.1.3B.

84 Cf EuGH C-19/11 and EuGH C-628/13.

85 Cf *Federal Reserve*, Overview of Risk Management in Trading Activities, Trading and Capital Markets Activities Manual, February 1998, 2000.1. – henceforth called Fed's risk management guideline.

assessment based on their risk management policy, which includes the available product, limit framework, a procedure in case a limit is over-utilized, and a frequent review. For example, the risk staff shall monitor whether the products of a trading desk are within the scope of their trading strategy. If a financial instrument is out of scope it would represent a breach of the trading strategy and a violation. Apart from this independent risk management function, a stress testing of plausible worst-case scenarios and a statement of the overall institutional risk appetite are necessary. Fed's risk management guideline proposes further requirements for an optimal, active position monitoring and risk management. As these additional measures are similar to those mentioned above, a detailed discussion is not provided.

Due to the nature of these requirements, a smart contract cannot contribute significantly because the review of risk management and stress testing requires a high degree of interpretation. Moreover, it is questionable, whether an institution may not be willing to bear the operational risk and delegate the risk management and other functions to a smart contract. One exercise, that a smart contract can handle is to monitor whether the periodic reviews are conducted and the necessary risk systems are functioning. Therefore, lit f of Art 103 (1) CRR represents a limitation in terms of supervision and review capability.

Meanwhile, Art 103 (1) lit g CRR also introduces the reclassification of a position between a trading and banking book. This is not reviewed here as Section 4.3 discusses it in details.

Besides the material scope of policies and procedure, Art 103 CRR introduces the necessary governance aspects in paragraph 2, that is, the standards that an institution shall comply with to appropriately manage their trading book positions. One of the key aspects of these paragraphs is the trading strategy. The purpose of a trading strategy is to determine a systematic method to make trading decisions. A strategy is mainly based on a predefined algorithm, logic or set of rules<sup>86</sup>. As all trading decisions can be traced back to a trading strategy, Art 103 (2) lit a CRR requires that the strategy be approved by the senior management. With this approval, the trading and overall business strategy is coordinated. Additionally, a trading strategy captures the expected holding period. Particularly, regarding the definition of »position with trading intent« pursuant to Art 4 (1) No 85 CRR, the expected holding period is important to determine whether the trading intent can be presumed. If the expected holding period is five months, the strategy would be short term resale displaying a strong indication for a trading book strategy. Such details are impor-

tant during the smart contract implementation as any financial transaction with an expected holding period of up to one year could be classified as short term. However, as mentioned earlier, the time period of one year is not a sharp boundary and further aspects should be reviewed.

The link between the trading strategy and policies as well as procedures can be found in Art 103 (2) lit c CRR: the institution shall have clearly defined policies and procedures to monitor positions against the trading strategy. Additionally, these policies and procedures must monitor the turnover and positions that are held longer than the intended holding period. As turnover captures how frequently financial instruments are bought and sold<sup>87</sup>, and due to the industry standard computed for a one year period, turnover represents a quantitative measure for the total trading volume and an indication of the average, realized holding period. For example, a portfolio with a size of EUR 100,- and a related turnover of EUR 200,- implies that the entire portfolio was rebalanced in terms of volume twice a year. Consequently, the average holding period of a position within this portfolio was half a year. This average and expected holding period can be compared to examine the trading strategy as the two holding periods are expected to be highly comparable. Otherwise, it would be an indication that the realized and approved trading strategy deviates substantially. Positions held longer than the intended holding period represent outliers and monitoring becomes necessary. In such cases, it is essential to verify the reason for extending the holding period and justify whether the longer holding period is in line with the trading strategy. Thus, the holding period is an essential component of policies and procedures and the legal definition of trading intent, thus implying regulatory relevance.

Art 103 (2) lit b CRR introduces additional items to be included in the policies and procedures such as position limits, regular reporting of positions to senior management, authority guidelines, or anti-fraud controls. In general, Art 103 (2) CRR does not present a limitation on the utilization of smart contracts as the requirements ensure a certain information flow and an approval process or outline a certain risk management framework. As all the requirements must be fulfilled, a smart contract needs to periodically review the execution of all processes. Nevertheless, a smart contract seems to be inappropriate to interpret and draw conclusions from all the requirements. If an institution aims to hand over such a task to a smart contract it would represent a limitation.

Furthermore, whether smart contracts can review »clearly defined policies and procedures« is debatable.

86 Cf Hayes, Adam. Trading strategy, Investopedia [Internet Page].

87 Cf Chen, James. Portfolio turnover, Investopedia [Internet Page].

This requirement can be a significant constraint for smart contracts – however it is largely dependent on the corresponding policy and procedure. For example, a policy or procedure is formulated in mathematical terms. As these documents are written quantitatively, a smart contract easily interprets them. However, a quantitative policy or procedure with vague terminology or formulations can be interpreted in various ways. The conceptual difficulty is that a smart contract requires a logic or method for interpretation or unclarity such that the smart contract is able to provide a solution. Designing such an algorithm is the computational issue. There are substantial challenges in making a smart contract to interpret the related policy or procedure accurately.

If an institution forces a smart contract to provide a general valuation and justification of information, the institution bears an additional operational risk due to misinterpretation and inappropriate actions. This incremental risk requires capital underpinning – meaning that such an additional operational risk could lead to a higher own fund requirement<sup>88</sup>. To minimize operational risk, policies, procedures and strategies must be formulated with no room for misinterpretation. For example, consider the following formulation of a strategy: »*The strategy of the segment is to invest short term in high quality and liquid assets (HQLA)*«. This seems to be clearly formulated, and a smart contract would be able to review whether the segments follow this strategy. A potential imprecise formulation would be »short term«. However, as discussed previously, short term can mean up to one year or the institution could define short term elsewhere. At first glance, HQLA appears to be clearly defined, but this definition varies between jurisdictions. A common practice is that the central bank of each jurisdiction defines which financial instruments are classified as HQLA. The American and the Swiss National Bank<sup>89</sup> provide different lists of eligible HQLA assets. Thus, the trading strategy is clearly formulated for a smart contract if »*the strategy of the segment is to invest short term in ECB-eligible high quality and liquid assets (HQLA)*«. Such a formulation has no room for interpretation, as short term refers to a particular time period and ECB provides a list of HQLA eligible assets to review.

## B. Requirements for a trading book

Art 102 CRR sets out further requirements for a trading book. The main difference between Art 102 and 104 CRR is that the former defines requirements regarding the

positions while the latter focuses on the management of a trading book. Thus, Art 104 CRR is of a higher level and more holistic than Art 102 CRR. Art 102 (1) CRR requires that trading book positions shall be free of restrictions regarding their tradability. Otherwise, hedges should be available<sup>90</sup> to offset material risks. Such a prerequisite is already mentioned in Art 103 (1) lit e CRR. However, there are conceptual differences between Art 102 and 103 CRR: Art 102 CRR sets out that a financial instrument is free of restrictions in general while Art 103 CRR refers to legal restrictions. Art 103 CRR specifies the extent of policies and procedures, while Art 102 CRR should be considered generally.

Regulated markets<sup>91</sup> have three categories of restrictions: administrative, margin trading, and short selling restrictions<sup>92</sup>. Administrative restrictions apply to trading and brokerage in abnormal situations, for example, if the entire market heats up abnormally. Here, prices would rise sharply and trading volume would be higher by a multiple factor compared to an ordinary business day<sup>93</sup>, resulting in investors facing the risk of unexpected losses. Thus, administrative restrictions should counteract and protect investors from financial losses. Such measures include, for example, the reduction of the daily price limit range, margin trading restrictions, trading halt, prohibition or market orders, an increase in the customer margin ratio, or amendment of cash collateral requirements.

Margin trading restrictions are regulatory measures intended to obtain profit on leveraged positions<sup>94</sup>. This means that money is borrowed from, for example, a broker to carry out a financial transaction. These measures limit excess margin trading and maintain the customer margin ratio for new margin trades<sup>95</sup>. The last category of restriction are related to short selling<sup>96</sup>. There exists two types of short selling: sale on margin<sup>97</sup> and borrowed financial assets<sup>98</sup>. To introduce short selling restrictions, the exchange must determine whether an order is long selling, that is, if an owner of a financial instrument wants to sell it regularly, or short selling. According to

88 Cf *Basel Committee on Banking Supervision*, Calculation of RWA for operational risk: Standardised approach.

89 The HQLA basket of SNB is available under *Swiss National Bank*. Collateral eligible for SNB repos [Internet Page].

90 Cf *Becker in Boos/Fischer/Schulte-Mattler*, 5<sup>th</sup> edition 2016, Regulation (EU) 575/2013 Art 102 Recital 2.

91 Cf Art 4 (1) No 13 *Directive 2004/39/EC*.

92 Cf *Japan Exchange Group*. Restrictions on trading [Internet Page].

93 Cf *Greenwood*, Trading restrictions and stock prices.

94 Cf *Fernando, Jason*. Margin, Investopedia [Internet Page].

95 Cf *Japan Exchange Group*. Regulatory measures, concerning margin trading [Internet Page].

96 Short selling is the sale of a financial instrument that is not owned by the seller. The seller therefore has to borrow the financial asset from a third party. The trading idea of short selling is to profit from a price decline.

97 This refers to a sale of security, where the seller temporarily borrowed the financial instrument from a security company for the exchange of a margin.

98 The financial instrument is borrowed from the shareholders by an agreement, which is utilized for a sale of security.

the FIEA Enforcement Order<sup>99</sup>, brokers are required to provide this information to the which can then limit the short selling activity. Additionally, there is a tool for price restrictions, also called an up-tick rule, where the short sale prices must have certain characteristics<sup>100</sup>.

Regarding a smart contract, it is questionable whether it has the ability to review the restrictions of a financial instrument. A smart contract must provide a justification whether the SEC restriction to temporarily halt trading for 15 minutes during abnormal periods represents a violation of Art 102 (1) CRR. Strictly speaking, such a restriction limits the general tradability of the underlying instrument. FRTB does not comment on or provide suggestions regarding trading restrictions. However, the overall aim of CRR and FRTB is to ensure an appropriate calculation of capital requirements to secure an institution's financial stability. It is therefore unclear whether a temporary trading halt would lead to a fundamentally different calculation of own fund requirements. A similar conclusion can be made for other restrictions. In addition, trading and banking book positions must follow the accounting framework. IFRS B4.1.2A requires that the accounting classification be made under the assumption of »business-as-usual« conditions, as worst-case scenarios could lead to a different classification. The accounting treatment can be used as an indication to interpret Art 102 CRR. This means that Art 102 (1) CRR should be interpreted under normal conditions that no restrictions on tradability refers to general limitations. Further, other articles such as Art 104a CRR refer explicitly to »exceptional circumstances«.

An example of a tradability restriction is, that a stock can be bought or sold only with the approval of a third party – meaning that the financial transaction is heavily dependent on the third party approval. Worthy to mention is that the financial instrument shall be either free of restriction or the related hedge. A hedge in accordance with Art 4 (1) No 96 CRR is a financial transaction that offsets the key risk elements of the underlying assets, that is, the material risk factors such as interest rate, or foreign exchange, etc. Hence, the requirements of Art 102 (1) CRR will not be fulfilled if the financial instrument is not free of restriction and there are no hedges to offset positions of material risk. This requirement presents several challenges for a smart contract, which are:

Each trading book position is reviewed for trading restrictions under normal circumstances. As the trading restrictions are not specified, it has to be assumed that restrictions on any trading platform of the financial instrument should be considered. If no restrictions

are observed, the position is free of restrictions<sup>101</sup>. Theoretically, one trading platform could have a restriction while on all other platforms the financial instrument is without any limitations. In such a scenario, it might be appropriate to examine the impact of this restriction on the overall position. As mentioned earlier, each institution has a specific demand for liquidity. If the restriction does not limit the general tradability of the institution's financial instrument, as other platforms provide enough liquidity, it seems to be appropriate to assume that the certain restriction has a limited impact. Moreover, the smart contract can analyze the related hedges and determine whether there are hedges of material risks. In case hedging can not be executed, the related policies and procedures may provide a guideline for the management of trading books shall be guided by clearly defined policies and procedures. The ability of a smart contract to review the Art 102 (1) CRR requirements is closely tied to a technical guideline that examines trading restrictions and identifies hedges. Generally, the more detailed the technical guideline, the more sophisticated the review of the smart contract.

Paragraph 2 of Art 102 CRR states that the trading intent shall be proven by strategies, policies, and procedures in compliance with Art 103, 104, and 104a CRR. Policies and procedures have already been mentioned several times in Art 103 and 104 CRR. The add-on of this paragraph shows that approved strategies in accordance with Art 103 (2) lit a CRR seem to be as relevant as the policies and procedures. However, policies and procedures seem to fulfill a more heuristic function as they provide a guideline or general resolution to classify positions to a banking or trading book. Strategies function on a lower level as trading decisions are based on them. From a business hierarchy perspective, policies and procedures are on the business area such as of an investment bank, treasury of an institution, or a sub-business area, while strategies satisfy a specific business need that a desk fulfills and contributes to the overarching business model.

The additional requirement regarding strategies for a smart contract is to review the trading decision and justify whether the additional position is in line with the strategy; this helps to determine the classification to a banking or trading book. A smart contract can revise a strategy only if the formulation is precise and abstract enough, similar to the policies and procedures. This means that the strategy needs to be formulated in a technical or quantitative manner. Additionally, the smart contract faces a practical issue: there are several evaluation outcomes of a trading decision. For exam-

99 Cf Order for Enforcement of the Financial Instruments and Exchange Act (No. 321, 1965). Tokyo Stock Exchange Inc. Art 26-3.  
100 Cf FIEA Enforcement Order Art 26-4.

101 Cf Becker in Boos/Fischer/Schulte-Mattler, 5<sup>th</sup> edition 2016, Regulation (EU) 575/2013 Art 102 Recital 2.



ple, a purchased bond can be allocated to a portfolio under fair value or AC at the initial stage, and a certain freedom exists with respect to the assignment. However, this example shows that a smart contract's review can provide more than one outcome, such that a trading decision is just one item in the set of solutions. This lack of uniqueness represents an additional difficulty in the practical implementation and usability of smart contracts as a trading decision is in line with a strategy if it is within the framework of trading possibilities.

### C. Reclassification of positions

A reason for the general revision of the boundary between trading and banking book is the opportunity to frequently reclassify positions between the two. This allowed optimization of own fund requirements. The Basel Committee therefore highlighted the concern regarding arbitrage opportunities<sup>102</sup>: »To reduce the incentives for arbitrage, the Committee is seeking a less permeable boundary with stricter limits on switching between books and measures to prevent capital benefit in instances where switching is permitted«<sup>103</sup>. To prohibit regulatory arbitrage, the Basel Committee suggested that a reclassification should not be allowed: »keep items in the regulatory trading or banking book once initially designated«<sup>104</sup>. This requirement has been introduced in Art 104a CRR.

Paragraph 1 of Art 104a CRR mentions the circumstances under which a position can be reclassified. Institutions shall maintain clearly defined policies to identify exceptional circumstances under which they can re-assign positions. However, this is always under the constraint of determining the requirements of own funds to »the satisfaction of the competent authorities«<sup>105</sup>. Excluding exceptional circumstances, an institution is prohibited from arbitrarily reallocating a position between a trading and banking book. However, which time period, events or occasions can be considered exceptional circumstances is unclear. For this purpose, according to the second subparagraph of Art 104a (1) CRR, the European Banking Authority (EBA) is expected to provide clarification regarding the interpretation of exceptional circumstances. This guideline will be issued by 28 June 2024. Until then, Art 104a (2) CRR authorizes competent authorities to grant permission in order to reclassify a position on a case-by-case basis. To obtain permission, an institution is required to provide sufficient evidence of an exceptional circumstance satisfies the related policies of Art 104a (1) CRR and that

the position does not fulfill the conditions pursuant to Art 104 CRR.

It is doubtful whether a smart contract can undertake such a request. Due to the individuality of such inquiries, a smart contract can barely solve such an exercise. This is because, first, a reclassification is always on a case-by-case basis<sup>106</sup> and hence no standard approach is possible. Second, each case requires an interpretation of the reason for reclassification at the initial stage, which requires a significant amount of cognitive ability<sup>107</sup>. Third, due to the economic importance of a reclassification, it is doubtful, whether an institution will bear such an operational or reputational risk in case the request is incomplete or – event worse – wrong. Thus, the smart contract might be a constraint as the institution may not be willing to utilize all the functionalities of a smart contract.

In the response to the EBA Discussion Paper on the revised market and counterparty credit risk framework<sup>108</sup>, the industry requested examples of exceptional circumstances. EBA provided four examples<sup>109</sup>: First is a significant shift in liquidity, with an additional condition that a large proportion of the financial instruments receives a negative liquidity shock resulting in a general re-consideration of the intent to hold these positions. As mentioned earlier, a negative shock in liquidity could also lead to a momentous disruption in price determination and the exchange could trigger regulatory measures such as a temporary trading halt. Such an extraordinary measure can also be used as an additional indication of a significant shift in liquidity.

Second is if the accounting treatment of financial instruments is amended, leading to a re-valuation of the positions from an accounting perspective. This could happen if an institution switches exemplarily to IFRS 9. Third is if the business model of an institution is revised, modifying the business behavior and the activity of financial assets. The second and third examples are comparable because IFRS 9 allows amendment to the accounting treatment, if the business model is revised<sup>110</sup>.

102 Cf FRTB, p.2.

103 Cf FRTB, p.2.

104 Cf FRTB, p.7.

105 Cf Art 104a (1) CRR.

106 Cf EBA/RTP/2021/19 from 24-June 2021 EBA Report on the monitoring of additional tier (AT1) instruments of European Union (EU) institutions – Update, 24 June 2021. Recital 52.

107 There might be the general understanding that a smart contract or artificial intelligence is able to solve such a highly cognitive exercise. However, the interpretation and argumentation of a reclassification requires several different subcategories of artificial intelligence such as identification of positions, adequate language processing, etc. Additionally, all of these subcategories have to function jointly, which is currently highly challenging.

108 Cf EBA/RTP/2021/19.

109 Cf EBA/DP/2017/04 from March 2018 Industry response to EBA RTS Discussion Paper on Ion Market Risk & Counterparty Credit Risk framework, March 2018. – henceforth called Industry Respond to EBA/DP/2017/04.

110 Cf IFRS 9.4.4.1.



Fourth is if a position is held with trading intent and allocated to a trading book. A business decision is made to amend the trading strategy, resulting in all positions should be held to maturity, i.e. long term. Here, the requirement to hold positions with trading intent in accordance with Art 4 (1) No 85 CRR would not be fulfilled anymore. The lack of trading intent might not be sufficient to justify a re-designation of the position to a banking book. This could be the case if a stock is delisted from an index<sup>111</sup>. However, keeping a position in a trading book when it does not satisfy Art 104 CRR does not comply with the regulatory framework. In addition to these, EBA classified the United Kingdom's departure from the EU as an exceptional circumstances<sup>112</sup>.

The overall industry feedback was that exceptional circumstances must be classified as circumstances beyond the institutions »sphere of control«. Moreover, the industry suggested that a notification to the competent authority should be sufficient rather than seeking pre-approval for each re-designation. According to EBA, it is extremely difficult to determine all exceptional circumstances on an ex-ante basis<sup>113</sup>. In CRR, the term exceptional circumstances is utilized in other articles as well, which indicates that further clarification of the general understanding of this term is necessary. Art 116 (4) CRR discusses the exposure treatment issued by the regional governments or local authorities under exceptional circumstances. In such situations, the central or regional governments or local authorities may provide an appropriate guarantee, leading to the related risks of all these issuers being similar. Historically, such guarantees have been implemented during financial turmoil<sup>114</sup> such as the 2007 Global Financial Crisis or the 2013 European debt crisis. The common characteristics of such a time period are severe economic distress for institutions, high probability of default, and devaluation of asset prices, etc. In a similar context, exceptional circumstances are utilized in Art 497 (3) CRR: »[...] in exceptional circumstances where it is necessary and proportionate to avoid disruption to international financial markets.«<sup>115</sup> The usage of exceptional circumstances in Art 116 and 497 CRR supports the industry interpretation: stressed time periods beyond institutions' area of control. Furthermore, since the default probabilities of institutions are higher during a financial turmoil compared to normal time periods, a re-des-

ignation of positions could support the market's financial stability.

Generally, exceptional circumstances refer to rare or »catastrophic« events. Financially, there are several measures and indications of these time periods or events. In such a case smart contract can help classify events as exceptional circumstances. A practical issue here is to determine the trigger for or the point at which the switch from normal to exceptional circumstance occurs. Typically, a change in circumstances can only be determined ex-post. A smart contract must determine whether the current circumstances are normal or exceptional. Such an ex-nunc justification is highly challenging. Art 104a (1) CRR requires that an institution has policies in place in order to identify exceptional circumstances. The institution has the opportunity to describe a scenario in detail as part of the related policies and translate the qualitative term exceptional circumstances in a quantitative context and measures. If such a description is in accordance with the upcoming EBA guideline, a smart contract could be a helpful feature. If the exceptional circumstances cannot be determined quantitatively, it will be an additional limitation of the smart contract's application.

Art 104a (3a) CRR sets out the requirements for an institution that has obtained the permission to re-designate a position. First, the reclassification needs to be publicly notified, where the publication process can be supervised by a smart contract. Second, the re-designation can have an impact on the own fund requirement. If the amendment creates a decline in own fund requirements, it must be publicly announced. However, the reduction shall not be recognized pursuant to paragraph 3b of Art 104a CRR until the reclassified financial asset matures and the institution receives permission from the competent authority. This condition of paragraph 3b means that an institution is not allowed to reduce own fund requirement due to a reclassification. According to FRTB, such a re-designation of position would represent a form of regulatory arbitrage<sup>116</sup>. If a reclassification leads to a decline in own fund requirement, this delta shall be a Pillar 1 capital surcharge<sup>117</sup>. Due to paragraph 3b, an institution must constantly review whether a re-designation leads to a decline in own fund requirements. This task can be done by a smart contract. Technically, this task would require various computations with different sets of parameters.

From an accounting perspective, a reclassification can cause several issues. Exemplarily, a typical banking

111 Cf Industry Respond to EBA/DP/2017/04, p.18.

112 Cf EBA/RTP/2021/19 Recital 123.

113 Cf EBA/DP/2017/04 from 18 December 2017 EBA Discussion Paper on Implementation in the European Union of the revised market risk and counterparty credit risk frameworks, 18 December 2017. Recital 111.

114 Cf Allen/Carletti/Goldstein/Leonello, Government guarantees and financial stability.

115 Cf Art 497 (3) CRR.

116 Cf Basel Committee on Banking Supervision, Minimum capital requirements for market risk Recital 25.14.

117 Cf Basel Committee on Banking Supervision, Minimum capital requirements for market risk Recital 25.15.

book business model where financial instruments are held till maturity aims to collect contractual cash flows. The instruments are therefore booked under AC. Due to a modification in trading strategy, the business model changes with the result that banking book is not the appropriate classification anymore. As earlier discussed, a change in trading strategy is classified as an exceptional circumstance that qualifies the financial instruments are qualified for a re-designation. Assuming the competent authority permits the reclassification, a requirement of Art 105 CRR is that trading book positions be fair valued<sup>118</sup>. This indicates that the accounting treatment of the financial assets must be amended. However, IFRS 9 allows a modification of the accounting treatment only if the business model of the entire company changes<sup>119</sup>. It is difficult to argue that a revised trading strategy leads to an update of the overall business model, particularly, if only part of the company is affected by the renewed trading strategy. Therefore, there is a clash of the regulatory framework and the accounting treatment, representing a general limitation.

As FRTB states, a re-classification is irrevocable<sup>120</sup> meaning that a position can be moved uniquely from a trading to a banking book, or vice versa. Art 104a (5) CRR is a direct implementation of this requirement. The proposal to amend CRR<sup>121</sup> suggests softening this paragraph. Art 104a CRR-PR states that a reclassification is irrevocable, except under exceptional circumstances. In theory, this allows a multiple re-designations of positions between trading and banking book under exceptional circumstances.

#### D. Art 104 CRR-PR

With CRR-PR, the EU aimed to fully implement the requirements of FRTB. As a major innovation, CRR-PR revised Art 104 in its entirety. The European lawmaker mentions that the motivation to replace Art 104 is to revise the assignment of positions to trading and banking book and allow several financial instruments a derogation from the general assignment. However, such a derogation shall be approved by a competent authority<sup>122</sup>.

The structure of the article is as follows: Comparable to Art 104 CRR, paragraph 1 of Art 104 CRR-PR provides the a general requirements for a position to be qualified as a trading book positions. All subsequent paragraphs are newly added. This means that Art 104 CRR-PR contains two lists of financial instruments that shall be assigned to trading or banking book. Moreover, institutions are able to derogate from these lists with the approval of the competent authority. In addition, institutions can request permission from the competent authority to remove financial instruments from these lists.

The main innovation of Art 104 (1) CRR-PR is that the link to the legal definition of »positions with trading intent« has been removed. However, this is just an editorial amendment as the legal definitions in accordance with Art 4 (1) No 86 CRR remains unchanged. Additionally, policies and procedures are subject to a yearly internal audit process, instead of a periodic review, and the results will be made available for a larger audience. Thus, the amendments to the first paragraph are both editorial and administrative.

#### 1. Presumptive list

Art 104 (2) CRR-PR introduces a list of financial instruments that can be assigned to a trading book. Lit a of this paragraph refers to financial instruments that meet the criteria formulated in Art 325 (6)–(8) CRR to be included in an alternative correlation trading portfolio (ACTP). Securitization positions and nth-to-default credit derivatives, such as single-name instruments, single-name credit derivatives, or commonly traded indices based on the single-name financial instruments are included in ACTP. It is noteworthy that a liquid two-way market is required for all these financial instruments. However, positions that are re-securitized, represent an option on a securitization tranche or any derivative of securitization exposures not providing a pro-rata tranche<sup>123</sup> that are not subsumed under ACTP.

Further, financial instruments are excluded from ACTP if the underlying instrument is assigned to an exposure class in compliance with Art 112 (h) and (i) CRR, that is exposure to a retail business and mortgages on immovable property. A financial instrument qualifies for retail exposure if the issuer is a natural person, a community of natural persons, or a small- or medium-sized enterprise<sup>124</sup>. In terms of mortgages on immovable property, these positions need to fulfill prerequisite of the Art 125 or 126 CRR, that is, the mortgages shall be fully collateralized risk positions. These positions

118 For further clarification, a question has been submitted to EBA with the ID 2022\_6458. The question is: Shall the fair value treatment of trading book positions in accordance with Art 105 (1) CRR be applied for reclassified non-trading book positions pursuant to Art 104a CRR?

119 Cf IFRS 9.4.4.1.

120 Cf FRTB, p.56, Recital 27.

121 Proposal for a regulation *amending Regulation (EU) No 575/2013* of the European Parliament and of the Council of 27 October 2021 on requirements for credit risk, credit valuation adjustment risk, operational risk, market risk and the output floor (Text with EEA relevance). – henceforth called CRR-PR (Proposed Regulation).

122 Cf CRR-PR, p.24.

123 Cf Art 325 (6) lit a CRR.

124 Cf Affeld in *Boos/Fischer/Schulte-Mattler*, 5<sup>th</sup> edition 2016, Regulation (EU) 575/2013 Art 112 Recital 12.

do not require a liquid two-way market. Further, Art 325 (8) CRR includes hedges for the positions described in Art 325 (6) and (7) CRR as a component of ACTP.

This paragraph does not add to the challenges facing a smart contract. This means that the requirement of this paragraph is to identify ACTP positions in accordance with Art 325 (6)–(8) CRR and determine whether a liquid two-way market exists for some of these financial instruments. All these requirements have already been discussed.

Lit b of Art 104 (2) CRR-PR introduces a net-short constraint for credit and equity positions. However, the market-making activity and own liabilities of the institution are excluded, from this prerequisite. The requirement includes all positions that create a net-short equity or credit position in the banking book. FRTB argues that the incremental exposure leading to a short position in the banking book is held with trading intent<sup>125</sup>, which are why the additional exposure is assigned to a trading book. In theory, such a rule and the underlying rationale is clearly understandable.

In practice, however, there are several uncertainties regarding the interpretation and implementation of this constraint. Therefore, EBA will create a regulatory technical standard to provide a guideline on how netshort exposure is to be calculated<sup>126</sup>. Meanwhile, the technical issues and uncertainties that institutions face must be noted. Consider, the simplistic case of an institution that is »vertically split« in a banking and trading book division. To apply the net-short rule, the institution can take the following approach: First, it must compute the credit and equity exposure of the banking and trading books. Second, short exposure for the total credit and equity positions must be isolated from long positions. Third, the institution must identify the positions that would lead to a net-short exposure in the banking book. In an ideal scenario, the institution is able to instantaneously compute whether incremental exposure would lead to a net-short position in the banking book for every new position<sup>127</sup>.

The first uncertainty with the net-short rule is the scope, that is, which exposure must be considered to calculate the credit and equity exposure. Focusing on credit exposure<sup>128</sup>, an institution could have credit exposure in European sovereign and corporates. However, whether a short position in European corporates is feasible to create an overall short position in the credit

exposure of European sovereigns and corporates is questionable. As per Art 277 CRR, each transaction must be mapped to risk categories. Art 277 (1) CRR provides risk categories such as foreign exchange, credit or equity risk, among others. As credit exposure is a subcategory of credit risk, this research investigation does not delve further into this topic.

Art 279a CRR further details the different risk categories, such as a split of the credit exposure in single and multi-name underlying instruments. This differentiation does not contribute to further clarify the above-mentioned example. Paragraph 3 includes the request to create a regulatory technical standard (RTS)<sup>129</sup> to clarify the procedures of mapping derivatives to risk categories<sup>130</sup>. This RTS seems appropriate to identify the categories of equity and credit exposure that can be used to calculate the net-short exposure. EBA proposes three different methods to classify a position to a particular risk category. However, commonality of all these methods is identifying the main or material risk driver of the financial instrument<sup>131</sup>. Applying this logic to the net-short rule, each position of credit exposure needs to be reviewed with respect to the main or material risk driver. Further, from an economic perspective, a difference in the risk driver can be observed in the European sovereign and corporate credit exposure. While a corporate credit exposure can be divided into a credit and a sovereign component<sup>132</sup>, a sovereign credit exposure does not capture the credit element. Moreover, this approach would indicate the existence of geographical differences that lead to distinct risk drivers. This means that the American and European credit exposure captures different risk components and diverging risk drivers.

In summary, a net-short credit and equity exposure is required to be calculated considering the sub-asset classes. An institution could including the (sub-)asset classes of the net-short calculation within its policies or procedures in compliance with Art 104 (1) CRR-PR to provide further clarification. With respect to credit exposure, which financial instruments capture a credit spread remain debatable. Within the internal model approach, FRTB introduces the credit spread risk as the differences between government and other fixed

<sup>125</sup> Cf FRTB, p.48 Recital 10.

<sup>126</sup> Cf Art 104 (8) CRR-PR.

<sup>127</sup> Due to the computational power, the large amount of trading activity and latency, such an ideal scenario might only be of theoretical nature.

<sup>128</sup> Credit exposure indicates the maximal loss a lender can have in case the borrower defaults. Cf *Chen, James*. Credit exposure, Investopedia [Internet Page].

<sup>129</sup> Cf *EBA/RTS/2019/02* from 18 December 2019 EBA Regulatory Technical Standards on mapping of derivative transactions to risk categories, on supervisory delta formula for interest rate options and on determination of long or short positions in the Standardised Approach for Counterparty Credit Risk under Article 277(5) and Article 279a(3)(a) and (b), respectively, of Regulation (EU) No 575/2013 (revised Capital Requirements Regulation – CRR2), 18 December 2019. – henceforth called *EBA/RTS/2019/02*.

<sup>130</sup> Cf Art 279a (3) CRR.

<sup>131</sup> Cf *EBA/RTS/2019/02*, p.3.

<sup>132</sup> Cf *Amato/Remolona*, The credit spread puzzle.

income instruments<sup>133</sup>. This means that all fixed income instruments, except government issuances, generally have a credit spread, as described in Collin-Dufresn/Goldstein/Spencer<sup>134</sup>.

The second uncertainty in this rule is the risk measure of how a net-short exposure will be computed. At first glance, the notional amount of the financial instrument might be appropriate. The second subparagraph of Art 104 (2) CRR-PR states that a net-short equity and credit position would create a gain if the equity prices decline and credit spreads widen, respectively. Suppose an institution processes two bonds of the same underlying corporate with identical notional, holding one bond in a short position with a maturity of 10 years and the other in a long position with a duration of 1 year. As the purchased notional value of both bonds is identical, the institution does not have a net-short position. However, if the credit spread widens, the institution gets a profit. The reason for this gain is that the duration of the bonds has an impact on the magnitude of the gains and losses.

Generally, the longer the duration, the higher the sensitivity in absolute terms with respect to a credit spread of a bond. The risk measure of a notional amount would therefore not be appropriate to compute the net-short positions. A risk measure suitable to calculate the net-short position would be the sensitivity with respect to the credit spread for credit exposure and equity prices for equity exposure. The approach to sensitivity would also be applicable to equity exposure – exemplarily for a portfolio containing equity and related options. As the sensitivity measure can be computed for both financial instruments, a net-short review is feasible.

The third uncertainty is with the level of aggregation. Suppose an institution is organized in several business divisions, such as treasury, wealth management, and investment banking and each division has a banking and trading book. On which level the net-short calculation must be performed, for example, for each business division or on an aggregate level is unclear. Generally, the higher the level of aggregation, the higher the potential for netting exposure across business divisions. Therefore, it is plausible that an institution tends to aggregate on the highest level possible. However, due to the fundamentally different purposes of the business areas, such as treasury versus investment bank division aggregating on a lower business hierarchy level, such as on business area, appears to be more appropriate.

Since the current proposal refers to EBA for an RTS, it is expected that the technical standard will pro-

vide further clarification. Finally, it is worth emphasizing that the selected risk measure and aggregation method could lead to significantly different results. The proposed risk measure sensitivity is additive in a mathematical sense, meaning that various aggregation methods always give the same result. In contrast, risk measures such as Value at Risk are not additive and will give different results depending on the approach of aggregation. Therefore an additive risk measure is essential to compute the net-short exposure.

As a side remarks, it is worth mentioning that there is one other additional uncertainty with respect to the scope of exposure for an international institution. Consider, an institution that is domiciled under EU but has also an entity or branch outside of the EU. It is questionable, whether the exposure of the non-European entity or branch is in material scope to compute the net-short equity and credit exposure of the European institution. Overall, from an accounting perspective, exposure that causes a net-short position needs to be held in fair value accounting treatment, thus not creating additional uncertainty.

Technically speaking, a smart contract can compute net-short exposure providing that the abovementioned uncertainties are addressed. However, at present, the net-short rule and its computation represent a limitation for smart contracts.

Lit c of Art 104 (2) CRR-PR assigns financial instruments to a trading book based on a security underwriting commitment. The additional constraint of these financial instruments is that financial instruments are expected to be purchased by the institution on the settlement date. An example of such a financial transaction is an initial public offering (IPO), where the underwriting institution agrees to purchase a fraction of issued securities<sup>135</sup>. The economic motivation for such a transaction is that the underwriting institution provides financial stability during the first business days after the IPO. Therefore, the underwriting institution is in demand for securities. However, the business intention of the underwriting institution is to quickly pull back its support, so that a short term resale can be assumed. This example shows the trading intent of an institution in such financial transactions. Identifying securities resulting from an underwriting commitment is possible and mostly supported by the organizational structure of institutions. Thus, a smart contract is able to identify these financial securities. As such financial instruments are on the presumptive list, a smart contract assigns these positions to a trading book. This requirement, therefore, does not represent a limitation for a smart contract.

133 Cf *Basel Committee on Banking Supervision*, Internal models approach: Model requirements (Calculation of RWA for market risk (MAR)) Recital 31.7.

134 Cf *Collin-Dufresn/Goldstein/Spencer*, The determinants of credit spread changes.

135 Cf *Smith, Tim*. Greenshoe option, Investopedia [Internet Page].



Lit d of Art 104 (2) CRR-PR introduces a direct link to the accounting treatment. It requires that any financial asset or liability flagged unambiguously with an accounting treatment indicating trading purpose be assigned to the trading book. As discussed earlier, IFRS 9 has three principal measurement categories: AC, FVtPnL and FVtOCI. FVtPnL has a subcategory called »held for trading«<sup>136</sup>. The intent of a position »held for trading« is to sell or repurchase the instrument in the short term, or it is a derivative<sup>137</sup>. A further indication is if there is evidence of the position being held to realize a short term profit<sup>138</sup>. Additionally, IFRS 9.BA.6 explicitly mentions that this accounting treatment expresses the intent to profit from short term price fluctuations or margin from market making activity<sup>139</sup>. In summary, such an accounting treatment reflects the definition of »positions with trading intent« with the result that »held for trading« is an appropriate flag. This requirement is the first direct link between a trading book and accounting treatment. The previous version of CRR consisted of only an indirect link via Art 105 CRR, claiming that the trading book position shall be fair valued, or via Art 24 CRR, stating that the accounting treatment shall be followed. Thus, the introduction of a direct link boosts the importance of the accounting treatment.

This requirement does not present a difficulty for smart contracts, as they only need information on the book or portfolio to which the financial instrument is assigned. As each book or portfolio has a certain accounting flag, the smart contract can assign all positions of the book or portfolio to the trading book.

Financial instruments related to market-making activity<sup>140</sup>, listed equity<sup>141</sup>, and trading-related securities financing transaction (SFT)<sup>142</sup> are also assigned as trading book positions. SFTs allow institutions to mobilize inventory such as their shares and bonds to secure funding<sup>143</sup>. Possible financial transactions include repurchase agreements, unsecured lending<sup>144</sup>, or margin lending transactions, among others. As SFTs are also used for other purposes, it is important to emphasize

that these SFTs are trade-related<sup>145</sup>, that is, they are intended for short term profit or a similar purpose. Additionally, collective investment undertakings (CIU), such as open-end real estate fund, hedge funds, or UCITS<sup>146</sup> with a trading intent shall also be assigned to a trading book. However, these CIUs shall meet at least one of the following conditions set out in Art 104 (7) CRR-PR. First, the institution is able to obtain a sufficient amount of information regarding the CIU's underlying exposure. Second, if the institution does not receive sufficient information about the underlying exposure, it is required that the institution has knowledge of the CIU's mandate and is able to value the CIU by daily price observations. These conditions allow wide interpretations, as it is highly debatable which information set can be classified as sufficient.

A similar argument can be made regarding the knowledge on the CIU mandate. However, it can be assumed that both conditions are comparable and act as substitutes in the sense that the institution receives an »equivalent« amount of data independent of the applied condition. This means that imprecise information on the mandate does not satisfy the condition »knowledge of the content of the mandate« as the set of information should be comparable with the information on the underlying exposure. As the knowledge on the mandate is less specific, the additional condition of CIU prices pursues the aim to provide further clarification. It is worth mentioning that the daily price observations are necessary to satisfy the daily fair value computation in accordance with Art 105 CRR.

A smart contract faces several issues in reviewing whether the conditions of Art 104 (7) CRR-PR are fulfilled as it has to verify issues or classify conditions when there is room for interpretation. A smart contract is therefore limited in its application.

A difference between RBC25.9, wherein the Basel Committee introduced the presumptive list, and Art 104 (2) CRR-PR is that CRR-PR refers to trading-related SFTs while FRTB includes trading-related repo-style transactions. SFT is a subset of repo-style transactions, and CRR-PR is more specific than RBC25.9. Additionally, RBC25.9 only excludes the repo-style transactions that are used for liquidity management of an institution<sup>147</sup>. It can be assumed that the motivation to exclude SFTs for liquidity management is that these financial transactions are used as a funding source. Therefore, this business activity has no trading intent and should belong to a banking

136 Cf IFRS 9.B4.1.5-6.

137 Derivates acting as a financial guarantee or as a hedging instrument are excepted from this consideration.

138 Cf *KPMG*, First impressions: IFRS 9 financial instruments Recital 5.3.5.

139 Cf IFRS 9.9.BA.6.

140 Cf Art 104 (2) lit e CRR-PR. Market making would already be assigned to a trading book as the accounting flag would refer to trading. However, it seems for the regulator to be highly important to mention this business activity explicitly. Market making is also indirectly introduced in the definition of trading intent pursuant to Art 4 (1) No 85 CRR.

141 cite Art 104 (2) lit g CRR-PR.

142 Cf Art 104 (2) lit h CRR-PR.

143 Cf *COM/2017/0604*.

144 Unsecured lending refers to lending a security and receive a fee in return.

145 Non-trade related SFTs are, for example, utilized for liquidity management of an institution.

146 Cf *BaFin*. Annual report 2016 Recital 6.2.

147 Cf *Basel Committee on Banking Supervision*, Boundary between the banking book and the trading book (Risk-Based Capital Requirements (RBC)), footnote 4 of Recital 25.9.



book although SFTs are typically short dated. Since an institution has the tendency to optimize its regulatory requirements, it is questionable whether an enhancement of regulatory requirements via SFTs represents a trading intent and thus should be allocated to a trading book. For example, an institution can increase its Liquidity Coverage Ratio by entering a 20 day reverse repo, where cash is exchanged through a non-HQLA collateral. Such a transaction may belong to liquidity management, because it can be performed only if excess cash is available. On the contrary, there may be a trading strategy where the preliminary reason is not liquidity management, thus proving that it is a trading-style transaction. However, a trading strategy is defined and agreed on the desk level in compliance with Art 104b (1) CRR-PR. Therefore, the purpose of the overall desk strategy must also be considered. Since it can be assumed that such a strategy is executed as part of the liquidity management function, it seems to be appropriate that financial transaction with excess liquidity appears to belong to the banking book.

The last item on this mandatory list is options or other derivatives, which are embedded in an institution's own liabilities or related to the banking book equity or credit risk. The third subparagraph of Art 104 (2) CRR-PR requires that the embedded option be extracted from the underlying position. This means that the financial instrument with the embedded option will be split into two components: an option and the residual financial instrument<sup>148</sup>. The embedded option will be assigned to the trading book according to Art 104 (2) lit i CRR-PR, while the residual financial instrument will be allocated to a trading or banking book independently.

Under IFRS 9<sup>149</sup>, however, embedded options and the host contract are generally considered an entire contract<sup>150</sup>. The regulatory requirement to separate the embedded option and the host contract is a deviation from the accounting treatment<sup>151</sup>.

To illustrate, the impact and scope of this split, consider the following example: A typical banking book business provides loans and mortgages to costumers. From a risk perspective, these financial instruments are required to be hedged by interest rate swaps or other derivatives. By definition, these hedges are also assigned to the banking book. However, an institution also issues

loans and mortgages, which include the risk of early redemption or a floor or cap on interest rate payments. For example, due to the low interest rate environment, a client's interest rate floor can be in Euro and Swiss franc at zero percentage. Such a loan or mortgage remains in the banking book. However, the institution needs to hedge the general interest rate risk on one side and early redemption risk and the floor or cap on the other. This can be done by financial derivatives, which include an option. Following the requirements of the third subparagraph of Art 104 (2) CRR-PR, this would mean that an institution must separate the embedded option from the mortgages, loans, and corresponding hedges to transfer the embedded options to the trading book.

This requirement is also stated in RBC25.9.6, where an embedded derivative is recognized separately from the issued instruments due to the accounting purposes. Therefore, it is necessary to consider the accounting perspective as an institution must fulfill accounting treatments. RBC25.9.6 also mentions that issued instruments and embedded derivatives should be bifurcated so that the accounting treatments are met.

Paragraph 4 of Art 104 CRR-PR introduces the possibility that an institution can derogate from the presumptive list. As mentioned earlier, such a deviation requires the approval of the competent authority and the institution must provide evidence that certain positions are not held or hedging a financial instrument with trading intent. The derogation is only allowed for financial instruments subject to lit d to i: instruments booked under an accounting treatment with trading intent or entered for market-making activity, CIUs with trading intent, listed equity, trading-related SFTs and embedded options. How an institution can justify assigning an instrument under an accounting treatment for trading purpose to a banking book is highly debatable. However, the reason for holding the position is non-trading. Meanwhile, an institution could also argue that the listed equity or embedded options are held for a long term purpose exemplarily due to bilateral agreements. If an institution provides evidence that the business intention for these financial instruments are held for non-trading purpose, the competent authority can provide approval to derogate. It is highly unlikely that an institution receives a general derogation for a particular financial instrument as procuring evidence for such a general exception could be highly challenging. However, a derogation for a particular business purpose and financial instrument appears to be achievable.

In conclusion, a smart contract could handle a deviation from the presumptive list. However, practically, it is advisable to separate the positions with approval to deviate from those following the logic of the presumptive list. Thus, the institution can provide an up-to-

148 The residual financial instrument is also called host.

149 Cf PWC, IFRS 9, Financial instruments: Understanding the basics, 6.

150 Under IAS 39, the entire contract is split to a host contract often measured under AC and an embedded option assigned to fair value.

151 For further clarification, a question has been submitted to EBA with the ID 2022\_6459. The submitted question is: Can an institution be compliant with Art 24 (1) CRR, if embedded derivative and its host contract treated independently pursuant to Art 104 (3) Second Subparagraph CRR-PR?

date overview of the exposure to the competent authority upon request.

The following example illustrates, why a derogation from the presumptive list could be useful. Consider a market-making activity, where an institution underwrites a loan, mortgage, or other assets and issues a synthetic financial product such as a pass-through note. Such an activity is a market-making transaction and hence subject to a trading book. It is possible for the institution to sell the entire volume to market participants such that a residual position remains in the trading book. Then, the institution will have to fulfill the trading book requirements for this residual. Assuming that the underwriting activity is related to a less liquid market, it is likely that, for example, no daily price observations are available. Thus, this position would violate the requirement of the daily fair valuation of the trading book positions and the residual would fulfill the banking book conditions. Additionally, it is likely that the institution would hold the position till maturity so that the residual is held with no trading intent. The institution could request an exception for this particular business activity according to Art 104 (4) CRR-PR to comply with the general trading book requirements.

The central question is whether a derogated classification of this business activity enhances the own fund computation. The aim of the differentiation between the trading and banking book position is to calculate the appropriate amount of own funds. Therefore, the general idea of market-making is a high daily trading volume so that the market maker improves the general market liquidity. Moreover, it can be argued whether the »one-off« transaction in the example is fully compliant with the market-making activity or whether it is more important to consider the long term residual position is arguable. If the long term consideration appears to be the dominating factor, it is justifiable to assign this business activity to the banking book.

Trading book positions are not limited to the instruments listed in Art 104 (2) CRR-PR. Paragraph 5 enables the competent authority to challenge the position assignment to the trading book, unless the positions are in accordance with Art 104 (2) lit a to c CRR-PR. If an institution fails to provide sufficient justification for the assignment, the competent authority may request the redesignation of the position to the banking book. For example, an institution may need to provide evidence that certain positions are subject to market-making activity. As Art 104 (1) CRR requires that an institution have clearly defined policies and procedures and the management of the trading book capture trading strategies in line with Art 103 CRR, the institution could demonstrate the trading intent of the position using the corresponding policies, procedures, and strategies.

Moreover, it could show the overall activity within such a market.

It seems that the competent authority requirements are on an individual basis. It is therefore highly likely that a smart contract cannot handle such a request due to the diversity.

## 2. Mandatory list

Paragraph 3 of Art 104 CRR-PR introduces a list of financial instruments to be assigned to a banking book. Instruments required for securitization warehousing, unlisted equities, instruments related to real estate holdings, or credit instruments related to the retail of small- and medium-sized enterprises are designated to a banking book along with derivatives or CIU containing one or more of the abovementioned instruments. Additionally, CIUs that do not satisfy at least one condition of Art 104 (2) lit f CRR-PR are assigned to a banking book. Here, it is highly relevant whether CIUs are held with trading intent. For example, a CIU consists of several unlisted equities and the institution has precise information about these unlisted equities. This means that condition lit a of Art 104 (7) CRR-PR is satisfied. This CIU is allocated to a banking book if it is not held with trading intent and to a trading book otherwise.

Art 104 (3) lit a–f CRR-PR introduce several financial instruments, that shall be assigned to a banking book. Hedges meant to offset a particular risk of these financial instruments shall also be designated to a banking book<sup>152</sup>. This is in line with the general approach of FRTB, as a financial instrument and its hedges should belong to the same type of book. Finally, a financial instrument of own liabilities shall also be assigned to a banking book<sup>153</sup>. However, the exception is that these instruments not being part of a market-making activity in accordance with Art 104 (2) lit e CRR-PR.

The regulation does not require a particular accounting standard of banking books, so these books are free of any accounting constraints. Therefore, from an accounting perspective, there does not exist any issues. As Art 104 (3) CRR-PR provides a precise list of financial instruments, particularly lit a–f and h, a smart contract can identify these products. Moreover, identifying hedges is a known difficulty that was discussed earlier. This paragraph introduces no additional constraints for a smart contract.

Comparable to Art 104 (5) CRR-PR, the competent authority may also ask for evidence as to why positions are assigned to a banking book instead of a trading book according to Art 104 (6) CRR-PR. Again, if the institution

<sup>152</sup> Cf Art 104 (2) lit g CRR-PR.

<sup>153</sup> Cf Art 104 (2) lit h CRR-PR.

fails to provide sufficient evidence, the competent authority may request the reclassification of certain positions.

### E. Risk management capabilities

Art 104 CRR requests that the requirements related to clearly defined policies and procedures and of Art 102 CRR as well as the definition of the trading book in accordance with Art 4 (1) No 85 CRR be supported by the appropriate risk management capacities and practices. Art 435 CRR sets out several requirements for institutions to disclose their risk management objectives and policies. The aim of this disclosure is two-fold. First, the institution must explain the risk of its overall business strategy<sup>154</sup>. The institution should also demonstrate whether there are sufficient risk controlling procedures and processes to monitor the institutional risk profile. Second, the institution must provide the public with information on each risk category to fulfill its responsibility and boost their trust in its financial stability and reliability<sup>155</sup>. Additionally, commercial accounting requires that the financial statement of an institution also capture the qualitative information about the strategy, aim, and processes to control certain risks as well as the risk measurement resulting from financial instruments<sup>156</sup>. Motivated by the 2007 Great Financial Crises that showed the shortcomings in governance arrangements, Art 435 (2) CRR expanded the requirements to publicly disclose certain corporate governance rules regarding the qualification and self-organization of the managing body.

Art 435 CRR focusses on the objectives and policies of risk management and does not specify risk areas. Certain risk areas such as interest rate risks are mentioned explicitly as these are regularly dominated by institutions<sup>157</sup>. This is because the risk areas are underpinned by capital requirements and disclosed with quantitative information on the extent of board risks. In the banking book, these are counterparty, credit, market, operational, and interest rate risk. However, liquidity risk is not mentioned, although this risk area is mentioned in the supervisory monitoring process, that is, pillar 2, as a general requirement of several trading book positions regarding a liquid market and discussed in several Basel Committee papers. Moreover, IFRS 7.39 also requires institutions to disclose liquidity risk in a qualitative and quantitative manner.

As liquidity seems to be an essential risk component<sup>158</sup>, the Basel Committee provided a guideline for sound liquidity risk management<sup>159</sup>. The reason for its higher priority is that institutions are largely exposed to liquidity risk as institutions perform a maturity transformation as from short term deposits into long term credit or loans. From an institution's perspective, short term deposits are obligations that need to be funded. Additionally, almost every financial transaction has an impact on the institution's liquidity. Therefore, effective liquidity management is vital to ensure that cash flow obligations are fulfilled<sup>160</sup>. The 2007 Global Financial Crisis revealed that several institutions had failed to apply basic principles of liquidity risk management. For example, some institutions underestimated the extent of liquidity they would need to satisfy contingent obligations<sup>161</sup>. As a key take-away from these crisis, the Basel Committee provided several principles to ensure sound liquidity management. Foremost, it is the institution's responsibility to maintain sufficient liquidity and establish sound liquidity risk management<sup>162</sup>. Sufficient liquidity is fulfilled by unencumbered HQLA. The amount of HQLA should support the institution's financial stability to withstand stressful events and turmoil.

It is worth mentioning that liquidity risk should not be considered in isolation, as this risk is linked to other risks such as credit, reputational, operational, or legal risk<sup>163</sup>. For example, in case of an error or inaccuracies in a legal agreement, this condition could limit or prevent both counterparties to fulfill the contractual duties. Hence, the collateral of involved in the agreement can be restricted from trading until the legal issue is resolved.

Other principles are related to the governance, measurement, and management of liquidity risk or its public disclosure. This means that an institution should develop policies, strategies, and practices to maintain sufficient liquidity and show a certain risk tolerance<sup>164</sup>. The senior management should be aware of these approaches and provide relevant approvals<sup>165</sup>. Factors such as liquidity costs, performance measurement, or general on- and

154 Cf Hillen in *Boos/Fischer/Schulte-Mattler*, 5<sup>th</sup> edition 2016, Regulation (EU) 575/2013 Art 435 Recital 1.

155 Risk categories are defined pursuant to Art 277 CRR.

156 Cf IFRS 7.22 (b).

157 Cf Hillen in *Boos/Fischer/Schulte-Mattler*, 5<sup>th</sup> edition 2016, Regulation (EU) 575/2013 Art 435 Recital 2.

158 The importance of liquidity management is also observable to the highly important regulatory measures liquidity coverage and net stable funding ratio.

159 Cf *Basel Committee on Banking Supervision*, Principles for sound liquidity risk mgmt & supervision.

160 Cf *Basel Committee on Banking Supervision*, Principles for sound liquidity risk mgmt & supervision Recital 1.

161 Cf *Basel Committee on Banking Supervision*, Principles for sound liquidity risk mgmt & supervision Recital 3.

162 Cf *Basel Committee on Banking Supervision*, Principles for sound liquidity risk mgmt & supervision Principle 1.

163 Cf *CEBS Guidelines on the management of concentration risk under the supervisory review process (GL31) Annex 1 Ex. 6*.

164 Cf *Basel Committee on Banking Supervision*, Principles for sound liquidity risk mgmt & supervision Principle 2–4.

165 Cf *Basel Committee on Banking Supervision*, Principles for sound liquidity risk mgmt & supervision Principle 3.

off-balance sheet activities should also be considered<sup>166</sup>. Moreover, the institution should maintain sound processes to identify, measure, monitor, and control liquidity risk<sup>167</sup> and implement a diverse funding strategy<sup>168</sup>.

Liquidity risk exists in single and multiple positions. Additionally, an institution must review its liquidity risk along with the concentration. From a market behavior perspective, this means that, for example, if an institution owns a large market share of fixed income products of a particular issuer, reducing the market share could have a significant price impact. However, the institution must also consider the liquidity concentration risk of its funding sources<sup>169</sup>. Therefore, an institution must understand the various funding sources and their contribution. Being highly dependent on one funding source represents a large liquidity concentration risk, as in a worst-case scenario, funding from different source may be needed. Thus, an institution must identify the concentrations of its liabilities and assets<sup>170</sup>. It should also implement a risk framework to minimize the liquidity risk concentration. Apart from the economic investigation, regulatory requirements might limit the free flow of financial assets<sup>171</sup>. Due to tax issues, regulatory ring-fencing, etc. the asset flow between entities and jurisdictions may be restricted. However, as the institution considered in this paper is a European standalone institution, such a limitation does not apply here.

The remaining question is whether a smart contract can contribute to risk management. Due to the high degree of complexity and diversity of tasks, a smart contract cannot fulfill every risk management task. As mentioned earlier, even if a smart contract would be able to be fully compliant with all the risk management requirements, an institution may hesitate to use it high operational and reputational risk. Thus, a smart contract's contribution appears to be mainly to support risk management by providing information such as feasible reports, or a summary of previous cases, etc. Thus, a smart contract would have the potential to make the risk management more effective and release capacity such that risk staff can run risk enhancement projects, for example.

With respect to the liquidity risk concentration, a smart contract can analyze and provide reports based

on the predefined triggers. This process could be mentioned in the policies or procedures to generally define under which circumstances an exposure is considered a liquidity risk concentration.

### 1. Market risk

Liquidity and market risk are closely related. Market risk monitors the risk caused by adverse movements in market prices that results in losses<sup>172</sup>. The Basel Committee also mentioned in FRTB that the market risk displayed during the 2007 Global Financial Crisis highlighted the insufficient boundary between the trading and banking book<sup>173</sup>. All risk positions, that is, trading book positions, commodities, and foreign exchange positions of the entire balance sheet, etc. capture market risk from a regulatory perspective. EBA has provided several guidelines, technical standards, and recommendations to supervise and review this risk area. The Financial Supervision Authority published a general guideline about market risk management<sup>174</sup>. The legal basis of the regulatory framework is the Directive 2013/36/EU of the European Parliament and of the Council of 26 June 2013 on access to the activity of credit institutions and the prudential supervision of credit institutions and investment firms, amending Directive 2002/87/EC and repealing Directives 2006/48/EC and 2006/49/EC (Text with EEA relevance), OJ L. 2013/176, 338 – henceforth called Directive 2013/36/EU<sup>175</sup>, Art 76 ff Directive 2013/36/EU introduces risk management and governance requirements for institutions. The potential losses monitored by market risk could be caused by interest rate, foreign exchange, or price fluctuations. A key element in controlling this risk is an appropriate strategy, that is, the institution should establish a risk management strategy approved by its Board of Directors and suitable for the market risk related to its business model<sup>176</sup>. This implies the risk appetite that the institution is willing to bear<sup>177</sup>. However, the market risk strategy should be developed by considering the macro economic factors such as liquidity, market and economic conditions, and its computational capacity to evaluate, measure, and control risk positions<sup>178</sup>.

166 Cf *Basel Committee on Banking Supervision*, Principles for sound liquidity risk mgmt & supervision Principle 4.

167 Cf *Basel Committee on Banking Supervision*, Principles for sound liquidity risk mgmt & supervision Principle 5–6, 8, 9.

168 Cf *Basel Committee on Banking Supervision*, Principles for sound liquidity risk mgmt & supervision Principle 7.

169 Cf *CEBS Guidelines on the management of concentration risk under the supervisory review process (GL31) Guideline 12*.

170 Cf *CEBS Guidelines on the management of concentration risk under the supervisory review process (GL31) Recital 97*.

171 Cf *CEBS Guidelines on the management of concentration risk under the supervisory review process (GL31) Recital 100*.

172 Cf *European Banking Authority*. Market, counterparty and CVA risk [Internet Page].

173 Cf Regulation (EU) No 2019/876 Recital 40.

174 Cf *Financial Supervision Authority*, Management of market risk.

175 Cf *Financial Supervision Authority*, Management of market risk Recital 4(1).

176 Cf *Monetary Authority of Singapore*, Guidelines on Risk Management Practices Recital 3.1.1.

177 Cf *Financial Supervision Authority*, Management of market risk Recital 5.2.4.

178 Cf *Monetary Authority of Singapore*, Guidelines on Risk Management Practices Recital 3.1.3.



The market risk strategy should be supported by the corresponding policies. The main policy objective is to reflect the institution's processes, strategies, and approaches to control and manage market risk. All three components should be considered jointly and fully integrated into the institution's overall risk management<sup>179</sup>. Additionally, policies should cover communication with and escalation to senior management, scope of the business activity with market risk, description of the authority and responsibility to manage market risk, and guideline on market risk control including limit structure as well as limit monitoring and limit excess management<sup>180</sup>. The market risk policies should be supported by a manual documenting the necessary market risk policies, processes, and strategies. All responsible employees must be familiar with this manual, which should provide guidelines for operational processes and steps to perform market risk control<sup>181</sup>.

Another essential part of market risk is the related framework, processes, and systems. This means that an institution must develop and maintain a sound and adequate risk management process and framework. This should include a process to identify risk, manage a market risk limit framework consistent with the institution's risk appetite to supervise market risk, and maintain a functioning management information system, among others<sup>182</sup>. The question of whether the market risk limit framework is within the risk appetite does not have a simple answer. The economic issue here is that there is no direct relationship between the limit framework<sup>183</sup> and risk appetite<sup>184</sup>. Therefore, the justification is frequently of a qualitative nature. A similar difficulty arises with the guideline to supervise market risk, as the measurement of market risk-taking is relative. This means that risk-taking and risk appetite need to be balanced. A comparison of the two can be supported by quantitative risk measures but requires a final interpretation by the risk staff as various measures need to be combined. However, risk management can only be performed with a functioning management information system, which provides a variety of risk measures such as sensitivities. Moreover, the information system must be appropriate in several dimensions: First, it must ac-

curate and timely, such that the risk staff do not monitor outdated portfolio compositions. Second, the risk data must be aggregated such that the risk staff can review the overall risk composition.

It is important that the risk management function be independent<sup>185</sup> from the risk-taking staff so that a risk review is unbiased. As market risk captures different risk categories, such as those related to interest rate, equity, foreign exchange, and others, institutions should develop and implement an appropriate market risk framework for each risk category<sup>186</sup>. This is because each risk category behaves differently and consequently needs a distinct monitoring and control process. However, due to the dependency among the risk categories, a holistic and aggregated view is still required<sup>187</sup>.

The central tool in risk management to control the risk-taking business is to introduce risk limits. However, limits should be appropriate as well as approved and regularly reviewed by senior management or, if required, by the Board of Directors. An amendment to the market conditions or a modification of the institution's resources could trigger an ad-hoc review of the limit structure<sup>188</sup>. For example, a financial turmoil could prompt the institution to reduce business activity in certain areas, which in turn reduces the limits. Apart from the limit structure, stress testing and scenario analysis are also essential component in the general market risk management process. Here, an institution develops certain scenarios based on historical observations or foresight<sup>189</sup>. The aim of stress testing is to examine the effects of these scenarios on the current asset allocation and determine whether the simulated scenario threatens the institution's stability. A requirement of such scenarios is that they should be severe, create extraordinary losses, and have a low probability of occurrence.

The market risk framework should also consider the accounting framework where the general concern of market risk is adverse price movements. This means, in an extreme scenario, financial instruments booked under AC cannot be sold but fairly valued financial instruments can be monetized. Therefore, accounting treatment must be considered within the overall risk management process.

179 Cf *Monetary Authority of Singapore*, Guidelines on Risk Management Practices Recital 3.2.1.

180 Cf *Monetary Authority of Singapore*, Guidelines on Risk Management Practices Recital 3.2.2.

181 Cf *Monetary Authority of Singapore*, Guidelines on Risk Management Practices Recital 3.3.1.

182 Cf *Monetary Authority of Singapore*, Guidelines on Risk Management Practices Recital 4.1.1.

183 Market risk aims to control risk by setting limits with the result that certain risk parameters are capped.

184 The reason for the missing link is that limit and risk appetite are mathematically measured differently, and a direct comparison is generally not obvious.

185 Cf *Monetary Authority of Singapore*, Guidelines on Risk Management Practices Recital 4.1.5.

186 Cf *Monetary Authority of Singapore*, Guidelines on Risk Management Practices Recital 4.2.1.

187 Cf *Monetary Authority of Singapore*, Guidelines on Risk Management Practices Recital 4.2.94.

188 Cf *Monetary Authority of Singapore*, Guidelines on Risk Management Practices Recital 4.3.1.

189 Cf *Monetary Authority of Singapore*, Guidelines on Risk Management Practices Recital 4.4.1.



Since Art 104 CRR requires that trading books be supervised by an appropriate risk management, whether a smart contract can oversee the market risk management capacities and practices is debatable. A smart contract can most likely fulfill governance demands. This means that, for example, the smart contract could review whether the risk staff are frequently performing certain tasks such as risk monitoring or controlling the limit framework. Based on that, a smart contract could also act as a support for risk staff by reminding or triggering review processes. A smart contract may not be able to oversee the entire risk management process, which is highly complex. Even if a smart contract is able to perform all the necessary examinations, the institution may not implement the process due to the large downside and reputational risk.

The previous sections described market risk as being predominantly driven by individual positions. However, such risk can also occur from exposure to a single or multiple risk factors<sup>190</sup>. For example, an institution may be invested in American government bonds and have interest rate swaps to U.S. dollar interest rates. Thus, all these positions are linked to the U.S. interest rates and have a common risk factor. Therefore, an institution is required to identify all material risk factors. Additionally, the institution should have a profound understanding of the impact of these risk factors during financial turmoil as correlations between positions can change or there could be non-linear effects. Institutions utilize Value at Risk models to monitor the overall market risk. These models use market observations over a certain time period to compute the corresponding Value at Risk. However, correlations based on unstressed time periods can be misleading as, for example, the benefits of diversification can vanish during financial turmoil due to an amending correlation structure<sup>191</sup>. Value at Risk models should therefore be carefully considered. Further, these models are limited in identifying systematic risk factors within the concentration risk.

The implicit objective of such models is to capture the market liquidity risk to unwind or hedge a certain position in the banking or trading book. Thereby, the impact on a market price disruption should be limited<sup>192</sup>. A smart contract may not be able to review the market risk with respect to concentrated positions. Identifying the risk factors that can represent material risk categories or factors is a highly challenging task.

Leaving this prerequisite exercise aside, an institution must define when a risk category is classified as a material risk. If this definition is made quantitatively, a smart contract can run the analysis and provide an overview of the potential risk factors. However, the final analysis still needs to be done by the risk staff to define the appropriate actions. Thus, a smart contract can support the entire process and make the risk management function more efficient.

## 2. Operational risk

Operational risk was mentioned earlier with respect to a bug or miscalculation of a smart contract. This risk covers a range of topics such as payment services, functioning of IT platforms, dependencies on external providers, and suppliers, among others. Since the research question is on the trading and banking book, operational risk concentrated on financial exposure that results in behavior risk, fraud, etc. is not considered.

Operational risk concentration is caused by a single or multiple operational risk positions, that can threaten the functioning of an institution in case of large losses<sup>193</sup>. Such a risk is ideally driven by a dependency on external providers to value financial instruments. Additionally, an institution could face an economic issue if certain financial instruments are traded only on a certain platform. As the key requirements of trading book positions can be highly dependent on the external suppliers or providers, the institution must determine such as operational risk factors ex-ante. Thus, the institution can verify how critical these dependencies are<sup>194</sup> for its business activity. In the case of a large operational risk concentration, it could be appropriate to diversify the trading activity across various platforms to reduce the dependency on one external provider<sup>195</sup>.

Since operational risk is mainly driven by qualitative factors, the contribution of a smart contract is limited. A purpose of a smart contract could be to review the general trading activity considering certain parameters. If a concentration is identified, the smart contract could trigger a notification to the risk staff, who can begin an investigation and provide suggestions.

190 Cf *CEBS Guidelines on the management of concentration risk under the supervisory review process* (GL31) Recital 71.

191 Cf *CEBS Guidelines on the management of concentration risk under the supervisory review process* (GL31) Recital 72.

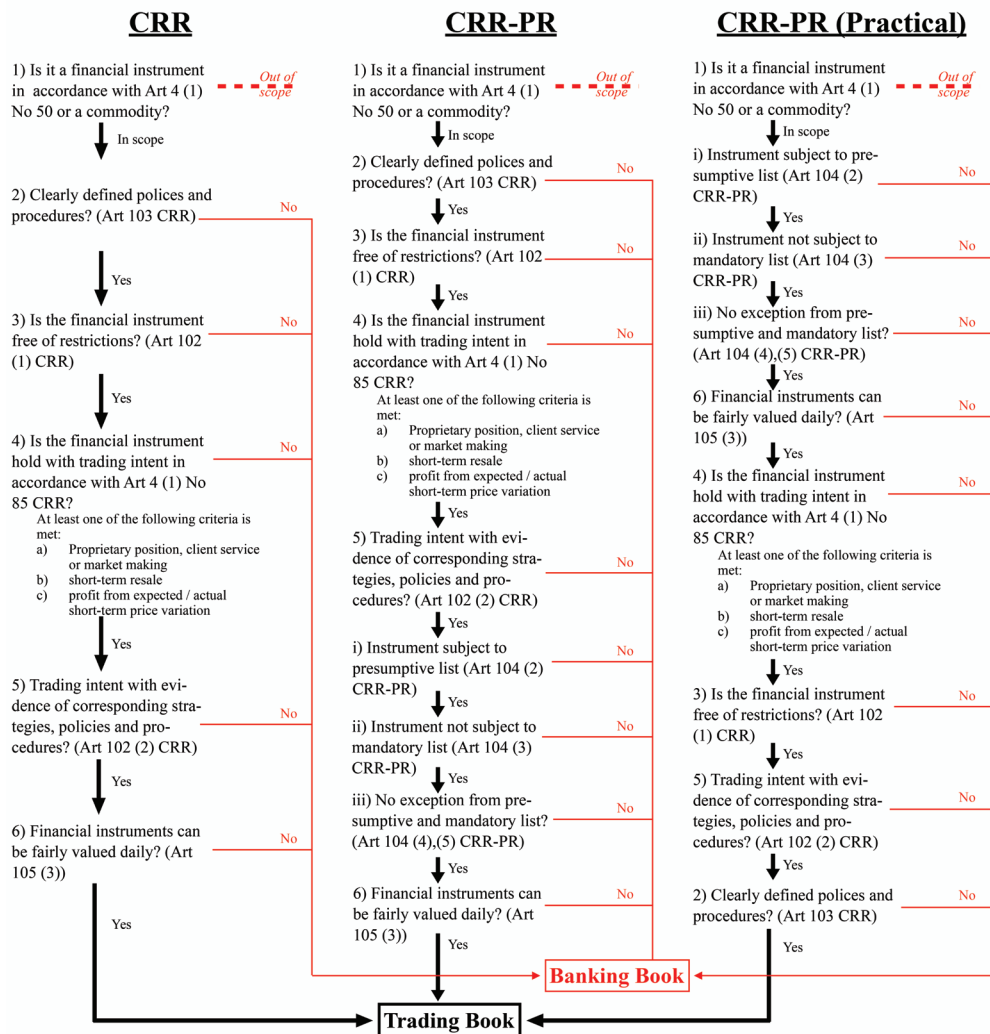
192 Cf *CEBS Guidelines on the management of concentration risk under the supervisory review process* (GL31) Recital 74.

193 Cf *CEBS Guidelines on the management of concentration risk under the supervisory review process* (GL31) Recital 76.

194 Cf *CEBS Guidelines on the management of concentration risk under the supervisory review process* (GL31) Guideline 10.

195 Cf *CEBS Guidelines on the management of concentration risk under the supervisory review process* (GL31) Guideline 11.

Figure 1: Decision Tree



This figure displays the decision tree to assign positions to a trading or banking book under different regimes. The first column CRR refers to the decision tree under CRR. The second and third column starting with CRR-PR specific the decision tree in accordance with CRR-PR. The main differences between these two columns is the order of decisions.

### V. Decision tree

So far, several requirements and conditions are needed to fulfill the prerequisites of trading book positions have been introduced. This section aims to provide an overview of the various requirements and, particularly, highlight the differences between CRR and CRR-PR. The related decision trees are displayed in Figure 1.

Under CRR, whether the considered instrument is a financial instrument in compliance with Art 4 (1) No 50 CRR or a commodity is first reviewed. If this requirement is fulfilled, the instrument is in scope of CRR and can be assigned to a trading or banking book. The order of decision making process strictly follows the sequence of requirements that are requested first. Therefore, the next requirement, whether there are clearly defined policies and procedures, needs to be reviewed, as this pre-

requisite is mentioned in Art 104 (1) CRR. Additionally, these requirements must be reviewed because the extent and content of clearly defined policies and procedures are introduced in Art 103 CRR.

Next, Art 104 (1) CRR makes a reference to Art 102 CRR, meaning that at the first instance, potential restrictions in accordance with Art 102 (1) CRR shall be revised. As trading intent is a legal term under Art 102 (2) CRR, a position is held with trading intent pursuant to Art 4 (1) No 85 CRR shall be analyzed. Once the trading intent is examined, Art 102 (2) CRR requires that the trading intent shall correspond to the related strategies, policies, and procedures. To assign a position to a trading book is, the last review is to determine, if a position can be fairly valued daily in accordance with Art 105 (3) CRR. Only if all the requirements are fulfilled, the position shall be assigned to a trading book. Otherwise, the position shall belong to a banking book.

The third column of Figure 1 displays a revision of the decision tree under CRR including the amendments of CRR-PR. The motivation of a different ordering of the requirements is the practical effort to verify certain aspects. The main distinction in the decision making process is highlighted by the questions with roman numerals in Figure 1. This means that the three additional review steps are included for the presumptive and mandatory list. Moreover, whether the institution has an exception for the instruments on the presumptive or mandatory list in compliance with Art 104 (4) and (5) CRR-PR must be reviewed.

It is worthy to highlight that the regulation does not request a particular order of priority how the requirements must be reviewed. Thus, from a practical viewpoint, a different order of the decision making process could be beneficial. For example, the review of the trading intent of an instrument from the presumptive or mandatory list is of legal and economic value, as these lists provide a precise guideline on how to assign certain instruments.

Therefore, the additional three review steps are allocated to the beginning of the decision tree to reduce the effort required to review the characteristics of the instruments that are not needed. The general logic of the practical decision tree is that the characteristics with the smallest effect are reviewed first, and the set of instruments is smaller for the characteristics that are difficult to review.

## VI. Requirements for a prudent valuation

The higher the market uncertainty, the more difficult the valuation of financial instruments. Such circumstances mainly exist during financial turmoil. During this time period, it is highly important to determine the »real« value of assets and liabilities and thus justify the financial stability of an institution. For this purpose, the institution must conduct a prudent valuation of the trading and banking book positions in accordance with Art 105 CRR.

The prudent valuation ensures an appropriate degree of certainty as the valuation of financial instruments becomes more conservative. However, the prudent valuation must mimic the dynamic of the financial instrument or its underlying instrument. Furthermore, the overarching aim of a prudent valuation for an institution is to maintain sufficient own funds<sup>196</sup> and remain financially stable and solvent. Generally, the valuation of a financial instrument is a less demanding exercise with the observation of market and historical prices. In time periods with large

uncertainty, institutions could price their financial instruments with a discount, but this would lead to a general de-valuation of the assets. However, liabilities are not discounted. The asymmetry of discounting financial assets and liabilities leads to a higher own fund requirement, which is economically less beneficial.

Financial instruments are traded in different platforms. Equities are traded on central platforms such as stock exchanges, while bonds are mainly exchanged over the counter. Generally, price observations on central platforms are more transparent than over the counter. That is neither fixed income prices nor their trading volumes are public or transparent, unlike the transparency on exchanges. Due the lack of transparency of fixed income products and given that regulatory measures such as the Liquidity Coverage Ratio are mostly fulfilled with rate instruments, the valuation is important for an institution.

Subsequently, however, it is debatable, whether a smart contract can review the requirements of Art 105 CRR and if the positions are consequently prudently valued.

Art 105 CRR applies prudent valuation to all trading and banking book positions under the fair value accounting treatment<sup>197</sup>. Consequently, all such positions of an institution are affected by the Art 105 CRR<sup>198</sup> requirements.

As the institution considered in this research paper applies IFRS 9, financial instruments are fairly valued if they are not held to consume contractual cash flows, in line with IFRS 9.4.1.2. Further, in compliance with Art 105 (14) CRR, on 31 March 2014 EBA an RTS<sup>199</sup> providing further clarification of prudent valuation in line with Art 105 (1) CRR.

The PV-RTS captures further requirements related to documentation, systems, and controls. It also discusses the additional valuation adjustments (AVA) of financial instruments. These adjustments should ensure that the assets and liabilities are prudently valued, as required by Art 105 (1) CRR. However, the adjustments create a deviation from the valuation approach proposed by the accounting treatment. These circumstances raise the following question: To which extent a prudent valuation of positions should be more conservative compared to the accounting standard. In particular, Art 24 CRR requires that institutions be compliant with a certain accounting standard. The International Accounting Standards

<sup>197</sup> Cf Art 105 (1) CRR.

<sup>198</sup> Cf Mikulik in *Laurer/Schütz/Kammel/Ratka*, BWG<sup>4</sup> Art 105 Recital 4 (As of 01-January 2019, rdb.at).

<sup>199</sup> *EBA/RTS/2014/06* from 23 Januar 2015 Final Report Draft Regulatory Technical Standards on prudent valuation under Article 105(14) of Regulation (EU) No 575/2013 (Capital Requirements Regulation – CRR), 23 Januar 2015. – henceforth called Prudent Valuation (PV)-RTS.

<sup>196</sup> Cf Art 105 (1) CRR.

Board (IASB) mentions that a key principle is the faithful representation of the assets and liabilities aiming for neutrality. According to IASB, a prudent valuation is supported by neutrality as assets must not be overvalued while financial liabilities must not be undervalued<sup>200</sup>. Moreover, an over- and undervaluation of assets and liabilities, respectively, are prohibited. Therefore, a prudent valuation is not in conflict with the accounting treatment and valuation adjustments are justifiable<sup>201</sup>. Additionally, an institution must be compliant with valuation adjustments in accordance with Art 105 (10) and (11) CRR. PV-RTS includes inter alia the types of valuation adjustments, which are explained in detail below.

### A. Concentrated positions

Art 105 (11) CRR addresses the concentration risk, which refers to the risk of an institution processing a large fraction of a certain issue or its issuer. The concern here is that the institution could have an essential or a significant market impact on some instruments due to its trading strategy. Concentration risk can be of two types: intra-risk concentration is the concentration risk, which emerges from the various risk positions of a single risk category<sup>202</sup>, and inter-risk concentration, which is driven by the various risk positions of different risk categories. However, the risk positions are correlated, resulting in the exposure being strongly related to an underlying risk.

As correlations are time-dependent, a low correlation during normal time periods could change to a high dependency during financial turmoil. This means that concentration risk must be constantly monitored. Additionally, concentration risk could have material impact on the institution's capital, earnings, or liquidity across various business divisions<sup>203</sup>. To illustrate the material impact of concentration risk, consider the following example. An institution with a specific business model is active in a certain geographical area or industry sector. This institution is closely connected to the business activities and development of the industry sector or geographical area with the result that the institution has a certain concentration risk and is vulnerable in terms of the specific cycles or geographical tensions<sup>204</sup>. This leads to a concentrated position of the institution.

For the financial stability of an institution, it is necessary to clarify the impact of these positions. This means that the institution may clearly review the related concentration risks and determine an appropriate risk management and governance framework<sup>205</sup>. Senior management and risk staff need to understand how the concentration risk emerges given the business model of the institution. Moreover, the risk appetite of the concentrated positions and the institution should be balanced. Therefore, the institution must define a limit of maximal total concentration of the different risk positions with respect to the institution's business model, size, and trading activity.

To determine the overall concentration risk, the institution should consider different aspects across risk categories<sup>206</sup>. The Committee of European Banking Supervisors suggests that the intra-risk concentration is either a separate risk discipline or completely included in the general risk management function. However, the practical »issue« regarding the inter-risk concentration is that various risk types and categories can be involved with several magnitudes and effects. Therefore, a risk view from a standalone perspective is less feasible. Practically, the risk measure Value at Risk can capture concentration risk, as risk factors across business divisions have an impact on this risk measure.

Thus, a sound concentration risk management should also include a process identifying the inter- and intrarisk concentrations. This procedure should capture all material risk concentrations. As per Art 24 CRR, concentration risk can be caused by off- and on-balance sheet items. It is also necessary that the various risk concentrations must be managed and reviewed jointly, as there could be dependencies among them. Additionally, financial markets developments must be included in the risk management process<sup>207</sup>. This includes system-wide interactions, such as those during a financial turmoil. It is relevant for an institution to evaluate the severity of a system-wide effect on the institution. For this purpose, institutions must perform a stress test to examine the impact of certain stress scenarios<sup>208</sup>. This stress test also highlights the scenarios' influence on the institution's solvency, liquidity and compliance to regulatory measures.

It is economically valuable that risk factors can net each other to reduce the overall concentration risk. How-

200 Cf Lübbig/Kühnel in Burne/Diresch/Schulz-Danso/Senger, Beck'sches IFRS Handbuch Recital 73.

201 Cf Becker in Boos/Fischer/Schulte-Mattler, 5<sup>th</sup> edition 2016, Regulation (EU) 575/2013 Art 105 Recital 15.

202 Cf CEBS Guidelines on the management of concentration risk under the supervisory review process (GL31) Recital 21.

203 Cf CEBS Guidelines on the management of concentration risk under the supervisory review process (GL31) Recital 22.

204 Cf CEBS Guidelines on the management of concentration risk under the supervisory review process (GL31) Recital 24.

205 Cf CEBS Guidelines on the management of concentration risk under the supervisory review process (GL31) Recital 26 and Guideline.

206 Cf CEBS Guidelines on the management of concentration risk under the supervisory review process (GL31) Guideline 2.

207 Cf CEBS Guidelines on the management of concentration risk under the supervisory review process (GL31) Recital 35.

208 Cf CEBS Guidelines on the management of concentration risk under the supervisory review process (GL31) Recital 37.



ever, such a netting approach must be appropriate and adequate. Thus, mitigation techniques must be fully understood and managed by the risk-taking and risk-controlling staff<sup>209</sup>. The reason for this governance requirement is that the downside potential of an institution can be significant and fundamental. This is driven by the risk concern that two risk positions may not offset each other and the residual open risk will become material.

As the previous paragraphs described the concentration risk on a macro level, the following subsections will focus on it in more detail. In case of a concentrated position, a timely trade execution could be less likely or it could have a significant impact on the market price due to its dominate position. An AVA is expected to satisfy the liquidation's »difficulty« in terms of concentrated positions. Subsequently, there could be legal or organizational restrictions leading to the absence of free tradability for the financial transactions<sup>210</sup>. Such trade restrictions are observable, which is why a smart contract can be used to review such constraints similar to the trading book restrictions pursuant to Art 103 (1) lit e CRR.

However, it becomes more difficult if the concentrated positions are reviewed on an institution-wide basis to determine the potential impact of certain market price evolutions. The reason for this complexity is that a market impact is only indirectly observable, mainly ex-post, and across different business divisions. Additionally, the volume of the concentrated exposure should be considered in relation to the trading volume, ability of the institution to trade in a particular market, and average trading volume of the institution<sup>211</sup>.

These market considerations are unique for each institution, so a general assumption about market liquidity and the tradability of financial instruments cannot be drawn. A sufficient market liquidity according to Art 338 CRR can be measured using several indicators such as market price volatility, relative bid-ask spread, and the average daily trading volume. The various dimensions of market liquidity should demonstrate the difficulty in the measurement of market liquidity. These relative dimensions make it tough to apply a smart contract to review the concentrated positions.

For concentrated positions, it is essential to determine the duration until the risk position is totally reduced under the condition that the market price is not significantly impacted. This time period is called »exit period«. A critical threshold of the exit period is 10 days. This

means that an exit period longer than 10 days leads to a valuation adjustment. Thereby, the adjustment considers factors such as the volatility of relevant input factors, variation of the bid-ask spread, and the interaction between market price and exit strategy<sup>212</sup>. Additionally, there exists the regulatory requirement that an exit strategy be carried out within 10 days. This is in line with Art 365 CRR to determine the capital requirements with respect to market risk. The AVA for concentrated positions is the sum of all individual valuation adjustments. Thus, no diversification effect is included. This effect is only indirectly possible through under- and overestimations of the AVAs<sup>213</sup>.

Further, concentration risk should not be singularly considered. The risk factors concentration and market risk are closely related. For example, the negative shock of creditworthiness of an issuer impacts its share price, the related fixed income instruments, and derivatives negatively. This means that there is an immediate impact on the equity, credit, and derivative pricing of this issuer. Hence, all financial instruments have common single risk factors and are highly correlated. The risk management regarding concentration risk should be able to identify such a dependency ex-ante, so the institution can evaluate whether a risk reduction is appropriate.

This example demonstrates the complexity of sound risk management. It also highlights that a smart contract supports the risk management process as a constant reviewing tool and provides early indicators.

The evaluation of concentration risk even gets more complicated if the additional dimension of market behavior is introduced. Market and concentration risk can also be caused by a change in the risk aversion of the market participants<sup>214</sup>. With an increased uncertainty about the economic outlook, market participants can become more conservative in buying risk positions. The shift in market sentiment could cause an increase in the risk premium, resulting in the re-valuation of financial instruments. In extreme scenarios, market participants become unwilling to buy any risk position, and consequently, the markets dry up. Such market behaviors should represent an integral part of the risk management process with the overarching aim of protecting the institution's inventory.

## B. Market price uncertainties

Art 9 PV-RTS discusses valuation adjustment with respect to market price uncertainties. This category refers to the risk that a financial instrument's price can

209 Cf CEBS Guidelines on the management of concentration risk under the supervisory review process (GL31) Recital 51.

210 Cf Becker in Boos/Fischer/Schulte-Mattler, 5<sup>th</sup> edition 2016, Regulation (EU) 575/2013 Art 105 Recital 56.

211 Cf Becker in Boos/Fischer/Schulte-Mattler, 5<sup>th</sup> edition 2016, Regulation (EU) 575/2013 Art 105 Recital 57 as well as Ly bek/Sarr, Measuring liquidity in financial markets, IMF [Working Paper].

212 An exit strategy specifies the trading framework in order to exit a concentrated position.

213 Cf Recital 7, as well as chapter 4.2.3 PV-RTS.

214 Cf CEBS Guidelines on the management of concentration risk under the supervisory review process (GL31) Annex 1 Example 4.

be determined with certainty. As previously mentioned, such uncertainty mainly occurs during time periods of extreme volatility or financial turmoil.

If an institution has convincing evidence regarding the tradable prices of financial instruments, the related AVA is set to zero. However, there is an additional requirement of sufficient market liquidity. As market price uncertainty is strongly related to market and concentration risk, introduced in Sections 4.5.1 and 6.1, a detailed discussion of this risk will not be provided here. Therefore, no further limitations regarding the application of smart contracts are detected.

AVA is not set to zero if the institution fails to provide the necessary evidence that there is a liquid market or sufficient tradable market offers. If the financial instrument is valued by market price observations, the AVA equals a common price discount. However, a financial instrument can also be valued indirectly using a model-based approach. Under these circumstances, the AVA is introduced by adjusting each input factor, which must be derived from the market price<sup>215</sup>. The data quality of the input factors can be either sufficient or not. Assuming sufficient market observations, the calibration of the input factors should ensure that the modeled price is realized in the 90 percent quantile. To provide enough evidence that the modeled prices meet the requirement, an institution should perform a back test regularly. Such a back test is an exercise a smart contract is able to execute, because the institution can define the term 'sufficient market data' in its policy. Afterwards, the smart contract performs the back test and computes the realized probability.

Assuming an insufficient data quality, the input factors are selected using an expert-based approach. The process is supported by additional qualitative and quantitative information<sup>216</sup>. Such an exercise can not be executed by a smart contract as a general interpretation of varied information is needed and the complexity is too high to ensure meaningful results. However, a smart contract can still monitor whether an expert-based justification has been performed and make the governance process more efficient.

The overall AVA for the market price uncertainties for an institution is calculated by first computing the adjustments for each position. Then, all the AVAs for the trading and banking book positions are cumulated to obtain the aggregated AVA. The computation of the total AVA can also be supervised by a smart contract.

### C. Close-out costs

As mentioned earlier an institution must have an exit strategy to reduce risk positions. This means that the institution owns a certain financial instrument and wishes to reduce the risk position by selling or buying the financial instrument<sup>217</sup>. These financial transactions can create close-out costs so that the valuation needs to be adjusted in accordance with Art 10 PV-RTS. The close-out costs emerge when an institution is unable to close the position at a certain price<sup>218</sup>, as for example, an instrument becomes more expensive than expected to sell. For illustrative purposes, the close-out of an existing position requires a match in the notional amount and maturity. For example, a long future position is neutralized by a short future position if both future positions have the same maturity date and underlying instrument. Economically, close-out costs and liquidity risk are highly codependent and, for example, observable at the bid-ask spread. An institution could have higher close-out costs if the financial instrument is less liquid. The lower liquidity is also observable at a larger bid-ask spread which is an indication of a higher liquidity risk.

The determination of the AVA for close-out costs can be compared with the adjustment of market price uncertainties. This means that the logic regarding sufficient data quality is applied here as well. In case of insufficient data, an expert-based approach is selected. To compute the overall AVA, an adjustment is first determined on an individual basis<sup>219</sup> and then an aggregated AVA is calculated which represents the AVA of the institution.

However, there are some differences between the AVA of market price uncertainty and close-out costs. The AVA for close-out costs is zero if the institution can close-out at mid-market prices<sup>220</sup>. A mid-market price is the average of the bid and ask price of a financial instrument. If an institution claims that a close-out is achievable at mid-market prices, it needs to prove that this is possible in at least 90 percent of the cases. However, the presence of a projected market liquidity is assumed.

To control and monitor the market risk related liquidity, an institution should maintain certain systems and processes<sup>221</sup>. The aim of this risk management procedure is to identify potential concentrated risk positions where risk reduction could be constrained by

215 Cf Becker in *Boos/Fischer/Schulte-Mattler*, 5<sup>th</sup> edition 2016, Regulation (EU) 575/2013 Art 105 Recital 37.

216 Cf Becker in *Boos/Fischer/Schulte-Mattler*, 5<sup>th</sup> edition 2016, Regulation (EU) 575/2013 Art 105 Recital 37.

217 An institution closes a long position by selling the financial instrument as the institution bought it in the first place. The opposite trading actions need to be done with a short position.

218 Cf Art 105 (5) CRR.

219 Cf Becker in *Boos/Fischer/Schulte-Mattler*, 5<sup>th</sup> edition 2016, Regulation (EU) 575/2013 Art 105 Recital 43.

220 Cf Becker in *Boos/Fischer/Schulte-Mattler*, 5<sup>th</sup> edition 2016, Regulation (EU) 575/2013 Art 105 Recital 44.

221 Cf CEBS Guidelines on the management of concentration risk under the supervisory review process (GL31) Guideline 5.

market liquidity<sup>222</sup>. For this purpose, a top-down risk management approach is essential. This means that the concentrations need to be reviewed on a firmwide and lower business level<sup>223</sup>. To identify the appropriate risk appetite for an institution, the close-out risk needs to be fully understood and recognized as per the corresponding risk limits.

As the approach is comparable with the previous section, the same argument about the usability of smart contracts can be made. However, a smart contract can support the calibration process for risk limits. This can be achieved, for example, by analyzing the close-out risk and estimating the economic impact.

#### D. Model risks

The previously mentioned valuation adjustments are caused by market events and potential uncertainty. The valuation adjustment related to model risk is theoretical and in compliance with Art 11 PV-RTS<sup>224</sup>. A model risk refers to when a model is applied for a purpose out of its scope<sup>225</sup>. This risk can also occur indirectly when input factors are calibrated by an inappropriate model, resulting in a calibration risk. However, between model risk and market price uncertainty must be differentiated as it ensures that the same risk component does not feed two AVA categories, which could result in a financial instrument being accidentally adjusted twice. The difference between model risk and market price uncertainty is that the former refers to the theoretical model, the corresponding calculation methods and implicit or explicit model assumptions, whereas the latter points to market observation and the uncertainty about the correctness.

The valuation adjustments of model risk follow the same logic as the AVA for market price uncertainty and close-out costs. However, as model risk cannot be determined in a quantitative manner, the valuation adjustment is expert-based. Factor specific to model risk such as the complexity of the model, unobservable model parameters, or model suitability, among others should be integrated into the risk assessment in accordance with Art 105 (12) and (13) CRR. This means, for example, that a highly complex model could lead to a larger valuation adjustment. As model risk is analyzed qualitatively, a smart contract has limited ability to contribute to this process. The main contribution of a smart contract here would be to monitor the review process and document the revision.

PV-RTS also lists additional valuation adjustments such that the presented AVAs represent main and diverse adjustments. For completeness, the remaining AVAs are as follows: uncollected credit risk premiums in line with Art 12 PV-RTS, investment and financing costs as per Art 13 PV-RTS, future administrative costs in accordance with Art 15 PV-RTS, early redemption under Art 16 PV-RTS, and operational risks pursuant to Art 17 PV-RTS. A detailed discussion of these AVAs is not provided here, as their valuation adjustments are similar to the ones mentioned earlier or their economic relevance is limited.

Finally, small institutions can follow a simplistic procedure to determine their valuation adjustment. Here, a small institution is when the total sum of the fairly valued assets and liabilities is less than EUR 15 billion. All AVA factors of small institutions are satisfied by an adjustment of 0.1 percent of the absolute sum of the fair value assets and liabilities<sup>226</sup>.

Thus, the usability of smart contracts in AVA is limited as the determination of valuation adjustments are typically qualitative. A smart contract always has severe difficulties to perform a qualitative exercise due to its nature.

## VII. Conclusion

Financial instruments are allocated to a trading or banking book according to the CRR. For this purpose, CRR has introduced a legal definition of the trading book such that all non-trading book positions are assigned to a banking book. A financial instrument is classified to a banking and trading book, if it fulfills a certain business purpose and, hence, requires a particular risk management. That is, the banking and trading books have different own fund requirements, and hence institutions have an economic incentive to minimize their total own fund requirement. As the 2007 Global Financial Crisis revealed several shortcomings of the boundary between trading and banking book, a review process was launched resulting in FRTB. The corresponding European regulation is CRR, where currently a proposal for amending this regulation, CRR-PR, be under review. Different legal initiatives aimed to turn FRTB into regulation, looking to sharpen the boundary between the trading and banking book. Consequently, regulatory arbitrage is not feasible anymore.

The aim of this paper is to examine the legal constraints of a smart contract in the context of Art 104 CRR. The investigation is performed according with the following framework: First, the considered institution is

222 Cf CEBS Guidelines on the management of concentration risk under the supervisory review process (GL31) Recital 43.

223 A lower business level could be a business division or a business function.

224 Cf Art 4 (1) No 12 CRR.

225 Cf Wiedemann, Modell risk, Gabler Dictionary [Internet Page].

226 Cf Mikulík in Laurer/Schütz/Kammel/Ratka, BWG<sup>4</sup> Art 105 Recital 12 (As of 01-January 2019, rdb.at).

domiciled in a European country and under the supervision of a European competent authority. Second, the institution does not have any branches or entities outside of Europe and is a standalone institution. Furthermore, purely European regulation is considered. Third, the institution applies the IFRS 9 accounting treatment. Fourth, the investigation is purely regulatory in nature. This means that any other legal aspect, such as the consideration of civil law, criminal law, etc, is not within the scope of this examination. Here, smart contracts are only considered as a technical vehicle and, exemplarily, no legal limitations regarding smart contract from a civil law perspective are drawn.

In conclusion, the observed legal constraints can be classified into two different groups: The first classification is technically driven in terms of the implementation of legal definitions or terms. The second captures the limitations regarding the governance and application of appropriate policies and procedures.

The technical limitations first emerged with the legal definition of »positions with trading intent«. A position has a trading intent if the trading purpose is, for example, a short-term resale. The limitation is driven by »short term«, as a smart contract requires a precise duration; thus a position may be flagged as short-term. CRR and FRTB contain a strong indication that short term refers to one year. As this is the only indicator, there remain still several exceptions such as short-term claims and uncertainty about a precise cutoff. Moreover, a position has a trading intent if the trading purpose is to profit from the expected or actual short-term price differences. The first issue with this trading purpose is the scope of the expected short-term price differences. This means that the expected price differences are related to a mathematical model. Therefore, the scope of the considered quantitative models needs to be defined. Additionally, an issue might occur between the trading purpose and the output of quantitative models. For example, if an institution aims to hold a position for a long term, the smart contract identifies a short-term price difference.

In compliance with Art 102 CRR, trading book positions must satisfy several requirements. A key condition is that trading book positions are free of restrictions. The issue with this requirement is two-fold. On one hand, it is debatable as to which restrictions need to be considered, as there are restrictions, for example, regarding insider information, trading restrictions implemented by an exchange, or bilateral agreements. On the other hand, a large proportion of the abovementioned restrictions are temporary. This raises the question how long a restriction can last until a financial instrument is classified as restricted.

A similar issue exists with the possibility of reclassifying a position between the trading and banking book

according to Art 104a CRR. A reclassification is allowed only under exceptional circumstances. EBA is instructed to provide further clarification regarding what counts as an exceptional circumstance by 2024. However, a smart contract requires precise definitions of normal or exceptional time periods. This is the issue because a smart contract must review the circumstances *ex-nunc* while the examination of exceptional circumstances typically occurs *ex-post*. Nevertheless, there appears to be a consensus between the regulatory body and industry that exceptional circumstances are those that are outside of an institution's sphere of control. Further, a trading book position must be under the fair value accounting treatment. A reclassification of a banking book position to a trading book position could also create an accounting issue if the banking book position is treated under amortised costs.

Apart from the requirement of trading book positions to be fairly valued, it is also mandatory to perform a daily valuation of the positions. Thus, daily price observations are necessary. This valuation obligation also exists for the corresponding hedges. Particularly, if a trading book position is not supported by a liquid two-way market, hedges offsetting the material risks of the trading book positions must have a liquid two-way market. The first issue here concerns the determination of whether a liquid two-way market as a justification of bona fide prices is needed. At first glance, the examination of bona fide prices appears to be less concerning. However, as each institution requires a certain liquidity, it is not enough to just obtain the bona fide prices. Moreover, a combination of the bona fide prices and tradable volume needs to be reviewed, which is highly challenging. The second issue is to determine the hedges that can offset material risks. The identification process of material risks and appropriate hedges is also a challenging exercise.

A liquid two-way market is essential in the management of trading book positions in line with Art 103 CRR. This article introduces several requirements for policies and procedures. Art 104 CRR sets out that policies and procedures hold the central and most fundamental characteristic to define which positions shall be assigned to a trading or banking book. Thus, applying a smart contract as a decision-making tool is highly dependent on the formulation of the related policies and procedures. The more quantitatively a policy or procedure is formulated, the higher the degree of usage of a smart contract. A similar conclusion can be drawn for trading strategies. The main difference between policies, procedures, and trading strategies is that policies and procedures are utilized on a heuristic level, while trading strategies provide the logic to justify a trading decision. As discussed earlier, it may be necessary to



hedge the material risks of a trading book position. As material risks are not specific, policies and procedures could be used to create a guideline or a method to determine material risks. This example shows that the limitation of smart contract application can be used to determine potential inaccuracies within an institution's policies and procedures, resulting in amendments to increase the soundness of the management process.

Additionally, trading books must be supervised and controlled by an appropriate risk management function that can independently review the business decisions of the risk-taking division. It is therefore questionable, what role a smart contract is able to cover in this spectrum. Due to the high degree of complexity and the individual examination conducted in a risk management, the utilization of a smart contract is limited. The reasons for this limitation are as follows: The first is a technical difficulty, as the smart contract must interpret the risk management exercise, perform an individual risk valuation, and finally draw a conclusion. Such a complex computation is currently not within the scope of a smart contract's ability. Second, even if a smart contract can perform such a risk management action, an institution may not be willing to utilize the smart contract due to high operational and reputational risk. Thus, a smart contract will mainly support the risk management and enhance the effectiveness of this function. A similar conclusion can be drawn for other risk management responsibilities such as reviewing position limits or monitoring exercises in accordance with Art 103 (2) lit b CRR.

To fully implement FRTB, CRR-PR is a proposal to amend CRR. One of the main innovations in CRR-PR is that a presumptive and mandatory list of financial instruments are included in Art 104 CRR-PR. The presumptive and mandatory list is not a significant challenge for a smart contract, as these lists explicitly capture groups of financial instruments. A smart contract can identify these instruments and assign them to a trading or banking book accordingly. Additionally, an institution can request an exception under several conditions for the assignment of financial instruments according to these lists. Due to the individuality and complexity of such requests, a smart contract can only support this process. It is noteworthy that one item of the presumptive list is related to the accounting treatment. In previous versions of the CRR, the link between the accounting treatment and boundary between trading and banking books is indirect, as in Art 105 CRR. This indicates that the relevance of the accounting treatment has now been upgraded by the proposal.

However, there is a mismatch between the regulatory and accounting treatment of embedded derivatives as part of the presumptive list. IFRS treats a financial instrument with embedded derivatives as one instrument.

In contrast, CRR-PR requires the split of embedded derivative from the financial instrument, leading to two instruments. The embedded derivatives are assigned to a trading book, while the residual instrument is assigned to a trading or banking book as indicated. It is worth mentioning that FRTB only considers bifurcated constructions for embedded derivatives and the corresponding financial instrument.

An additional limitation of a smart contract with respect to Art 104 CRR-PR is the requirement that positions causing a net-short credit or equity exposure be assigned to a trading book. The issue with this limitation is the method used to determine net-short positions, that is, the level and material scope used. Due to the lack of certainty about how a computation will be executed, the utilization of a smart contract is limited.

In summary, the advantages of a smart contract are its efficient and transparent assignment process. Further, the classification can be reviewed independently from any participant who has access to the distributed ledger technology and any amendment to the smart contract is documented. The disadvantages are mainly driven by the legal constraints due to the misinterpretation of legal terms or the qualitative formulation of policies, procedures, and strategies.

However, our view is that the advantages clearly outweigh the legal constraints, and institutions should try to utilize smart contract. Nevertheless, it is advisable that institutions must perform an appropriate risk assessment to highlight the related risks. To minimize risks, the institution can apply an iterative approach starting with the instruments on the presumptive and mandatory list and continuing with an evaluation of the trading intent. Learning from these two implementations, the institution can carry on with further features, and specifications such as accounting treatment with trading intent.

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## VIII. Appendix: EBA submissions

This section provides a detailed overview of the submitted EBA questions including the related background and proposed answer.

### A. Reclassification of banking book positions

**Question:** Shall the fair value treatment of trading book positions in accordance with Art 105 (1) CRR be applied for reclassified non-trading book positions pursuant to Art 104a CRR?

**Background:** Non-trading book positions can be recognized as fair value and amortised costs. Under exceptional circumstances, an institution may reclassify a non-trading book positions booked under amortised costs to a trading book. A strict application of Art 105 CRR requires that the institution processes an accounting reclassification of the related position to fair value. As accounting standards, such as IFRS 9.4.4.1, does not allow under exceptional circumstances a reclassification in accounting treatment, the requirements of CRR and accounting standards interfere with each other.

**Proposed Answer:** Art 105 (1) CRR is not applicable for reclassified position with the result that the accounting treatment remains unchanged. First, an institution shall be compliant with accounting standard in accordance to Art 24 CRR. If the institution for example applies IFRS, IFRS 9.5.1.1 requires that the classification is performed at initial recognition. Second, the same approach as for the fair value measurement frequency of non-trading book revaluation can be selected. This means that non-trading book positions under amortized costs are disclosed under fair value (Question 20 of Industry Response to EBA RTS Discussion Paper on Market Risk & Counterparty Credit Risk framework, March 2018).

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### B. Embedded derivatives

**Question:** Can an institution be compliant with Art 24 (1) CRR, if embedded derivative and its host contract treated independently pursuant to Art 104 (3) Second Subparagraph of Proposal for amending CRR?

**Background:** The Proposal for amending CRR in 2021 proposes in Art 104 (3) that an embedded derivative shall be split from the host contract with the result that both instruments are classified to a trading or nontrading book independently for each other. However, accounting standards, such as IFRS 9, generally treat embedded option and host contract as a joint contract as in IFRS 9.4.3.3. To be compliant with Art 24 (1) CRR, an

institution shall treat the embedded derivatives and host contract as one contract, while the regulatory treatment requires a split.

**Proposed Answer:** The recital of the Proposal mentions under the section »Market Risk Framework« that the European Parliament and the Council agreed to implement FRTB standards. The Basel Committee mentioned in RBC25.9 (6) that the embedded derivatives and host contract should be bifurcated and from an accounting perspective separately recognized. By limiting the second subparagraph of Art 104 (3) to bifurcated contracts, an institution is able to be compliant with Art 24 and 104 (3).

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### List of abbreviations

AC	Amortised Cost
ACTP	Alternative Correlation Trading Portfolio
AT1	Additional Tier 1
CET1	Common Equity Tier 1
CIU	Colletive Investment Undertaking
EBA	European Banking Authority
ECB	European Central Bank
EU	European Union
FRN	Floating-Rate Note
FVtOCI	Fair Value through Other Comprehensive Income

FVtPnL	Fair Value through Profit and Loss
HQLA	High Quality and Liquid Assets
IAS	International Accounting Standards
IASB	International Accounting Standards Board
IFRS	International Financial Reporting Standards
IPO	Initial Public Offering
LCR	Liquidity Cost Ratio
NSFR	Net Stable Funding Ratio
PR	Proposed Regulation
PV	Prudent Valuation
RBC	Risk-based Capital
RTS	Regulatory Technical Standard
SFT	Securities Financing Transaction
TVM	Time Value of Money

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