



EUROPEAN CENTRAL BANK  
EUROSYSTEM

## Occasional Paper Series

Alessandro Santoni, Ghislain Rossignol,  
Richard Akhouen

### Wind-down of bank trading books

Operational aspects and hidden costs

No 316

# Contents

<b>Abstract</b>	<b>2</b>
<b>Executive Summary</b>	<b>3</b>
<b>1 Orderly versus disorderly wind-down</b>	<b>6</b>
<b>2 Overview of the ongoing policy discussion</b>	<b>7</b>
<b>3 Operationalisation of the wind-down</b>	<b>9</b>
3.1 Scenario analysis	9
3.2 Wind-down strategies	9
3.3 Operational aspects to be mitigated during the wind-down strategy	11
<b>4 Valuation assumptions in the trading book wind-down</b>	<b>12</b>
4.1 Fair value – a partial view of a solvent-wind down (SWD) value	13
4.2 From fair value to SWD value	16
4.3 Estimating rump costs	23
<b>5 Conclusion</b>	<b>24</b>
<b>Annex – Operational strategies and commonalities observed in publicly available resolution and recovery plans</b>	<b>25</b>
<b>References</b>	<b>27</b>

# Abstract

The writing of this article predates by several months the failure of Silicon Valley Bank and the takeover of Credit Suisse which occurred in March 2023. It does not represent the views of the European Central Bank (ECB) and should not be construed as linked to or an advice for the winding down of those banks.

This article focuses on some of the operational aspects of winding down a bank's trading book portfolio and discusses the hidden exit costs that can sometimes exist. The article provides a deep dive on valuation principles and exit strategies currently considered by industry practitioners when designing a solvent wind-down plan. It also provides the reader with an overview of key underpinning valuation or pricing concepts, such as 'fair value', 'realisable value' and 'solvent wind-down (SWD) value'. In particular, it argues that the cost to wind down a trading portfolio beyond the usual accounting carrying value might be largely driven by wind-down operating costs (including bank liquidity and funding costs) and two main pricing components, namely the capital valuation adjustment (KVA) and margin valuation adjustment (MVA). We advocate that bank recovery and resolution plans should, in contrast to current practice, properly factor in these additional costs. We also argue that conducting SWD exercises in a pre-crisis period can be very useful in understanding the costs of winding down a trading book. The article follows the ongoing policy discussion on the topic subsequent to the consultative document of the FSB (Financial Stability Board) on the solvent wind-down of derivatives and trading portfolios and the SWD guidance of the SRB (Single Resolution Board).

**JEL Codes:** G12, G13, G14, G15, G17, G18, G32, G33, G34

**Keywords:** bank's trading book, market risk, solvent wind-down, fair value, realisable value, solvent wind-down value, recovery plan, resolution plan, crisis management

# Executive Summary

**The global financial crisis and the experiences of winding down massive trading portfolios, as happened at Lehman Brothers in 2008, has taught us several valuable lessons when it comes to banking supervision policy.**

Regulators sought to understand, from a supervisory, recovery or resolution perspective, the maturity and complexity of the trading book, intercompany dependencies, and ultimately the possible capital, funding and liquidity implications that might result from a wind-down of such trading portfolio. This led to a better understanding of what a solvent wind-down exercise fundamentally entails.

**The wind-down of a trading portfolio should be carried out in orderly fashion when it is part of recovery option for a bank under stress or part of a resolution strategy.**

Otherwise, when it is the result of a fire sale, it would likely end up as a disorderly wind-down. A disorderly wind-down would normally be very costly for the bank, triggering significant value disruption of the trading book and potentially impacting the bank's soundness and resolvability. In addition, it could create significant risks to the financial system, especially if it involves a G-SIB (Global Systemically Important Bank) with a large portfolio and a high level of interconnection.

**This paper follows the 2021 SRB SWD guidance and the 2019 public consultation conducted by the Financial Stability Board (FSB) on the solvent wind-down of derivatives and trading portfolios.**

The SRB and the Prudential Regulation Authority (PRA) mainly focus on providing guidance on minimum expectations for SWD planning and potential execution. This paper, starting from the operational factors related to SWD, provides an understanding of key challenges related to the valuation concepts, valuation principles and exit strategies currently faced by industry practitioners when designing a solvent wind-down plan.

**The starting point to consider when designing a wind-down strategy is portfolio segmentation together with scenario analysis.**

This process involves segmenting the trading book into various sub-portfolios broken down into trade complexity and counterparty type. Following the full segmentation, the bank should clarify the specific target for each trading portfolio, and this encompasses several approaches that could be used in isolation or in combination.

**Additional steps would then be to aim at exit cash trades or derivatives maturing within the exit period.**

Particular attention should be placed on assets that are required for hedging purposes. Packaging and reselling to other dealers or banks would be a key exit.

**However, SWD execution clashes with several obstacles, notably the exit price determination.**

By design, a solvent wind-down analysis is a rather extraordinary exercise that requires distinct calculations and information compared to regular accounting, regulatory and risk reporting. Key elements of this intelligence are a deep understanding of market pricing practices of assumptions or overlays to be

applied to the balance sheet carrying value to estimate the Solvent Wind-Down Value of a portfolio.

**A sound SWD analysis should rely on realistic market evidence (when possible) and economically plausible and conservative assumptions.** On that basis, the estimation of the overall exit cost should achieve a higher level of certainty than that normally assumed under the accounting framework, which among other things typically does not factor in the risk premium for concentrated positions.

**In this paper we investigate whether the valuation of the positions, under solvent wind-down conditions, could qualify as realisable value.** Despite the prudential framework requiring banks to measure in their capital the cost of exiting exposure under 90% of confidence, this prudent concept might not be sufficient to achieve realisable value, and consequently SWD value, for several reasons: its procyclical effect, the lack of relevant information available on the market to measure the prudent exit price of L3 exposure with material non-observable input, and the non-financial risk not sufficiently factored in the prudent exit price (for example, legal risk or reputational risk). Ultimately, these factors do not call into question a financial institution's compliance with its applicable accounting or regulatory framework, or mean that the financial information it reports is inaccurate; rather, it implies that under an SWD scenario different assumptions or overlays might have to be considered.

**Key differentiating assumptions between SWD value and realisable value include expected operational costs, costs of future financial resources, concentration risk costs and administrative costs.** Financial institutions should pay close attention to capturing these costs when conducting an SWD analysis. Several other costs could influence the SWD of derivatives and trading book portfolios, such as the rump costs or the day one profit (DOP) deferral. Rump portfolio consists of the residual "sticky" positions, meaning positions that will remain on the institution's balance sheet after performing the wind-down exercise. Day one profit deferral or day one losses deferral arises at the trade recognition when the transaction price and the fair value price using non-observable inputs are different. The exiting of related transactions will have an effect on capital, either capital benefit or capital drag, due to the early exiting of the positions as a result of the SWD exercise.

**All else being equal, the net capital impact of an SWD should be equal to the difference between the net expected impact on cash flows resulting from the SWD and the adjustments already accounted for in regulatory capital** (i.e. excess cash flows over fair value, balance sheet correction – i.e. DOP/DOL deferral –, AVA, net liquidity and funding costs).

**Derivative trading activities generate several additional adjustments, collectively known as X-valuation adjustments, or XVAs.** The global financial crisis led to a structural shift in the operation of the global banking sector. A significant change has been the introduction of new regulation to ensure that banks are adequately capitalised. The new regulation requires derivative instruments that are not cleared through central clearing houses to be collateralised, as required for

exchange traded instruments such as futures contracts. The costs of margining and associated liquidity volatility are an additional cost when trading derivatives. As a result, various derivative valuation adjustments are required, essentially to reflect the additional 'costs' in holding derivative contracts. Overall, the industry has reached a sound degree of maturity as regard the usage of XVA metrics in pricing or accounting. That said, XVA remains an evolving landscape where a significant degree of diversity can still be observed across the different metrics. From an accounting and regulatory perspective, provisions are mostly set aside for credit or debit valuation adjustment (CVA and DVA), funding valuation adjustment (FuVA) and, to a lesser extent, for the costs of funding collateral, also known as collateral valuation adjustment (COLVA), while the margin valuation adjustment (MVA) and the capital costs of a derivative (i.e. the capital valuation adjustment, KVA) are not yet widely considered for fair value or prudent value measurement purposes. Hence, when conducting an SWD analysis for bank recovery and resolution plans, such additional costs should be properly factored in.

**There is neither a one-size-fits-all SWD strategy, even for similar portfolios, nor a commonly accepted market approach on how to estimate the corresponding exit cost.** Indeed, a trading book wind-down may result from a wide range of exit options, ultimately exposing the bank to different costs. We advocate that recovery and resolution plans should, contrary to the current practice in some cases, factor in exit costs on a broader basis.

**In pre-crisis periods, SWD exercises would be very useful for understanding the costs of winding down a trading book.** SWD exercises provide a useful view on the segmenting of the trading book, product characteristics and intercompany dependencies. They give an understanding of the maturity and complexity of the trading book, as well as a view on the funding and liquidity implications resulting from the wind-down. Overall, we believe the SWD exercise to be useful from a supervisory, recovery and resolution perspective, and we expect it could be expanded not only to UK banks but also EU and US banks.

In the annex, we provide a compendium of the most common assumptions and operational strategies observed in publicly available resolution and recovery plans.

# 1 Orderly versus disorderly wind-down

*‘Solvent wind-down’ means that all claims are paid in full, and all obligations are met in connection with the derivatives and trading book portfolio that is wound-down in a timely and measured manner’ – FSB Solvent Wind-down of Derivatives and Trading Portfolios.<sup>1</sup>*

**A successful wind-down strategy needs to be precisely defined.** A bank that has successfully implemented a wind-down strategy – following a period of financial stress or experiencing the cancellation of its license – should be capable of ceasing its regulated activities with minimal adverse financial impact and limited effects on its banking franchise customers, counterparties, or the wider financial markets. Successful wind-down of a trading portfolio would thus be characterised by an orderly execution when it is part of a recovery option for a bank under stress or part of a resolution strategy. Otherwise, a disorderly wind-down usually occurs when it is the result of a fire sale.

**A disorderly wind-down would typically be very costly for the bank, triggering significant value disruption of the trading book and potentially impacting the bank’s soundness and resolvability.** In addition, it could create significant risks to financial systems, especially if this involves a G-SIB with a large portfolio and high level of interconnection. The preparation phase is a key factor in achieving an orderly as opposed to a disorderly wind-down.

**Planning an orderly wind-down entails creating the conditions to properly manage the exit of a bank from a regulated business when the firm is no longer viable, or has deliberately decided to exit a regulated business.** Among various considerations, the most important aspects of a wind-down plan are the scenarios setting the conditions for the company to exit the business, a plan to orderly execute the exit, an assessment of the financial and non-financial resources needed to face the relevant scenario and a detailed analysis of the potential risks that could hinder or frustrate a proper wind-down.

---

<sup>1</sup> “Solvent Wind-down of Derivatives and Trading Portfolios”, Financial Stability Board, 3 June 2019.



## 2 Overview of the ongoing policy discussion

**The topic of the orderly wind-down of trading portfolio has recently attracted much attention among authorities dealing with financial stability risks.** The intense policy discussion on the topic originates mainly from the negative experiences encountered when winding down Lehman Brothers' massive trading portfolio. According to Michael J. Fleming and A. Sarkar,<sup>2</sup> the recovery rate among Lehman creditors for over-the-counter (OTC) derivatives transactions was below historical averages of comparable failed firms. The settlement of OTC derivatives was a long and complex process, with some of the losses borne by Lehman investors. Such outcome could have been avoided in a more orderly process. One of the key weaknesses of the Lehman bankruptcy process was the poor preparation and planning of the wind-down procedure (e.g. it was prepared just one week ahead of the bankruptcy).

**Since 2015, the PRA has been asking overseas banks to conduct SWD exercises with the aim of supporting resolution authorities in understanding the cost of winding down trading books.** Notwithstanding the preparation and the learning by doing process, the SWD exercises conducted by the PRA from 2015 to 2021 highlighted several deficiencies among UK banks regarding their capacity to carry out an orderly wind-down of their trading activities in recovery and post-resolution restructuring. In October 2021, the PRA published a consultation paper proposing that firms engaging in derivatives and trading activities should be able to carry out a full or partial orderly wind-down of their trading activities in recovery and post-resolution restructuring. The PRA proposals deriving from the approval of the consultation paper would result, among other things, in a new Supervisory Statement on trading activity wind-down, and amendments to recovery planning.

**Trying to build upon the experiences in the United States and the United Kingdom, the Single Resolution Board (SRB) made SWD of trading book its 2021-2023 priority topic to support Internal Resolution Teams (IRTs) in the drafting of resolution plans.** At global level, the FSB published a discussion paper in August 2019 focused on the solvent wind-down of the derivatives and trading book portfolio of G-SIBs. The FSB discussion paper for public consultation addressed the capacity among banks to execute a wind-down strategy of a derivative and trading book, the resources (capital and liquidity) necessary to properly implement a wind-down, and the potential impact on the viability of the wider group.

**Following a public consultation, the FSB decided not to develop further guidance.** Members highlighted that regulatory divergence and differing business models could inadvertently lead the FSB to develop fragmented requirements that would be inconsistent across jurisdictions and therefore difficult for G-SIBs to implement. The responses from the GFMA (Global Financial Markets Association),

---

<sup>2</sup> "The Failure Resolution of Lehman Brothers", *Economic Policy Review*, 10 April 2014.



IIF (Institute of Internal Finance) and ISDA (International Swaps and Derivatives Association) reveal substantially differing SWD requirements among jurisdictions, making a common guidance very challenging. As an illustrative example, while the primary objective of SWD in the United Kingdom is capital preservation, the aim of SWD in the United States is liquidity generation. The FSB accepted these reservations while strengthening its commitment to promoting solvent wind-down planning as part of overall resolution planning.

**Following the work initiated by the FSB, the SRB published guidance<sup>3</sup> on the solvent wind-down of sizeable and complex derivatives and trading books in resolution.** The guidance sets out the scope and minimum expectations for SWD planning and potential execution. Banks are expected to properly plan an exit strategy and the potential financial implications for the various segments of their trading activities. This would need to be accompanied with continuous monitoring and capacity to update the plan in a timely manner by relying on internal capabilities to execute the wind-down. An essential element of the SWD would be a playbook focusing on governance as escalation points, parties involved in the decision-making and communication with relevant stakeholders.

---

<sup>3</sup> "Solvent-wind-down-guidance-for-banks", Single Resolution Board, 1 December 2021

## 3 Operationalisation of the wind-down

**In this chapter we develop some operational aspects of an SWD, starting with some general considerations on solvent wind-down strategies and operational preconditions for a successful SWD.** Among the most important operational

factors to consider when designing a wind-down strategy are the scenario analysis, which consists of segmenting the trading book into different sub-portfolios, depending on variables such as product characteristics or the trade counterparty involved.

**Following the full segmentation of the trading book, the bank should clarify the specific target for each trading portfolio. This encompasses several approaches that could be used in isolation or in combination.** The next step

would then be aiming to start exiting maturing cash trades or derivatives maturing within the exit period. Close attention would need to be paid to assets required for hedging purposes. Packaging and reselling to other dealers or banks would be a key exit strategy. The success of this strategy would mostly depend on the liquidity and complexity of the underlying assets.

### 3.1 Scenario analysis

**The scenario analysis is among the most important steps when designing a wind-down strategy.** From an operational viewpoint, the starting point of a wind-

down strategy involves identifying, within a range of plausible scenarios, the SWD scenario that minimises the impact on the franchise, counterparties and the wider financial markets considering multiple internal/external dependencies (such as market conditions, expected return of buyers, and legal constraints). Because of its multidimensional nature, an SWD exercise is data-intensive and consequently very demanding in terms of IT infrastructure and modelling capabilities.

**A scenario analysis also requires strong involvement from front office, as well as support from other bank functions (mainly Risk and Finance).** While scenario

analysis might take several forms, in practice it involves segmenting the trading book into different sub-portfolios, depending on variables such as product characteristics or counterparty to the trade. This leads to a segmented disposal strategy for each sub-portfolio, highlighting the financial impact in terms of both capital and liquidity. The analysis should clarify all the assumptions and include rump identification and related rump maintenance costs.

### 3.2 Wind-down strategies

**Other important factor to consider when designing a wind-down strategy are portfolio and product characteristics,** including complexity (possibly apprehended through the fair value classification: i.e. Level 1, Level 2, or Level 3 instruments) and

maturity, the existence of collateral agreements with the counterparties, the liquidity and depth of the underlying primary (interbank market) or alternative financial market (unregulated financial counterparties such as hedge funds). Another key element relates to the definition of the SWD time horizon, and, within this timeframe, the most appropriate SWD strategy.

**Once SWD strategy and timeframe have been defined, a detailed product and business segmentation would be required to price and wind down the portfolio.** This is represented by a detailed segmentation of the portfolio, highlighting the governing jurisdiction, product type, OTC, booking entity, structural balance sheet hedge, and differentiating derivatives books, highlighting the one that is part of the banking book, liquidity, and fair value hierarchy level. The presence of Level 1 High-Quality Liquid Assets (HQLAs) would facilitate the task, with no need for significant segmentation since they should be easy to liquidate.

**Following the full segmentation of the trading book, the bank should clarify the specific target for each trading portfolio.** Banks could in fact decide to sell certain portfolios for explicit imminent liquidity needs, or instead to wait until the expected maturity of the trades composing the trading book. Alternatively, the target could be an intermediate approach that would seek to minimise costs, optimise capital and leave the bank with sufficient liquidity at all times to complete the wind-down. Such intermediate approach could rest, among other choices, on a client-initiated early termination assumption. From a capital standpoint, a quick wind-down could release capital in the medium to long term by reducing risks, RWAs (Risk-Weighted Assets) and some capital deduction such as the AVA (Added Value Adjustment) under the Prudent Valuation Regulation for European banks. In the short term, the capital relief benefit would be more than offset by the costs, as selling quickly into a stressed market would likely imply heavy discounts. Lastly, the bank could simply classify certain assets as illiquid with limited wind-down possibilities as it awaits better market conditions.

**The wind-down strategy should encompass several approaches, which may be used in isolation or in combination:**

- Roll-off of positions with finite contractual timespans (i.e. positions that are not replaced or rolled over as their maturity nears).
- Unwinding of positions prior to their maturity date (i.e. close-out or termination of a financial instrument prior to maturity though payment of a termination fee by the cancelling counterparty, such as client-initiated or incentive for early termination).
- Disinvestment of stand-alone financial instruments or portfolios through sale (primarily for cash instruments) or novation (through tripartite agreement whereby both rights and obligations arising from derivative instruments are transferred to a third party).
- Compression or bilateral tear-up (post-trade balance sheet reduction technique whereby two or more counterparties replace multiple offsetting derivatives

contracts with fewer contracts of the same net risk exposure but reduced portfolio notional value).

**The next step would then be aiming to start exiting cash trades or derivatives maturing within the exit period. Close attention should be paid to assets required for hedging purposes.** The strategy could also envisage re-hedging activities to manage market risk during the wind-down activity. During this period, any position where the contract could be terminated or cancelled could be closed. Termination rights could be invoked. The exit costs of winding down the derivative and trading portfolios need to be factored in, including compensation paid to dealers or counterparties to incentivise them to close out open positions.

**Asset packaging and reselling to other dealers or banks would be a key exit strategy.** Identification of the right buyers, which is an essential tool to execute a rapid and effective wind-down, should be based on selecting buyers that could be natural owners with a low weighted average cost of capital. Alternatively, one might look at the potential buyers' funding situation and capacity. When assessing this strategy, institutions should calculate the cost because a rebate in the fair value is often observed when exiting portfolios and their hedging arrangements, especially for the less liquid ones.

### 3.3 Operational aspects to be mitigated during the wind-down strategy

**An important element that would facilitate the wind-down of a derivatives portfolio in a resolution scenario is the concentration of the positions among relatively few subsidiaries, all with material operating activities.** This would facilitate liquidity support from the parent company. However, if the entities are sub-investment grade and unlikely to regain investment grade status during the wind-down process, this will limit access to the bilateral OTC market, thus forcing the entities to rely on exchange-traded and cleared instruments for hedging purposes.

**An aspect that would need to be mitigated is the increased interconnectivity resulting from intercompany derivative transactions.** Affiliates engaging in external activities should be subject to a certain cross-default and early termination rights. Derivatives contracts should envisage mutually agreed "tear-ups" and risk-free netting. Centralised clearing arrangements between material operating entities should be set to eliminate "interconnectedness risk." As common to other resolution processes, close cooperation between home/host authorities is essential to facilitate the Bank's activity during the wind-down process.

## 4 Valuation assumptions in the trading book wind-down

**Wind-down execution clashes with several obstacles, among which are price determination, fair value and costs to wind down.** Estimating the cost to wind down a portfolio requires further market intelligence on possible exit strategies. Key elements of this market intelligence are market pricing practices and a deep understanding of assumptions or overlays to be applied to the balance sheet carrying value to estimate the solvent wind-down value of a portfolio. In this chapter we propose an overall evaluation of valuation challenges, valuation principles and exit strategies currently considered by industry practitioners when designing a solvent wind-down plan.

**By design, a solvent wind-down analysis is an extraordinary exercise that requires distinct calculations and information compared to regular accounting, prudential and risk reporting.** Quantifying the overall cost to exit a trading book entails:

- developing a market intelligence on how pricing balance sheet or capital intensive transactions or portfolios (i.e. understanding the factors or mechanisms at play behind the costs associated with winding down the in-scope portfolio);
- in-depth analysis and understanding of wind-down strategies (e.g. derivative portfolio compression, novations,...), the market absorbing capacity (liquidity and breadth), the associated costs and accounting impact according to pricing choices and conventions
- understanding the legal, tax or regulatory constraints to transfer contracts to another solvent market participants (e.g. client consent, tailored legal set-up, regulatory holding hurdle,...), as well the costs and financial strain associated with client-initiated early termination;
- analysing the risk of additional margin requirement due to market instability and possible cascade effects on credit ratings, as well as external factors such as idiosyncratic reactions by counterparty or local authorities;
- identifying the residual portfolio (rump) that is expected to remain on the balance sheet following the SWD period.

**Although this article focuses on some of the operational aspects of winding down a bank's trading book portfolio a number of elements outlined in this document might also be applicable in the context of a banking book solvent wind down exercise.** In effect, liquidating a banking book portfolio might not entail material differences from an operational angle. Similarly, such an exercise might also be useful to identify possible hidden unrealised losses for financial instruments measured at the amortised cost due to changes in market values (e.g. Increase of

interest rates or unanticipated economic downturn). Ones should not underestimate the emergence of this unrealised losses from the banking book which might be proven very steep as observed recently by market participants who had to realise their losses due to the change in their trading intends.

## 4.1 Fair value – a partial view of a solvent-wind down (SWD) value

**A good SWD analysis should rest on realistic market evidence (wherever possible) and economically plausible and conservative assumptions.** On that basis, the estimation of the overall exit cost should achieve a higher level of certainty than that typically achieved under the accounting framework. According to IFRS 13, the fair value of an instrument is defined as the exit price from the perspective of a market participant. This exit price should in principle include an adjustment for risk that market participants would include when pricing the asset or liability.

### **Is fair value reflective of realisable value under solvent wind-down conditions?**

This question of whether accounting fair value is a substantial and accurate representation of realisable value attracted the scrutiny of regulators, who consequently sought to address the measurement uncertainties by publishing prudent valuation guidance and laying out prudent valuation requirements for regulatory purposes (though not foreseen in all jurisdictions). However, fair value and prudent value might still deviate from realisable value, and consequently SWD value. Ultimately, these aspects do not call into question a financial institution's compliance with its applicable accounting or regulatory framework, or mean that the financial information it reports is inaccurate; rather, they imply that under an SWD scenario different assumptions or overlays might have to be considered.

### 4.1.1 Accounting and capital reserve

#### **What are the peculiarities of wind-down cost assumptions compared to the assumptions typically used under an accounting and prudential framework?**

The evaluation of the exit and operational costs associated with winding down a portfolio should be based on a combination of common, alternative, and additional assumptions and arrangements to those assumed under the accounting or prudential framework. In turn, releasing valuation reserves recognised under the various frameworks would ultimately generate capital benefits upon exiting the portfolio. As an illustration, an accounting B/O (Bid-Offer) adjustment booked by an Institution in its ledger to measure an outright equity exposure at the fair value (i.e. exit price) would have to be realised at the date on which the exposure is removed from the balance sheet. This balance sheet entry would generate a PnL benefit that should compensate for the transaction cost, or a portion thereof, that would be charged by the willing buyer.

**All else being equal, the net capital impact of an SWD should equal the SWD value net of fair value, balance sheet corrections and other various valuation-**

**related adjustments already accounted for in the regulatory capital.** The SWD impact could schematically be depicted as follows:

$$\text{SWD impact} = \text{SWD value} - \text{Fair Value} + \text{DOP deferral} + \text{Regulatory valuation adjustments}$$

Where:

- SWD value = Fair Value +/- Additional SWD adjustments (ref. 6.2 for more details)
- Fair Value = Accounting exit price
- DOP deferral = Stock of deferred Day One Profit
- Regulatory valuation adjustments = Capital adjustments for valuation risk

In addition, executing a SWD might probably have second order consequences on the funding profile of the institution and on its remaining business lines or activities, which in turns could generate indirect costs not captured in the SWD value.

As an overview, Table 1 provides a list of the main derivative pricing drivers (non-exhaustive list) that might be considered by market practitioners when running an SWD analysis, with an indication of the elements commonly captured under the accounting or prudential frameworks.

**Table 1**  
SWD exit cost components

Main derivative pricing drivers (under SWD analysis) compared to accounting and PVA frameworks

SWD exit cost components	Accounting adjustments	Prudent valuation adjustments
Market price uncertainty adjustments / Bid-offer costs / Model risk adjustments	Included	Included
Credit valuation adjustments / Funding valuation adjustment / Collateral valuation adjustment	Included	Included
Concentrated risk costs	Excluded	Included
Future administrative costs	Commonly excluded	Included
Margin valuation adjustments	Commonly excluded	Included
Capital valuation adjustments	Excluded	Excluded
Ticket-based costs	Excluded	Excluded
Other costs	Excluded	Excluded

Each component is further detailed later in this section.



## 4.1.2 Fair value

**When fair value cannot be determined on the basis of observed prices in an active market, it is estimated using valuation techniques** (mark-to-model).

Where no observable information is available, the valuation technique may be based on proxy or historical approach.

**Several adjustments are required to adjust the mid value:**

Market risk adjustments.

- A market price uncertainty (MPU) adjustment aims to cover the uncertainty of mid-market parameters of a financial instrument.
- A close-out costs (CoC) adjustment is used to adjust the mid-value to the exit price using appropriate bid/offer market value.
- Model risk (MoRi) adjustment. This additional adjustment might be required when uncertainty arises from the model used in the valuation technique (e.g. model limitations i.e. risks not reflected in the valuation technique, specific market premium to account for the price difference between the cost-to-hedge value (hedging cost of the risk components) and the market price of the instrument).

Credit risk adjustments, also commonly known in general terms as credit valuation adjustments (CVA).

- This adjustment (credit or debit valuation adjustment) reflects the expected credit losses arising from a derivative credit exposure, considering the effect of any collateral, the counterparty credit risk and the loss given default of the counterparty.

Funding adjustments.

- Funding adjustments might be required to discount derivative exposures at an appropriate market funding level. A funding valuation adjustment (FuVA) is an adjustment designed to reflect the funding costs/benefits to hold an uncollateralised OTC derivatives, while a collateral valuation adjustment (COLVA) accounts for the valuation difference between interbank offered rate discounting and overnight rate discounting.

Those three cost categories – frequently known globally as “fair value adjustments” or “fair value reserves” are commonly embedded in the bank’s valuation processes when measuring fair value and correspond to specific risk adjustments over valuation model mid-values.

**These adjustments might in several cases rely on assumptions or accounting choices that could be challenged under an SWD scenario, regarding for instance:**

- **The level at which fair value adjustments are calculated**

Under the discretion allowed by accounting standards, institutions can decide the level at which offsetting positions and risks can be aggregated when measuring fair value (also known as portfolio exception). However, the netting level used for accounting purposes might not necessarily reconcile with how an institution would economically unwind its portfolio or risk under an SWD (e.g. group level vs. region/business/product level). Consequently, the price that would be received upon selling a package of products might not necessarily match the accounting exit price estimated based on net position calculated at a different node level. As a result, additional hedging costs could possibly arise from replacement trades to replace or re-hedge the risk exposure upon close-out when using different netting assumptions.

- **The choice of the pricing convention**

Accounting standards do not preclude the use of one specific pricing convention but require institutions to use judgment to decide which price within the bid-ask spread is most representative of fair value. For instance, among a range of market practices, institutions providing market-making services might consider that mid-prices are most representative of fair value. Conversely, a bank acting as a broker could elect for a policy requiring the use of bid prices for long positions (assets) and ask prices for short positions (liabilities). In an SWD context, it is of major importance to understand the effect of the SWD exit strategy on the institution's capability to exit its portfolio according to the elected accounting pricing convention. All in all, additional bid-offer costs, due to the loss of market maker exemption, should be taken into account.

## 4.2 From fair value to SWD value

**As described above, realisable value tends to differ from fair value typically because it does not embed all pricing components.**

$$\text{Realisable Value} \neq \text{Fair Value}$$

Where:

$$\text{Realisable Value} = \text{Fair Value} + / - \text{Additional adjustments}$$

*Fair Value*

= "Risk-free" Model mid – value"

+ / - valuation adjustments (MPU, CoC, MoRi, CVA, Funding adjustments)

*Additional adjustments = Ticket/portfolio based cost, Concentrated risk cost, Future administrative cost, MVA, KVA, Other*

Conversely, it is expected that SWD value would be more aligned with realisable value, though not fully identical as both regimes follow different objectives.

$$\text{SWD Value} \approx \text{Realisable Value}$$

When applied the valuation adjustments and additional adjustments in most cases reduce the value of the financial assets or increase the value of the financial liabilities, which in turns generate a cost for the institution.

**Key differentiating assumptions between SWD value and realisable value relate to:**

- **Expected operational costs**

Realisable value may incorporate the “likely to be incurred” additional costs (future hedging costs and administrative costs) of the investor to risk manage the portfolio until maturity (see 6.2.3), whereas the SWD value may include not only the “likely to be incurred” additional costs (for the position due to be early terminated), but also all direct and indirect costs of the institution holding the position during the execution of the SWD plan, including any re-hedging costs that might arise during the close-out horizon.

- **Costs of future financial resources**

The costs of anticipated capital and leverage resources may be estimated from the perspective of a market participant for realisable value, while the SWD value may incorporate an overlay to account for the institution’s own future cost of capital for holding a position until its derecognition from the institution’s balance sheet.

- **Market risk and liquidity costs**

The evaluation of realisable value may incorporate anticipated hedging and transaction costs that may not be relevant to consider in the case of the SWD value for rump positions (e.g. where a perfectly hedged portfolio is constructed).

The additional adjustments to fair value required to reflect the amount that could be realised upon exiting a position and to estimate the SWD value are presented in the following sections.

- **Funding and second round financial impacts**

Executing a SWD would probably have side effects on the funding profile of the institution and on its remaining business lines or activities, which in turns could generate additional costs not captured in the realisable value.

#### 4.2.1 Ticket/portfolio-based costs

When exiting a cash position (ex. structured loan) or derivative position, the counterparties might encounter one-off costs that are likely to be factored into their price (e.g. legal, advisory, tax, or additional administrative costs).

## 4.2.2 Concentrated risk costs

### **Concentration risk has traditionally been analysed in relation to credit**

**activities.** However, concentration risk does not only arise from credit activities but also from market activities. For this paper the definition of concentration risk is aligned with the Joint Forum's working definition of concentration risks<sup>4</sup>, i.e. the risk arising from sizeable exposures, relative to the market liquidity and market volume, that may arise within or across different risk categories throughout an institution and can be difficult to unwind or hedge without significantly influencing the market price because of inadequate market depth.

### **Concentrated position can produce large losses and threaten an institution's financial and capital position during periods of market stress.**

This is why supervisors have sought to develop holistic concentration risk management capabilities, notably in terms of recognition of concentration risk in pricing practices. However, unlike the incorporation of concentration risk in the pricing practices of banks or capital prudent valuation adjustment for banks subject to prudent valuation requirements, it has been interpreted by several market participants as meaning that the fair value measurement under accounting should not reflect risk premiums or discounts for concentrated position. As a general principle, the unit of account for financial instruments under accounting standards is usually the individual financial instrument, except when portfolio exception is used. In the latter case, the fair value of a portfolio is then conducted based on net risk position.

**Therefore, institutions shall identify a concentrated portfolio and positions.** For each identified concentrated position, where a market price applicable for the size of the positions is not available, institutions should estimate an exit period commensurate to the liquidity, the volatility of the bid-offer spread and the impact of the hypothetical exit strategy on market prices. This exit period should be properly documented, frequently reviewed, and tested. The identification of the concentrated positions should consider the size of all positions relative to the liquidity of the related market, the institution's ability to trade in that market, and the average daily market volume and typical daily trading volume of the institution. In addition, institutions should factor, either in their capital or their fair value, the slippage<sup>5</sup> of the price and an adequate margin period of risk (MPOR)<sup>6</sup>, especially in the case of positions for collateral positions.

Lastly, institutions should integrate for OTC transactions with concentrated counterparties making it more difficult to novate the positions.

---

<sup>4</sup> "Cross-sectoral review of group-wide identification and management of risk concentrations", Basel Committee on Banking Supervision, April 2008.

<sup>5</sup> Slippage typically occurs when market liquidity is low or when volatility is high. In the context of low liquidity, there are fewer market participants willing to trade. Thus, more time is needed between when you place your order and when it will be executed. Due to this delay, the price of the asset may change and thus create a phenomenon of slippage. In volatile markets, price movements are very rapid and can occur within seconds of executing the order.

<sup>6</sup> Margin period of risk is the time period from the last exchange of collateral covering a netting set of transactions with a defaulting counterparty until that counterparty is closed out and the resulting market risk is re-hedged.

To conclude, additional premia for concentrated positions should be considered by financial institutions when conducting an SWD analysis.

#### 4.2.3 Future administrative costs

**With maybe a few exceptions market participants do not usually consider future administrative costs as a risk and therefore do not integrate it in their valuation techniques when measuring fair value.** As an example, when the portfolio is measured on a “cost-to-hedge” basis (e.g. when using dynamic self-financing replication strategy), there is often an assumption of a complete and frictionless market such that a financial product can be perfectly replicated using costless continuous rebalanced trading strategy.

**However, in the real world a perfect replication strategy might be impossible.** Therefore, even an optimal hedging strategy (i.e. limited hedging activities within risk appetite) is likely to generate transaction costs when readjusting the hedge, and administrative costs to risk manage the portfolio. In this respect it could be reasonable to assume that complex products, such as products sensitive to stochastic volatility and non-constant correlation risks, might attract higher costs due to more intensive risk management activities, more frequent rebalancing of the hedging portfolio, and incremental ad-hoc back-office treatments.

**Careful attention should be given by financial institutions when conducting an SWD analysis, considering:**

- the “likely to be incurred” additional costs that might be charged by a willing buyer to risk manage the portfolio until maturity, namely future hedging and administrative costs.
- the direct and indirect costs of running the business during the execution of the SWD plan, including any re-hedging costs that the institution could encounter during the close-out horizon.

Direct and indirect costs should be as comprehensive as possible and ideally cover, among other elements, staff costs (including severance packages), IT costs, costs for facilities, and costs for professional services, infrastructure and legal services. Associated costs should also reflect the different operating models and intragroup dependencies.

#### 4.2.4 Derivative trading wind-down: XVAs

**Derivative trading adds complexity to the SWD activity of the trading book. It generates several different and additional costs collectively defined as X-Value Adjustments, or XVAs** (umbrella term referring to a number of different “valuation adjustments” covering the different types of valuation adjustments in relation to derivative contracts). The industry has been progressively factoring XVAs into derivative pricing practices; the credit or debit valuation adjustment (CVA and DVA)

of an uncollateralised derivative, the funding valuation adjustment (FuVA), the costs of funding collateral, also known as the collateral valuation adjustment (COLVA), the margin valuation adjustment (MVA), and the capital costs of a derivative (i.e. the capital valuation adjustment, or KVA). However, except for the more traditional credit and funding adjustments presented in Section 6.1 (CVA/DVA, FuVA and COLVA), MVA and KVA are not widely considered yet for fair value or prudent value measurement purposes.

### Initial valuation adjustment: MVA

**MVA is a relatively new concept within the XVA category.** It aims to capture the additional costs resulting from the introduction of mandatory Initial Margin (IM) rules (initial margin protects derivative counterparties from gap risk, i.e. market movements experienced during the liquidation period of the portfolio of the defaulting counterparty, also referred as margin period of risk).

It is likely that for trades requiring mandatory IM posting, a buyer would expect a discount to cover the corresponding funding costs. Hence, those costs should be factored into the exit price of a derivative portfolio under an SWD exercise.

### Capital valuation adjustment (KVA)

**Learning from the global financial crises, with the introduction of Basel III regulators led banks to strengthen their capital requirement for holding derivatives, including for the market risk free portfolio.** As an illustration, consider an unsecured 10- to 25-year swaption traded with a corporate client together with its hedging transaction. Assuming that during a wind-down period banks need to continue complying with regulatory requirements, both the trade and the hedging transaction create regulatory leverage, individually market risk (unless perfectly hedged), counterparty credit risk and CVA capital requirements.

**Capital valuation adjustment, also referred to as KVA, reflects the cost of this additional derivative regulatory capital requirement, and permanently affected how market participants were used to price derivatives.** Conceptually, KVA requires simulating future capital usage throughout the life of the trade. It represents a complex quantitative and computational challenge which arises from multiple elements such as:

- Absence of market consensus on how to compute future RWAs and regulatory leverage into future capital requirements. KVA computation has not reached a mature state yet. Under an SWD, KVA should reflect the KVA costs of the most punitive regime (most conservative approach).
- How and whether upcoming regulatory changes such as incoming FRTB rules should be considered. **An observation as to the evolution of the industry practices for XVA does not provide a clear answer to this question.** However, under an SWD it would be conservative to consider that a market

participant would likely include the capital impact of incoming regulatory changes, notably for long-dated and capital-intensive derivatives (likely to be the most affected transactions).

- The choice of the underlying assumptions regarding the potential primary buyers and other related KVA inputs.

The KVA amount charged by a market participant, i.e. its cost to capital, might be highly sensitive to heterogeneous constraints such as its regulatory regime<sup>7</sup>, its type and activities, and the regulatory effect of netting agreements.

**Therefore, the KVA computation should not only be economically sound and reflect generally accepted market assumptions but also be consistent with the exit strategy and idiosyncratic constraints of the identified primary buyers.** For instance, primary buyers with high RWA constraints might offer less competitive prices compare to low RWA-constrained institutions. For instance when comparing the effect of regulatory CVA impact of a portfolio made of transactions with non-financial counterparties, European banks exempted from CVA requirements for non-financial counterparties would charge no or limited capital costs while US banks not benefiting from this exemption would. Similarly banks subject to prudent capital valuation requirements would be at a competitive disadvantage compared to counterparties evolving under different regulatory regime.

#### 4.2.5 Other costs to be considered

##### Liquidity and funding costs

**Capacity to monitor liquidity imbalances and the impact on profitability is a crucial aspect for an orderly wind-down.** The wind-down of trading book activities is likely to have an impact on the overall funding profile of an institution and might require treasury measures such as new issuances (in case of deficit of liquidity) or buy-back (in case of excess of liquidity). While exiting cash positions might be immediately accretive to liquidity, on the other side an excess of liquidity might increase negative carry, thus causing a drain on the bank's net interest earnings and additional SWD costs for remaining businesses.

At the same time imbalances could arise, mainly for G-SIBs, when exiting funding and liquidity positions across legal entities and jurisdictions. This could create liquidity needs with extra costs.

Furthermore, winding down trading activities might harm the institution's capacity to serve customers and non-SWD business lines, and could consequently generate second-round financial impacts on the remaining business lines (in terms of hedging

---

<sup>7</sup> For example: minimum leverage ratio target of 3% for European banks under the revised Capital Requirements Regulation as opposed to a supplementary leverage ratio (SLR) set at around 5% to 6% for US G-SIBs



costs, sales and trading capabilities, or cross-selling), or due to the reallocation of sticky infrastructure costs.

## Climate risk-related adjustments

**Supervisors have recently been focusing their attention on climate and environmental risks and on associated risk management practices, including pricing practices.** This topic has yet to translate to a change in market practices in relation to derivatives. Several challenges need to be overcome first to adapt – with the required level of sophistication – the risk identification and assessment processes for climate and environmental risks. However, as derivative pricing is constantly evolving, we may well see emerging climate change valuation adjustments in the future.

### 4.2.6 DOP deferral – a specific balance sheet correction

**One of the principal drivers of trading revenues for corporate and investment banks is what is commonly known as first-day profit, also referred to as Day One P&L (DOP hereafter).** DOP arises at trade recognition from the difference between the transaction price and the exit price. Assume an exotic note sold in the over-the-counter market where the bank includes a spread when selling the product to cover its risks and generate a profit. The DOP would correspond to the difference between the transaction price offered to the client (i.e. transaction price) and the cost to exit the corresponding market risk on the wholesale market (exit price).

**According to IFRS 9, paragraph B5.1.2.1A, the best evidence of the fair value of a financial instrument at initial recognition is normally the transaction price.** If the fair value at initial recognition differs from the transaction price, the difference between the fair value and the transaction price as a gain or loss shall be recognised upfront in the profit and loss account (PnL hereafter) if the fair value is observable<sup>8</sup>. In other cases, the difference between the fair value at initial recognition shall be deferred<sup>9</sup>, and then recognised through PnL over the remaining life of the trade (to the extent that the difference arises from a change in a factor – including time – that market participants would consider when pricing the asset or liability).

**From an economic perspective this DOP deferral corresponds to a stock of uncertain unrealised PnL.** Therefore, when a position is exited, the corresponding residual DOP deferral must be recognised through PnL. Consider the sale of a product for €800, with a fair value of €1,000 and a residual DOP deferral of €100 (unrealised gain). The net PnL effect would be -€100 (+€800 – €1,000 + €100). To put this into an SWD perspective, the recognition of stock of DOP deferral upon exiting the related transaction would have an effect on capital, either capital benefit

---

<sup>8</sup> i.e. evidenced by a quoted price in an active market for an identical asset or liability (i.e. a Level 1 input) or based on a valuation technique that uses only data from observable markets.

<sup>9</sup> Although the deferral of both DOP and DOL is allowed by IFRS standards, the deferral of expected losses might not be regarded as a sound practice from a risk management and prudential perspective

when the DOP deferral corresponds to unrealised gain, or capital drag when the Day one P&L corresponds to an unrealised loss.

## 4.3 Estimating rump costs

**According to the FSB discussion paper on SWD of derivatives and trading book portfolios<sup>10</sup>, the rump portfolio consists of the residual “sticky” positions**, meaning positions that will remain on the institution’s balance sheet after performing the wind-down exercise. Rump portfolio can be decomposed further between:

- Discretionary rump: positions where costs to exit are greater than the hold-to-maturity value (costs over the expected or contractual lifetime of positions).
- Non-discretionary rump: positions hard to liquidate despite reasonable efforts because of their complexity, illiquidity, lack of attractiveness, or the existence of dependencies blocking the possibility for winding down (e.g. legal or regulatory hurdles).

**The primary objective of the estimation of the all-in maintaining cost of a rump portfolio is to take a reasoned decision on the exit strategy that should be applied (trade-off between the cost of holding the trade and selling it).** It consists mainly in estimating the future cash flows of the rump portfolio until its maturity. This estimation of the hold-to-maturity value should consider a wide range of factors and reflect:

- The expected resource consumption of the rump portfolio over its expected lifetime, in terms of both financial resources (capital, leverage, funding) and future operational costs.
- The expected credit losses of the asset until its maturity (irrespective of the existing impairment status of the asset at the SWD reference date).

Given the high degree of judgement necessary in this exercise, the estimation should be based on prudent assumptions.

---

<sup>10</sup> See 2019 discussion paper at <https://www.fsb.org/wp-content/uploads/P030619-1.pdf>.

## 5 Conclusion

In several jurisdictions, SWD practices rely on guidance on minimal requirements for carrying out an orderly wind-down. However, SWD execution often clashes with several practical obstacles, most notably price determination and fair value. Fair value does not always reflect realisable value under solvent wind-down conditions. SWD costs may significantly exceed the accounting carrying amount. The cost to wind down a trading portfolio beyond the usual accounting carrying value might be largely driven, among other factors, by wind-down operating costs together with the rump costs or the Day one Profit (DOP) deferral and, for derivative trading activities, by two main pricing components, namely the capital valuation adjustment and the margin valuation adjustment. We advocate that bank recovery and resolution plans should, contrary to the current practice, properly factor in these additional costs. We believe the SWD exercise would be useful from a supervisory, recovery and resolution perspective, and we expect it could be expanded to not only UK banks but also EU and US banks.

## Annex – Operational strategies and commonalities observed in publicly available resolution and recovery plans

Below we provide a synopsis of the main commonalities in terms of assumptions and operational strategies observed in publicly available information.

As explained, an SWD plan should derive from three main considerations:

- How is the portfolio under an SWD going to be segmented?
- What is the most realistic and actionable exit strategy?
- What are the most likely costs for each exit strategy or segment?

This implies that an SWD plan and associated costs are closely tied to the bank's portfolio characteristics, trading capabilities and market conditions at the time of the SWD. Accordingly, there is no one-size-fits-all SWD strategy, even for similar portfolios, nor a commonly accepted market approach on how to estimate the corresponding exit costs.

However, a close examination of publicly available information, of which resolution and recovery plans, reveals certain commonalities in terms of underlying assumptions or operational strategies. The main ones are summarised below:

- Cash security sale or buyback and short-dated derivatives are assumed to mature contractually.
- Internal transactions are torn up at no cost (internal trade between two SWD business units) and at cost ((internal trade between a SWD business and a non-SWD business unit).
- Exchange traded derivatives are closed out.
- Part of the OTC trades are terminated by the institution (termination by the bank if contractually feasible), or at the initiative of the counterparty. Compensation is assumed to incentivise counterparties to close out open transactions.
- Derivative exposure is reduced through bilateral compression.
- Non-terminating/long-dated OTC derivatives are exited (novated) through active package-and-sell strategies of market risk-neutral portfolios. Packages are constructed according to a variety of dimensions (e.g. product, tenor, currency, counterparty type, region) and trading strategies that limit risk and maximize return (e.g. call spread and/or butterfly spread option strategy).

- Additional hedging costs are assumed in order to manage market risk throughout the wind-down process (estimated costs of re-hedging or replacing risk, both for roll-off and terminated positions).
- Lower exit costs are perceived when novating portfolios comprising clients with prospective major business opportunities (premium clients).
- Hard-to-sell transaction (trades that cannot be wound down within the wind-down period) are held to maturity.

Ultimately, a trading book wind-down may result from a wide range of exit options used in isolation or in combination with the sole aim of maximising the portfolio value and minimising the exit cost. Cost of wind-down across trading books includes the impacts of part-year revenues, full existing reserve release and estimated cost of liquidation under normal and non-stressed market conditions. The cost to close out all positions should be estimated conservatively and would increase significantly if less time was available to trade out of the positions (i.e. forced sale).

For banking book positions, a 10%-15% cost of exit for forced sales is usually assumed, depending on the underlying assumptions.

The cost estimate may assume:

- The global element of the cost base (e.g. global overhead allocations, technical entities) does not decrease.
- The local fixed element of the cost base (e.g. premises, certain infrastructure allocations, especially where staff are not dedicated, etc.) does not decrease.
- The local variable element of the cost base is zero within a year.

Executing this measure under a systemic market stress scenario (such as a Lehman's style scenario with highly illiquid, volatile markets and significantly reduced risk appetite across peers) would result in significant cost.

# References

Bank of England (2021), Consultation Paper | CP20/21, “Trading activity wind-down”, October 2021.

Fleming, M.J. and Sarkar, A. (2014), “The Failure Resolution of Lehman Brothers”, *Economic Policy Review*.

Financial Stability Board (2019), “Solvent Wind-down of Derivatives and Trading Portfolios”.

Financial Stability Board (2018), “Funding Strategy Elements of an Implementable Resolution Plan”, June.

Financial Stability Board (2016), “Guidance on Arrangements to Support Operational Continuity in Resolution”, August.

Financial Stability Board (2017), “Guidance on Continuity of Access to Financial Market Infrastructures (FMIs) for a Firm in Resolution”, July.

Financial Stability Board (2011), “Key Attributes of Effective Resolution Regimes for Financial Institutions”, November (updated in October 2014).

Financial Stability Board (2015), “Principles for Cross-border Effectiveness of Resolution Actions”, November.

International Swaps and Derivatives Association (2015), “Universal Resolution Stay Protocol”, November.

Single Resolution Board (2021), “Solvent Wind down of trading books. Guidance for banks 2022”.

Valukas, A. (2010), “[Report of the Examiner in the Chapter 11 Proceedings of Lehman Brothers Holdings Inc.](#)”, March 11.

**Alessandro Santoni**

European Central Bank, Frankfurt am Main, Germany; International Monetary Fund, Washington DC, United States;  
email: [asantoni@imf.org](mailto:asantoni@imf.org)

**Ghislain Rossignol**

European Central Bank, Frankfurt am Main, Germany; email: [ghislain.rossignol@ecb.europa.eu](mailto:ghislain.rossignol@ecb.europa.eu)

**Richard Ahkouen**

European Central Bank, Frankfurt am Main, Germany; email: [richard.ahkouen@ecb.europa.eu](mailto:richard.ahkouen@ecb.europa.eu)

**© European Central Bank, 2023**

Postal address 60640 Frankfurt am Main, Germany  
Telephone +49 69 1344 0  
Website [www.ecb.europa.eu](http://www.ecb.europa.eu)

All rights reserved. Any reproduction, publication and reprint in the form of a different publication, whether printed or produced electronically, in whole or in part, is permitted only with the explicit written authorisation of the ECB or the authors.

This paper can be downloaded without charge from the [ECB website](http://www.ecb.europa.eu), from the [Social Science Research Network electronic library](https://www.econometricsociety.org/) or from [RePEc: Research Papers in Economics](https://www.repec.org/). Information on all of the papers published in the ECB Occasional Paper Series can be found on the ECB's website.

PDF ISBN 978-92-899-6060-1, ISSN 1725-6534, doi:10.2866/225374, QB-AQ-23-007-EN-N