Analysis

Estimating Initial Margins

The COVID-19 market stress as an application

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Estimating Initial Margins: The COVID-19 market stress as an application

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1 Introduction

Key points

Insights: policy relevant findings

- Using ISDA's Standardised Initial Margin Model (SIMM), we find a tenfold increase in collateral requirements aggregated across all institutions within the banking and pension fund sector as a result of the recent phase of lowered thresholds on the notional amounts at which margin requirements become mandatory (September 2021).
- Centrally cleared derivatives show stronger procyclicality in the initial margin requirements compared to non-cleared derivatives based on the SIMM model. This finding means that during periods of market volatility, institutions are more likely to face a sudden increase in their margin requirements, and thus their liquidity needs, when their derivatives are centrally cleared. Institutions that already have or expect to face central clearing requirements in the near future should take these differences in procyclicality into consideration.
- During the COVID-19 market stress, interest rates temporarily increased and as a result, the market values of swap derivatives for pension funds and insurers declined substantially, but increased slightly for banks. This finding is in line with the directionality of the average portfolio in these sectors.

Insights: Dutch derivatives market

- The Dutch interest rate derivatives market is highly interconnected with a few large banks that facilitate clients.
- Pension funds and insurance companies have strong directional portfolios (net long receiver swaps) compared to banks, financial corporations, and non-financial corporations.
- The fraction of non-cleared derivatives is still substantial: 32% of the notional amount outstanding and 42% of the total number of transactions are non-cleared.

1.1 Background

Over-the-counter (OTC) derivatives markets, and the interest rate derivatives markets in particular, are large and important markets for many types of institutions. Market participants use derivatives either to hedge risk exposures such as interest rate risk or to take a position in an underlying security. The gross market value of OTC derivatives globally equals $15.5 trillion, of which $11.7 trillion in interest rate contracts (BIS, 2020).[1] Notwithstanding the importance, we did not have an adequate understanding of this market because data on OTC market activity used to be limited. This poor understanding became apparent during the global financial crisis (GFC) when several institutions incurred significant losses from economic shocks and defaults through OTC derivatives (BIS, 2013).[2]

In response to the GFC, the European Market Infrastructure Regulation (EMIR) came into force to improve transparency and regulation of the OTC derivative market to limit excessive and opaque risk taking through these markets. This regulation includes reporting requirements for OTC derivative transactions, which we will refer to as

[1] BIS 2020
[2] BIS 2013

EMIR data. EMIR also mandates to clear certain derivatives (cleared derivatives) with a Central Clearing Party (CCP) and requires exchange of margin on non-cleared derivatives. By clearing a transaction, the CCP severs the bilateral link between the two institutions and becomes the counterparty to each of them (BIS, 2018)[3].

To minimize the counterparty credit risk of a derivative, both counterparties exchange collateral – either in cash or in securities. Collateral or margin exchange comes in two shapes: variation margin (VM) and initial margin (IM). The market value of the contract is computed frequently, and the party that experiences an increase in the value of the contract receives collateral to reduce the exposure at default. This exchange of collateral is called VM. In addition, both parties exchange margin as a buffer for the potential additional costs that could arise to replace the existing contract in the (unlikely) event that the other counterparty defaults. Replacing a contact will take some time and during this period the market might move adversely. This exchange of collateral to cover replacement risk is called IM and is also computed frequently. Both parties will have to post additional IM if the estimated buffers need to increase, for instance when market volatility increases.

1.2 What we do

There are several reasons why our analysis provides timely and relevant insights. First, we provide the first description of the Dutch interest rate swap market on a transaction level. Such an overview provides a good starting point to understand the market structure and its implications for, amongst others, financial stability. For instance, to show the vulnerabilities to economic shocks for different institutions and sectors within the derivative market, we estimate the margin requirements for individual institutions as well as aggregated over several sectors such as banks, corporations, insurance companies, and pension funds.

Second, we shed light on the debate about the procyclicality of initial margin requirements. Derivative market reforms have transformed counterparty credit risk into liquidity risk (Glasserman and Wu, 2018). Central clearing and more frequent exchange of collateral imply that market participants no longer have to concern themselves about the default of their counterparties. Instead, they might experience unexpected high collateral calls if volatility spikes. In the first wave of the COVID pandemic, the market experienced such an unexpected episode of volatility. By the end of March 2020, the ESRB estimated a relative increase in total initial and variation margin posted by EU clearing members by more than 30 percent and 75 percent of pre-crisis levels, respectively.[4] These substantial increases in margin requirements may have important consequences for the economic vulnerabilities of institutions, because they increase institutions' liquidity risk. These liquidity risks materialize through the increased collateral demand used to meet margin requirements (Duffie et al., 2015). Our analysis also sheds light on the magnitudes of the margins that were exchanged during the first wave of the COVID pandemic.

Third, we provide an assessment of the next steps in the phase-in of the IM requirements for non-cleared derivatives. The threshold for mandatory margin requirements is based on the average aggregate notional amount (AANA) outstanding of the derivative portfolio. In September 2021, the threshold for posting IM dropped from an AANA of 750 billion to €50 billion and in September 2022, the threshold will drop even further to an AANA of €8 billion. We estimate that for the Netherlands the number of institutions that post IM rises by 22 and 110 respectively in these two phases. The notional amount of the transactions affected by the recent phases rises by €1.0 trillion (6 times increase) and €1.2 trillion (8 times increase), respectively.

[3] BIS 2018
[4] ESRB 2020

1.3 The EMIR data

EMIR data contains the trade level derivative positions of all counterparties for which at least one institution is domiciled in Europe. The total notional outstanding of the EU derivative market equalled €681 trillion by the end of 2019 (ESMA, 2020).[5] Institutions report, among others, the contract type (e.g., swaps, options, futures), details on the transaction such as notional, effective date, maturity date, information on price, clearing status, payment frequencies, currencies, and the contract's counterparty.

We analyse those derivate contracts for which at least one counterparty is established in the Netherlands. We receive the data on derivative positions and the corresponding transactions on a daily basis. We use an extensive cleaning methodology to detect duplicate trades, swap characteristics, and reporting errors.[6] We then obtain a set of close to 200,000 bilateral trades per trading day that can be used to estimate the margin requirements of institutions.

1.4 How we compute margin requirements

Although EMIR data contains many other types of derivates, we started with estimating the margin requirements for interest rate derivatives, because it is the category with the largest volumes. Currently, we are extending the analysis to foreign exchange swaps and forwards. As noted, there are two different types of margin: VM which we proxy by the daily change in the market value of the derivative positions and IM. For IM, important parameters in the calculation of their requirements are the volatility of the underlying (in our case the interest rate) and an assumption about how long it takes to replace the contract. The replacement window depends on the derivative type and is generally modelled between 5 and 10 days. For centrally cleared trades, CCPs apply their own proprietary models so we use the reported initial margins. For non-centrally cleared derivatives, we apply the Standardized Initial Margin Model (SIMM), which is a standard in the industry, to estimate initial margin requirements between counterparties on a daily basis. The SIMM model is not as risk sensitive as the CCP models, because the risk weights are calibrated historically and are not impacted by current market volatility.

To compute initial margins, the SIMM methodology requires the calculation of interest rate sensitivities (pv01's) towards specific tenors netted across the portfolio. Netting across portfolios implies that we aggregate interest rate sensitivities of various contracts between pairs of counterparties. The sensitivities are subsequently multiplied with tenor specific risk weights, which are calibrated using historical rate movements. These risk weight values are defined in the ISDA SIMM methodology and publicly available via the official website of ISDA.[7]

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[5] ESMA 2020

[6] Our analysis is coded in R and Python and is available to others with access to EMIR. We provide details on how we work with EMIR data in the conclusion.

[7] The most recent version of the ISDA SIMM methodology at the time of writing can be found here: ISDA Publishes ISDA SIMM v2.3 – International Swaps and Derivatives Association.

2 A description of the Dutch interest rate derivative market

2.1 Summary statistics

To get a better understanding of the Dutch interest rate derivative market we first present summary statistics in Table 1 and 2. Table 1 focuses on the sizes of the various sectors. The table reveals that banks are the connecting nodes in the interest rate derivative market with outstanding positions with many other market participants (counterparties), and the largest number of transactions and outstanding notional values. There is a relatively small set of central clearing parties used for interest rate derivatives, which are mostly used by banks, insurance companies, and pension funds. With slightly over one hundred pension funds with the biggest derivative positions, only small pension funds are not present in this market. Dutch banks play an intermediary role in the management of interest rate risk using derivatives and therefore all the larger banks are present with a sizable number of counterparties. As for insurance companies, primarily life insurance companies are present which, similarly to pension funds, have strong interest rate hedging incentives that arise because of the long-term nature of their liabilities. Non-financial corporations are large in number, but substantially smaller than banks, insurance companies, and pension funds in terms of total notional volumes.

Table 1 **Summary statistics by NL sectors**

EUR, average total per day, January-June 2020

Sector	# Institutions	# Counterparties	# of which CCPs	Notional (bn)	# Transactions
Banks	30	2646	4	4908	70278
Financial corporations	64	62	1	74	1637
Insurance companies	17	35	3	234	3842
Non-financial corporations	1334	76	1	47	2754
Other	278	28	2	41	1091
Pension funds	107	46	4	929	10915

If we turn to market activity, Table 2 shows that banks are by far the most active participants. The COVID-19 stress period shows some heightened activity, especially for financial corporations which engaged in 7% more transactions. These increases are however fairly small and suggest that interest rate derivative contracts are primarily used for long-term hedging needs.

Table 2 **Average number of outstanding transactions per day**

Average total per day, January 2020 vs March 2020

Sector	# Transactions January	# Transactions March	Δ March - January %
Banks	69024	70553	2%
Financial corporations	1482	1585	7%
Insurance companies	3674	3742	2%
Non-financial corporations	2738	2753	1%
Other	1067	1097	3%
Pension funds	10285	10744	4%

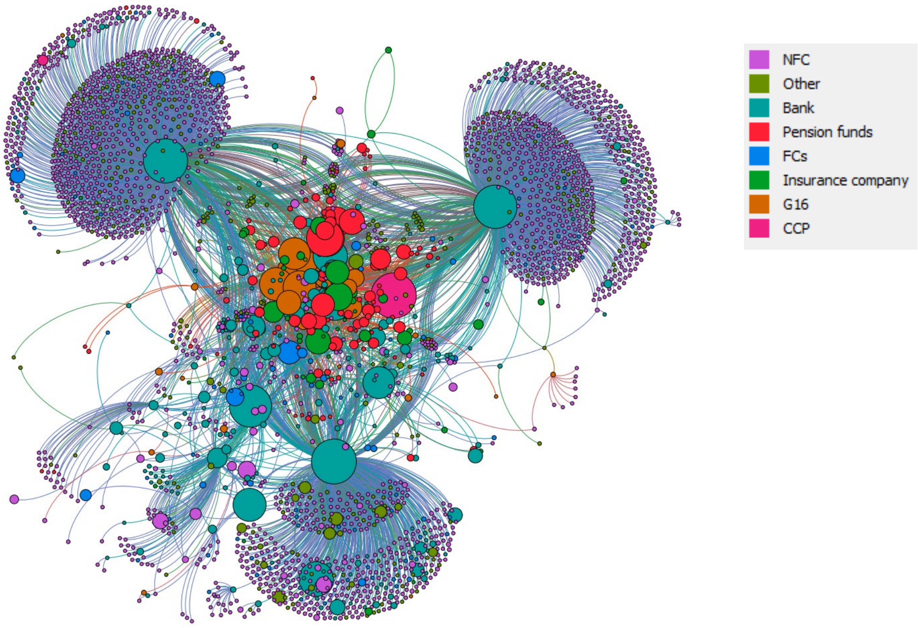
Furthermore, we also computed the fraction of trades that are centrally cleared. An interesting observation is that non-cleared transactions are still a significant part of the market. If we look at the notional values, we observe that 68% is cleared. A full one-third is thus still bilateral. The non-cleared market is even bigger in terms of the number of trades: two-fifths is not centrally cleared which implies that especially smaller counterparties and clearing exempted parties still base their initial margin estimations on the SIMM model.

2.2 Network analysis

We now turn to the degree of interconnectedness of derivative positions across institutions. Figure 1 shows that the system is highly interconnected with three large Dutch banks (turquoise) that facilitate most clients and have access to CCPs. The clients of these banks are mostly non-financial corporations (purple) who in turn just have a single counterparty. In the centre of the graph, we observe large international banks (G16) and the CCPs, as well as insurance companies and pension funds. This clustering in the middle shows that Dutch pension funds and insurance companies do not trade exclusively with Dutch banks but also use large international banks and CCPs to take on derivative positions.

Figure 1 **Network analysis of interest rate derivatives.**

The colours of the dots indicate the different sector types and the sizes of the dots reflect the (logarithmic) aggregate size of the derivative positions.



3 Initial Margin Estimation

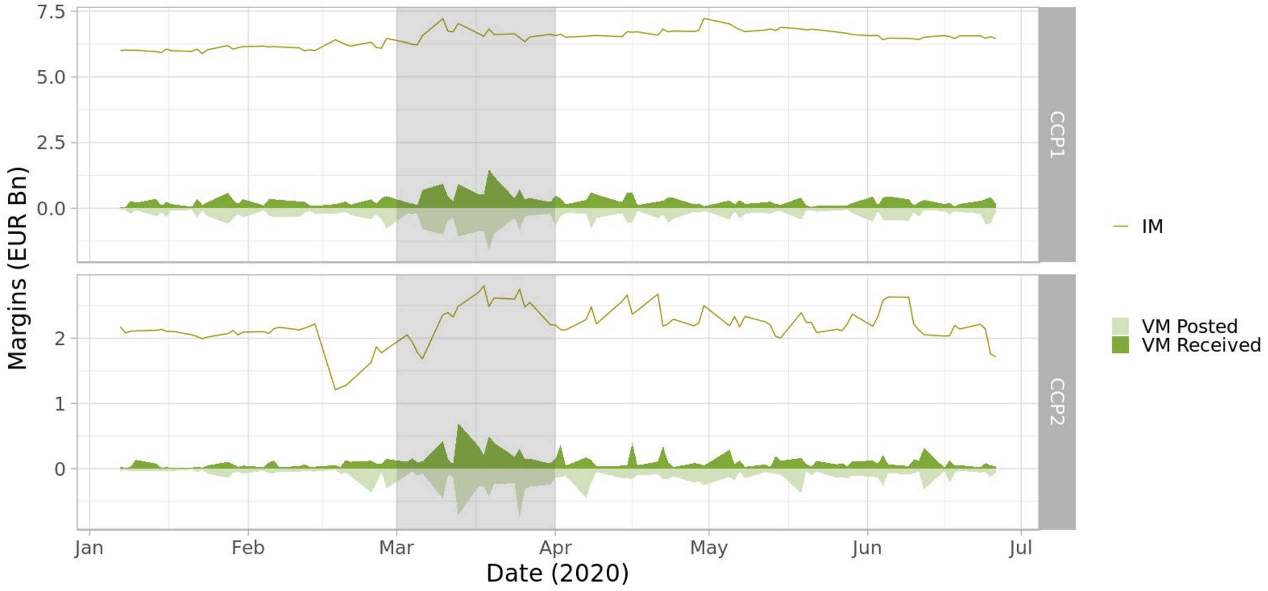
3.1 Central Clearing

We proceed to assess margin requirements based on the EMIR data. First, we assess directly cleared derivatives as reported by the CCPs. CCP IM models react to increased market volatility to reflect the uncertainty of the potential future value of the derivative portfolio. Moreover, note that competitive pressures might lead CCPs to require relatively low levels of initial margins. However, these models should also be sufficiently anti-procyclical to avoid systemic liquidity constraints. The models CCPs use to estimate initial margins are proprietary and are likely to differ in significant ways from SIMM. In this section we will therefore not employ SIMM but look at margins as reported by the CCP.

In the March 2020 initial COVID stress period, denoted in grey in Figure 2, Dutch clearing members saw initial margin increases on interest rate derivative portfolios of around 20%-30%, depending on the specific portfolio and CCP. Margins peaked mid-March, when interest rates became more volatile. Additionally, following the changes in interest rates, the volatility of variation margins posted and received increased significantly. These movements in margins during the COVID period do not originate from strong deviations in portfolios, which implies that the increases in IM and VM are indeed primarily driven by market movements.

Figure 2 **Margins for centrally cleared trades**

Over the period January-July 2020, including the market stress of COVID-19 during March reflected in the grey area. Variation margins (VM) are from the perspective of the CCP and do not need to net to zero in the figure for the CCP to have a balanced book; we only observe a subset of the CCP's portfolio.



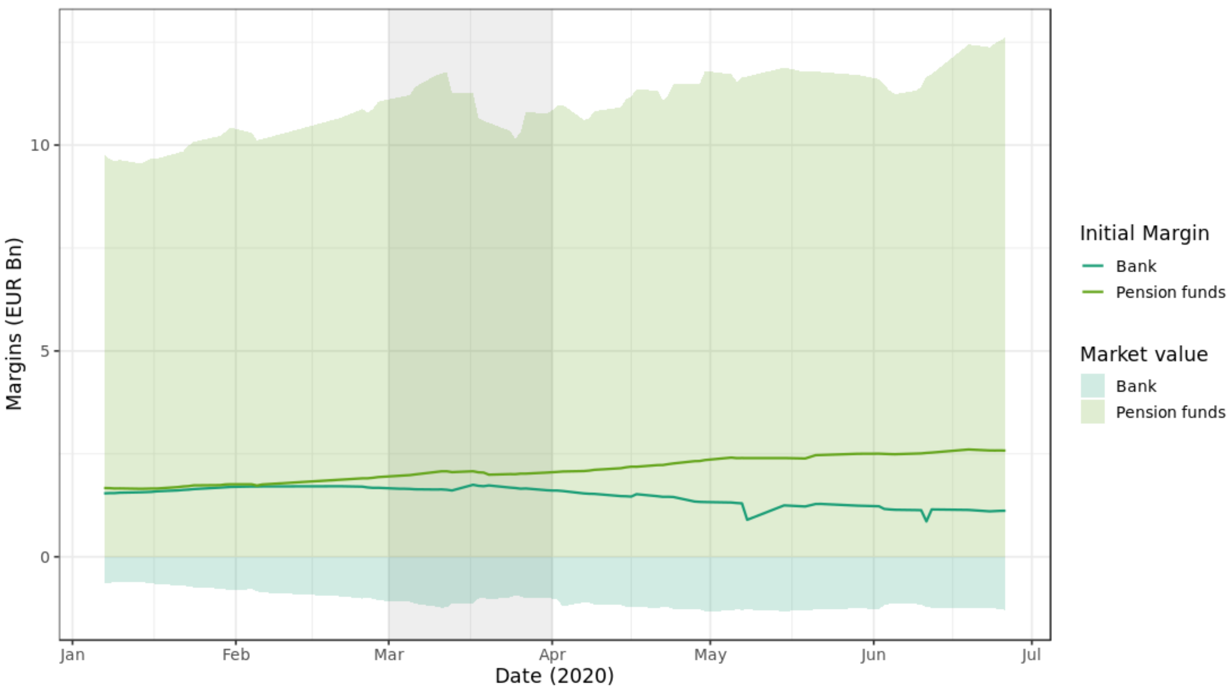
3.2 Bilateral Margins

The requirement to post initial margins on non-centrally cleared OTC derivatives is subject to a phase in, based on the aggregate average notional amounts (AANA) outstanding of the two parties. Up until very recently, the threshold for mandatory exchange of IM was an AANA of €750 billion. However, in September 2021 (phase 5) the threshold declined to an AANA of €50 billion. In September 2022 (phase 6), it will decline to just €8 billion.[8] In this section we quantify the impact of this regulatory change and assess the behaviour of margins during the COVID-19 stress period. Note that the analysis does not take into account the minimum threshold based on IM amount, by which parties may be exempted from exchanging IM if the sum of all initial margins is lower than €50 million. So, the calculated figures provide an upper bound on the exchanged non-cleared margins.

In Figure 3, we show the recent situation with a €750 billion threshold, which does not apply to many Dutch institutions, except for a few banks and pension funds. First, the shaded green areas indicate the total market value of the swap positions aggregated across all institutions within a certain sector. In general, Dutch pension funds have a clear directional portfolio of net long receiver swaps, which have a high market value because of the low interest rate environment, but showed a significant decline during March 2020. Second, the lines indicate the posted initial margin, as estimated by the SIMM model. The IM values are fairly constant, especially when we compare the volatility of initial margins to the centrally cleared margins in Figure 2. This is in line with the expectation, because the SIMM model uses fixed historically calibrated parameters compared to CCP margin models, that tend to move with market volatility.

Figure 3 **Phase 4 Bilateral Initial Margins (SIMM) and aggregate market values**

Margin exchange notional threshold: €750bn. Over the period January-July 2020, including the market stress of COVID-19 during March. Figures are aggregated by sector and apply only to Dutch institutions.



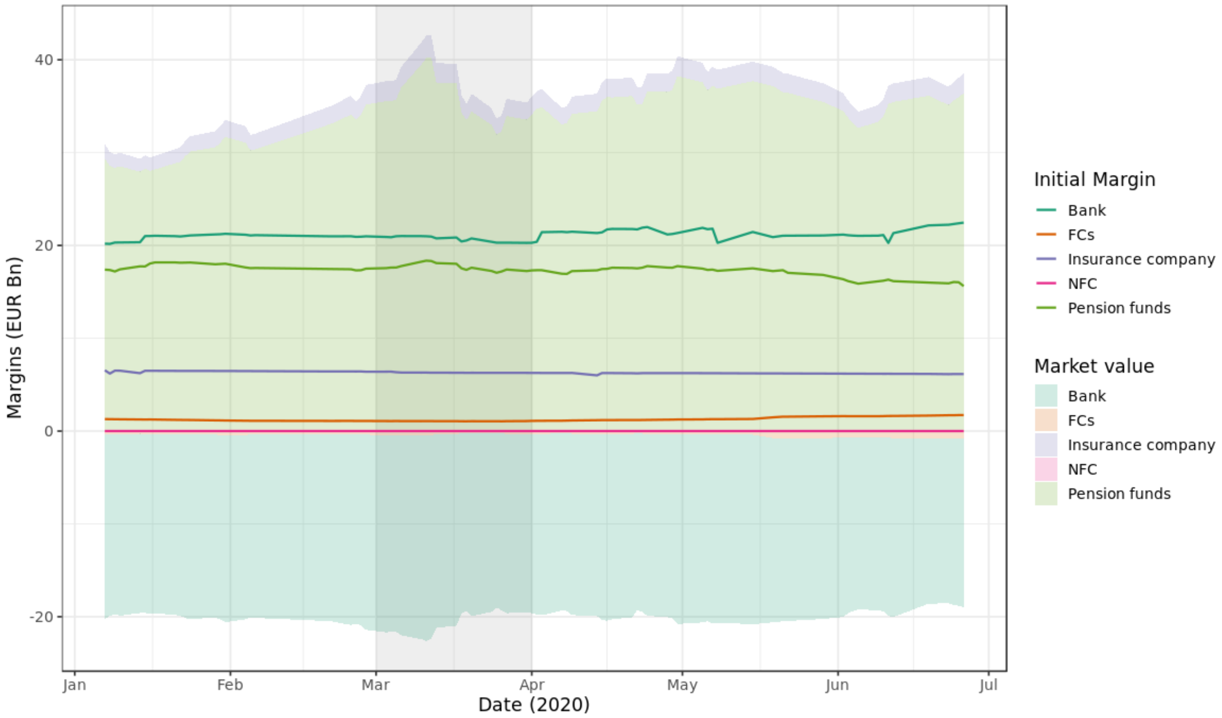
[8] Due to the market stress in 2020 caused by the COVID-19 pandemic, the phase in was delayed by one year.

Next, we assess the margin requirements if phase 5 eligible institutions are required to post margin (see Figure 4). In the recently implemented phase of margin requirements, a significant number of additional institutions are required to exchange margin. Next to banks and pension funds, this includes insurance companies, financial corporations (FCs) and non-financial corporations (NFC). Compared to phase 4, the next phase will increase the absolute value of margins for banks and pension funds from approximately €2.5 billion to €20 billion, or a tenfold increase. These increased margin requirements require banks, and pension funds in particular, to reassess the liquidity of their portfolios. For instance, pension funds hold little cash and invest a substantial part of their portfolio in illiquid assets such as mortgages, real estate, and private equity (see, Broeders, Jansen, and Werker 2021 and Jansen and Tuijp 2021). This tends to be less of an issue for banks, that currently maintain relatively high levels of liquid assets. A reassessment of the liquidity of pension funds' portfolios is not only relevant in light of the recently implemented phase 5, but also in anticipation of the central clearing requirements from which pension funds are currently exempted but is foreseen to come into effect halfway through 2023. The need for liquidity reassessment noticeably also depends on whether margins in OTC markets can be delivered in-kind (increasing encumbrance but reducing the need for cash) and the exemption granted to forego IM on the first €50 million euro (RTS on risk mitigation techniques, Article 9).

Similarly to phase 4, IM values show a relatively constant pattern over time, including March 2020. In terms of market values, which are an indication of the variation margin, there is a strong decrease for the pension sector in March of about €10 billion. Note that banks mostly have centrally cleared swap positions, for their own portfolio and to hedge uncleared client positions. Therefore, the aggregate market value for banks is less indicative of the sector's total market value than for other sectors, where only a fraction of the institutions clear their swaps.

Figure 4 **Phase 5 Bilateral Initial Margins (SIMM) and aggregate market values**

Margin exchange notional threshold: €50 billion. Over the period January-July 2020, including the market stress of COVID-19 during March. Figures are aggregated by sector and apply only to Dutch institutions.



Finally, phase 6 that lowers the AANA threshold to 8 billion (September 2022) will mostly affect smaller institutions and in turn their counterparties, which are mostly banks. The additional IM increase for banks is estimated to be around €5 billion. This phase affects a larger amount of insurance companies than phase 5, and increases total IM requirements to approximately €25 billion.

5 Conclusion

This analysis improves our understanding of the structure of the Dutch derivative market. We have shown that the Dutch derivative market is highly interconnected, with a few large banks facilitating most clients. We then specifically assessed the risk exposures of different sectors within the interest rate derivative market, measured through their margin requirements. We show that for the recent phase of margin requirements substantially more institutions have to post initial margin, in particular the pension and insurance sector. These increased margin requirements raise their liquidity needs which could potentially require substantial reassessment of their balance sheets in order to be able to fulfil the margin requirements at all times.

Furthermore, our work relates to the discussion about the procyclicality of initial margin requirements. We show that centrally cleared derivatives have more volatile margins compared to non-cleared derivatives. As more and more derivatives are centrally cleared, market participants should take into account this increased volatility in margin requirements. This finding does not necessarily mean that the models of CCPs are less desirable, because central cleared and bilateral trades are not fully comparable on other grounds. For instance, CCPs also have default funds and different, typically more stringent, collateral type requirements. With the increased potential for netting, CCP margins could also be lower than bilateral margins. In addition, larger than historically observed shocks could cause the SIMM model to underestimate the initial margin requirements. For interest rate swaps, the SIMM model is able to avoid procyclicality through the use of fixed, historically calibrated shocks. After the market shocks in March 2020 however, the SIMM model may need a recalibration of its calibration period, given the significant stress events that occurred.

In the current analysis, we primarily focused on the procyclicality of initial margins and the effect of the different phases of margin requirements on the levels of initial margins. Our setup can also be used to study the effects of regulatory changes on the derivatives market. For instance, in January 2023, the new Dutch pension agreement will come into effect. Under the new agreement, pension funds will no longer make promises about the amount of benefits they intend to pay out in the future and solvency requirements are therefore no longer needed. A key aspect of current solvency requirements is interest rate risk. As such, pension funds may change their interest rate derivative portfolios, which, in turn, may lead to structural changes in the derivatives market. We consider the implications of this type of regulatory changes for derivatives markets as a fruitful topic for future research.

As EMIR data contains European data and SIMM is a common methodology meant to be used across Europe to – among other things – reduce the potential for disputes, our analysis is relevant for institutions beyond the Dutch Central Bank. With that in mind, we have put significant effort in developing our code in a way that it can be reused and extended. Although in this study we have focused on Dutch interest rate derivatives, we are currently extending the model to foreign exchange swaps. Other asset or product classes, such as credit or equity, will provide additional insights into the behaviour of risk exposures and margins in the derivatives market.

We have developed the code in the open source languages Python and R. To improve the quality of our implementation, we have already shared our code with several authorities and highly encourage others with access to EMIR to improve upon and extend our code. For access, please get in touch with us and we would be happy to add you to our repository with the SIMM implementation.

6 References

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