Quantitative Analysis of SFTR Data

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1 Introduction

Luxembourg is one of the largest financial centers in the world. As the second largest hub for investment funds in the world after the United States of America and the third largest exporter of financial services in the world, the control of the Luxembourg financial sector plays a crucial role. The body responsible for this is the Commission de Surveillance du Secteur Financier (CSSF).

1.1 Commission de Surveillance du Secteur Financier

The Commission de Surveillance du Secteur Financier (CSSF) is the financial supervisory authority in Luxembourg. The CSSF is a public institution that supervises the professionals and products of the Luxembourg financial sector. It is responsible for protecting consumers in the financial sector and promoting general awareness of financial products and services.

The CSSF took over the banking supervision of the Institut Monétaire Luxembourgeois (IML), which was merged into the Banque Centrale de Luxembourg on June 1, 1998, and the stock exchange supervision of the former Commissariat aux Bourses.

1.1.1 Missions of the CSSF

The CSSF represents Luxembourg at the international and European level.

The CSSF carries out its mission as a supervisory authority with the aim of ensuring the soundness and stability of the financial sector. This is done exclusively in the public interest. Within the scope of its powers, the CSSF ensures that authorized companies and issuers comply with the legal provisions applicable to them.

The CSSF is responsible for prudential supervision of:

- banks,

- investment firms,

- professionals in the financial sector,

- professionals supporting the financial sector,

- other financial service providers, in particular investment firms,

- investment funds,

- investment fund management companies,

- pension funds,

- securitisation vehicles that regularly issue financial instruments to the public,

- Venture capital companies

- Payment institutions,

- e-money institutions.

The CSSF also monitors compliance with the rules on the prevention of money laundering and terrorist financing by all persons and entities subject to its supervision.

1.1.2   Prudential supervision and risk management of investment funds (OPC PRUD)

The department I've joined is organised into two main areas, prudential supervision and risk management of investment funds, and its activities are divided into a total of five divisions.

The department is responsible for:

- the prudential supervision of undertakings for collective investment (UCIs) in the categories of undertakings for collective investment in transferable securities (UCITS), specialised investment funds (SIFs) and investment companies in risk capital (SICARs), the latter two being grouped together as alternative investment funds (AIFs),

- risk management from a micro-prudential and macro-prudential perspective in relation to UCITS, AIFs and International Fund Managers (IFMs),

- the monitoring of international risk management and financial stability issues relating to the business of UCIs, in particular those dealt with by the European Union, the European Securities and Markets Authority (ESMA), the European Systemic Risk Board (ESRB), the Financial Stability Board (FSB) and the International Organisation of Securities Commissions (IOSCO),

- the actuarial aspects of pension funds and all related techniques.

The prudential supervision part is carried out by 2 divisions. The risk management part is divided into 3 divisions, one for the international aspects and regulatory monitoring of risk management (RISK INTL), one for all off-site and on-site reviews of risk management methods (RISK MICRO) and the one I worked in, where risk analysis is performed based on reports provided by various data sources (RISK MACRO).

1.1.3 RISK MACRO

The RISK MACRO division that I have integrated is responsible for the following missions and tasks:

- Define, develop, prepare and maintain periodic micro and macro prudential analyses of Luxembourg UCITS, AIFs and IFMs, applying the concept of risk-based supervision of UCIs and analysing the various aspects of the Luxembourg UCITS/AIF/IFM population.

  In particular, this involves analysing the periodic financial information provided by the UCITS/AIF and formalising the results of these analyses in a summary report for the attention of the management and the heads of department of the UCI department.

- Develop, implement and maintain a risk-based approach to the off-site and on-site review of the risk management methods implemented by UCITS/AIFs/IFMs, with the aim of making this approach a central tool in the supervision carried out by the UCI business line, thereby providing valuable input for the identification of risk factors.

- Contribute to the definition, development and implementation of an approach aimed at identifying and assessing potential sources of systemic risk arising from the activities of UCITS/AIFs/IFMs. To this end, the department should draw on studies carried out by international organisations (central banks, FSB, etc.).

- Contribute to the quarterly report to the Executive Committee of the CSSF, summarising the risks/irregularities identified at the level of the UCI business and also presenting the main trends observed in the Luxembourg UCI sector.

- Contribute to the development and improvement of the Luxembourg regulatory framework for risk management and financial stability (e.g. CSSF regulations, circulars, guidelines) in the field of UCIs.

- Assist in the handling of regulatory issues related to UCITS/AIF/IFM risk management or provide support and advice on such issues handled by other members of the UCI department.

- Collect data through survey techniques and distribution of questionnaires in order to supplement/support the risk management analyses carried out by the three RISK departments and to contribute to the specification of the data needed to carry out the department's tasks.

1.2   Definitions

Before explaining the objectives of the internship, it is important to know the definitions of some key words.

- **Investment funds**

  An investment fund is a pool of capital that is collected from multiple investors with the purpose of investing in securities. The primary goal of an investment fund is to maximize returns for the investors, while managing the level of risk according to the funds investment strategy.

- **Financial Securities**

A security is a tradable financial instrument that holds some type of monetary value. The term encompasses a variety of investments, including stocks, bonds, investment contracts, notes and derivatives. Generally you can distinguish between three types of securities: equity, which provides ownership rights to the holder; debt, which are essentially loans repaid with periodic payments; and hybrids, which combine aspects of equity and debt.

Every security can be uniquely identified by a 12-digit alphanumeric code, called it's International Security Identification Number (ISIN).

- **Collateral**

In the financial world, collateral is a valuable asset that a borrower puts up as security for a loan.

For example, when a house buyer takes out a mortgage, the house is the collateral for the loan. For a car loan, the car is the collateral. When you borrow a financial asset, you can put up another asset, cash or goods as collateral.

2 Objectives

The objective of the internship is to contribute to the integration of innovative machine learning and, more generally, artificial intelligence techniques into CSSF's prudential supervision tools for investment funds. The work that has been done can be divided into two main subjects:

1. **Analysis of the SFTR dataset**

The first topic focused on working on a specific database, the SFTR (Securities Financing Transactions Reporting) database. The first step was to gain a better understanding of the structure and information contained in the dataset. The next step was to explore the possibility of applying machine learning techniques to the dataset, with a view to developing an outlier detection algorithm or an early warning model. Therefore, we focused on 2 different types of financial entities, each of which had gone through a crisis. Finally, a template showing

statistics for a specific investment fund could also be tried to be implemented using SFTR data.

2. **Analysis of ESG data**

   Once the work on the SFTR data was completed, and depending on the time left, there was a possibility that I could work on ESG (Environmental, Social and Governance) data, focusing on the environmental aspect, to detect cases of greenwashing.

2.1   Tools

To load and perform operations on the SFTR dataset, I used Apache Zeppelin, a web-based notebook that allows you to perform data analysis using SQL, Python, R and more.

My work on the dataset was done using Pyspark, a Python API for Apache Spark that allows large-scale data processing tasks to be performed in a distributed environment using Python.

The newly created dataframes were exported as a CSV file to MinIO Browser, an object store designed for large database workloads.

From there, the dataframes can be downloaded and imported into PowerBI, a Microsoft data visualisation software.

For working with ESG data, the dataframes were already integrated into PowerBI, so that all the work (data manipulation, graphing) could be done directly in PowerBI.

3   Analysis of SFTR Data

3.1   Definitions

- **Securities Financing Transactions**

  A securities financing transaction (SFT) is an operation between two parties in which securities are lent to one of the counterparties, similar to a collateralised

loan. There are 4 types of SFTs:

1. Repurchase or reverse repurchase (repo/reverse repo)

2. Buy-sell-back or sell-buy-back

3. Lending/borrowing of commodities or securities

4. Margin lending agreements

In many cases, the counterparty receiving a loan must provide collateral to the other counterparty to protect the borrower. This collateral may take the form of cash or one or more securities.

- **Securities Financing Transactions Regulation**

The Securities Financing Transactions Regulation (SFTR) is a regulation published by the European Securities and Markets Authority (ESMA) in December 2015. It requires financial and non-financial counterparties engaging in securities financing transactions to report these transactions to a trade repository recognised by ESMA.

Reports for counterparties established in Luxembourg will be transmitted by ESMA to the CSSF.

3.2 Dataset Description

The SFTR dataset provided by the CSSF has 136 fields containing all the relevant information for each transaction. It includes information on each counterparty, the type of SFT concluded, all relevant information on the security borrowed and its value, the start and end dates of the transaction, and information on the collateral if a transaction is collateralised.

3.2.1 Counterparties

For each transaction, there are at least 2 parties involved in the reporting of an SFT. Namely, the reporting counterparty, i.e. the one who reports an SFT and whose perspective is used for all reported information, and the "other counterparty",

i.e. the one who is on the other side of the transaction reported by the reporting counterparty. The only critical information that is always provided for these 2 parties is their Legal Entity Identifier (LEI), which is a unique global identifier for legal entities involved in financial transactions. This information allows you to identify the 2 counterparties involved in a transaction. An additional piece of information you will receive from the other counterparty is the country in which the other counterparty is located.

In some cases, we also get the LEI of the reporting counterparty's manager, and sometimes the entity submitting the report is not the same as the reporting counterparty, so there may be another LEI corresponding to the entity submitting the report.

The last piece of information we get here is that in the case of collateral posted for a transaction, the reporting counterparty is the collateral giver of the collateral taker. This is the only field that allows us to identify which counterparty is the collateral taker and which is the collateral provider.

3.2.2   Loan Data

All information about the security lent in an SFT is referenced under the "Loan Data" item in the dataset. The first information we get is the type of SFT that is being executed. Based on this information we can deduce the most important information of the trade, which is the value of the loan. For REPO's and Security Lending the value can be found under "Principal Amount", for Buy-Sell Back transactions under "Loan Value" and for Margin Lending transactions we will find a list of values in the field "Margin Lending Attributes", where the sum of these values represents the total value of the loan. The currency of the transactions is given in an additional field, as the value is often not given in Euros.

An SFT can be either an open or a fixed-term transaction. In both cases, the value date is reported, i.e. the date on which the exchange took place. For fixed-term SFTs, we also get the maturity date, which is the date on which the loaned security is returned.

If a loan fee is payable, this information must also be provided. This fee, paid by the borrower to the lender, is expressed as a percentage.

3.2.3   Collateral Data

In the case of collateral posted for a transaction, all information about the collateral is provided in the "CollData" field. The most important information is the type of collateral. There are 3 categories a collateral can fall under: Cash, Securities or Commodities. In the case of cash collateral, the only information provided is the amount of cash and its currency. In the case of securities used as collateral, there are many more fields: the ISIN of the security, which can be used to identify the security, the issuer of the security, its market value and the currency in which the value is provided. The third type are commodities, which are raw materials used to make consumer goods. The most important information provided is the type of commodity and its value. However, we won't focus on commodities used as collateral because there is not a single transaction in the SFTR dataset conducted by an investment fund where a commodity was used as collateral.

3.2.4   Action Type

There are 8 different types of actions that can be used to define the scope of a report:

1. "New" for an SFT being reported for the first time.

2. "Modification" to indicate a change for a previously reported SFT.

3. "Valuation" to indicate the price of a security or commodity that is the subject of a securities or commodities lending transaction.

4. "Collateral Update" to indicate a change in the details of collateral data.

5. "Error" to indicate the cancellation of an erroneously submitted report where the SFT never occurred or was not subject to the SFT reporting requirements.

6. "Correction" to correct data fields that were incorrectly submitted in a previous report.

7. "(Early) termination" where an open term SFT is closed or an SFT is terminated before the previously reported maturity date.

8. "Position component" for an SFT reported as a new trade and also included in a separate position report on the same day.

3.2.5   File Info

Finally, there is some additional information provided by the CSSF in the dataset. Each transaction has a file name and a file ID. Each report has the date and time when its file was created by the CSSF. We also get the information from which trade repository the report was sent.

3.3   Dataset Analysis

Of the 2674939 different LEIs in the CSSF database, we will only look at those that fall under the OPC category (investment funds). There are only 30351 entities in this category, or 1.13%.

However, despite representing only slightly more than 1% of the entities, investment funds are involved in almost half of the reports represented in SFTR (from May 2023 to April 2024):
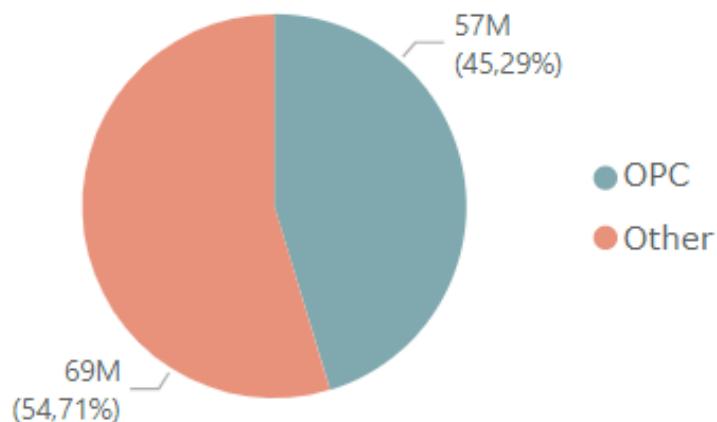

Figure 1: Total Number of Transactions by OPC/Other

Looking more closely at the transactions per month, investment funds sometimes made more transactions than all other entities combined. However, between November 2023 and February 2024, the number of transactions made by investment funds gradually decreased, so that in the last few months investment funds only accounted for about one third of SFTs.
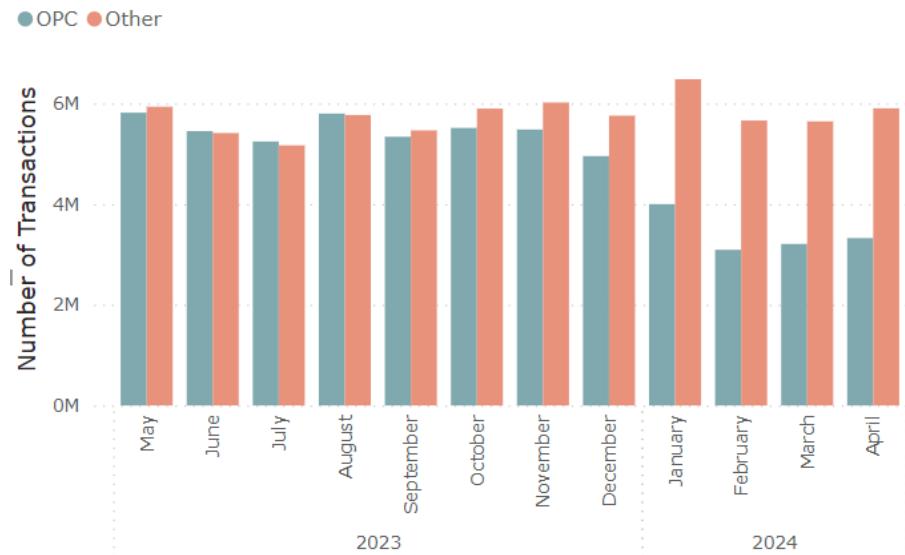

Figure 2: Number of Transactions by OPC/Other per Month

For the rest of the work on SFTR, we will only look at transactions reported by investment funds.

Let's start by looking at the number of transactions by action type:
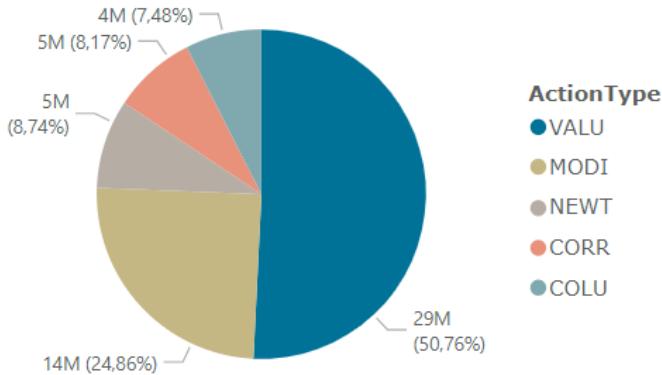
Figure 3: Number of Transactions per Action Type

Looking at the graph, half of the reports were valuation updates and a quarter were modifications. The last quarter is made up of new transactions, corrections and collateral updates. There weren't any errors, early terminations or position components reported.

Now the same for the type of SFT:
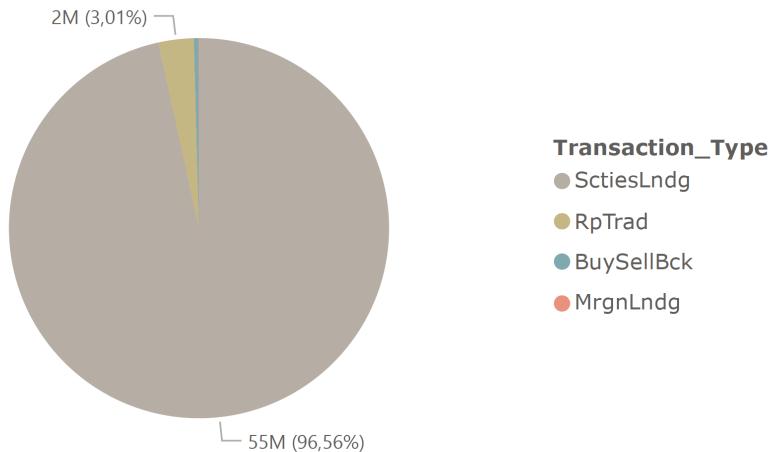
Figure 4: Number of Transactions per SFT Type

Securities lending transactions account for the largest number of reports at around 96.5%. This is followed by REPOs with around 3%, and Buy-Sell-Back and Margin

Lending transactions represent the smallest number in SFTR.

Let's take a closer look at the transactions per month:
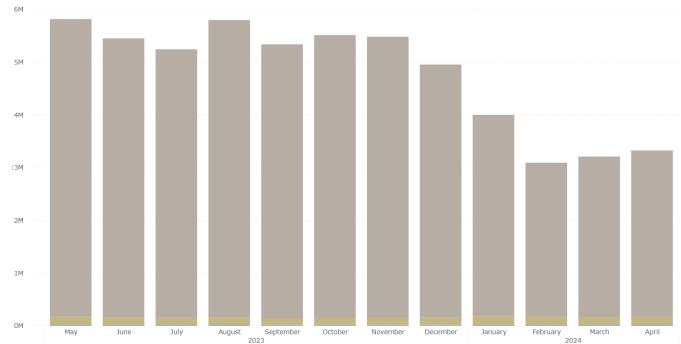
Figure 5: Number of Transactions per SFT Type per Month

The number of REPOs remains stable throughout the year. The number of securities lending and borrowing transactions also remains relatively stable until December 2023, at which point there is a sharp drop. Therefore, the large decrease in the number of SFTs reported by IFs is due to the decrease in the number of securities lending and borrowing operations.

3.4 Financial crisis analysis

There are two financial crises for which we will analyse the entities involved. The first concerns LDI funds and the second some American banks.

3.4.1 LDI funds crisis

Definition:

A liability-driven investment (LDI) is an investment in assets that can generate the cash to pay financial obligations, also called liabilities.

This type of investment is common in defined benefit pension plans because companies and pension funds are required to pay the guaranteed income promised to beneficiaries.

Most LDI funds are therefore pension funds, but they are also used by other in-

vestors such as foundations, endowments, insurance companies and even individual investors who wish to secure a guaranteed retirement income and manage investment risk.

Context:

The LDI crisis in September and October 2022 was a significant event in the United Kingdom financial markets. It was primarily triggered by a sudden and sharp rise in gilt (UK government bond) yields following the announcement of a controversial mini-budget by the UK government on 23 September 2022.

Many UK pension funds use LDI strategies to manage their liabilities. These strategies often involve the use of derivatives and leverage to hedge against interest rate movements. The sharp rise in gilt yields led to significant losses on these derivative positions, forcing pension funds to sell gilts to meet margin calls.

The forced selling of gilts by pension funds created a liquidity crisis in the gilt market. As more gilts were sold, prices fell further, exacerbating the situation and leading to a vicious circle of selling and falling prices.

To stabilise the market, the Bank of England intervened by buying gilts and injecting liquidity into the market. This helped to calm the situation and restore some stability.

Objective:

Our primary objective was to identify one or more indicators or patterns in the SFTR data that could have been used to predict the crisis for a given fund. In addition, we wanted to evaluate the possibility of using machine learning techniques to assist in data analysis and to assess the issue of data quality. We focused mainly on the collateral used to settle the transactions.

For our analysis, we chose a 6-month period from June 2022 to November 2022. We therefore looked at 95 investment funds managed by 2 managers (referred to as Gestionnaire 1 and 2). The results therefore group the values of all the funds that have the same manager.

Results:

The first thing that stands out when analysing the data for the selected funds is that they are only involved in REPO transactions and don't carry out any of the other three types of SFTs. The second is that only securities were used as collateral and no cash.

The first half of the analysis focuses on the transaction where our funds provide collateral to the other counterparty.

Let's first look at the graphs of the numbers and the value of the collateral given by our 2 managers in question:
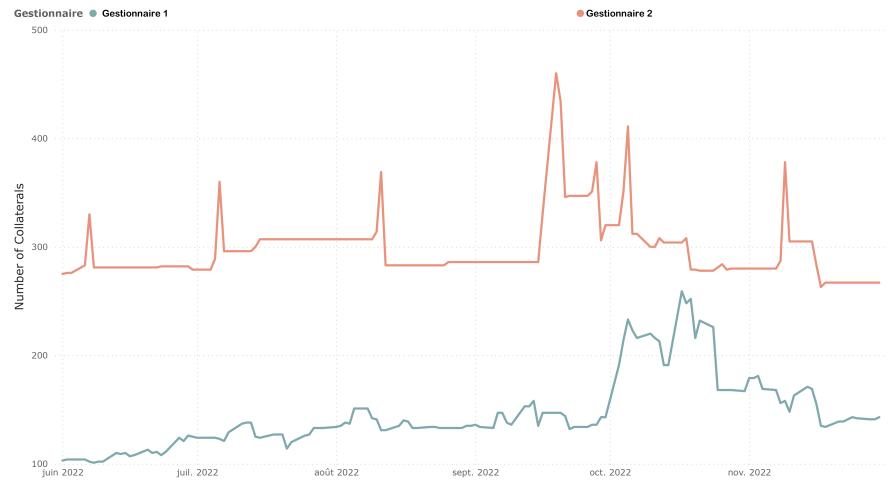

Figure 6: Number of Collaterals given by Manager
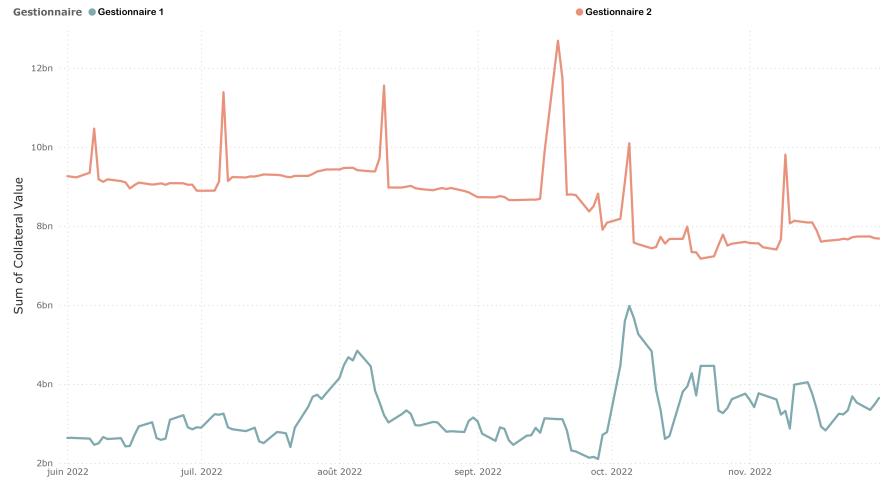
Figure 7: Total Collateral value given by Manager

For Gestionnaire 2, the number of collaterals and the total collateral value is peaking regurlarly, which may reflect a rolling effect.

For both the managers, we can see a higher collateral activity after the UK mini-budget crisis, but only during a limited time frame.

The next graph shows the average value of the collateral used:

Figure 8: Average Collateral value given by Manager

The average collateral value decreases until October 2022 for both managers due to the combined effect of a slight increase in the number of transactions and a decrease

in the total value of collateral.

One figure that can be used to determine whether a transaction is over-collateralised is the ratio of the value of the collateral used in a transaction to the value of the loan.


Figure 9: Coll/Loan Ratio in case of Collateral given by Manager

We see a difference between the value of the collateral and the value of the loan for both actors: the operations of the funds of Gestionnaire 2 are slightly over-collateralised, while those of Gestionnaire 1 tend to be under-collateralised.

During the mini-budget crisis, we observe a fall in the ratio of collateral to loan value, particularly for Gestionnaire 1. This probably reflects the sharp fall in the value of the gilts used as collateral.

The next step is to look at the haircut applied to the collateral. In finance, a haircut is most commonly used to refer to the percentage difference between the market value of an asset and the amount that can be used as collateral for a loan.

For example, if a person needs a $10,000 loan and wants to use their $10,000 stock portfolio as collateral, the bank is more likely to recognise the $10,000 portfolio as worth only $5,000 as collateral. The $5,000 or 50% reduction in the value of the asset for collateral purposes is called the haircut. If the person's stock portfolio declines in value, the person may still have sufficient collateral for the amount of

debt issued.
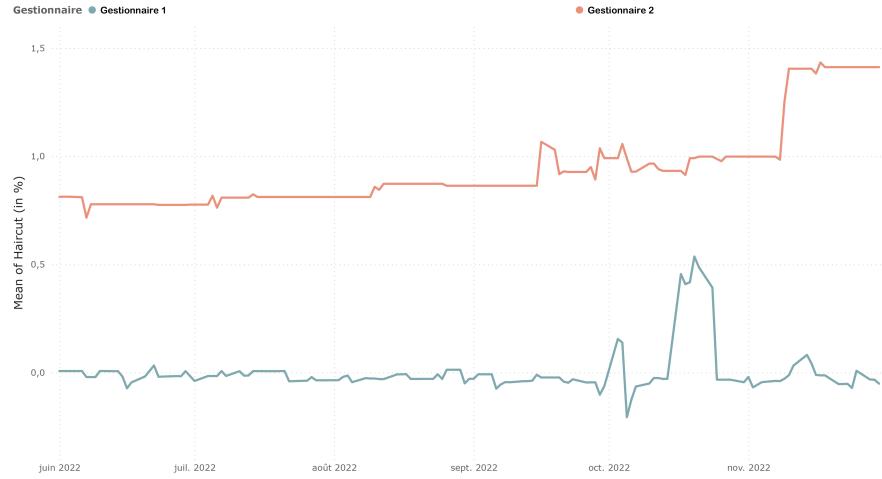
Figure 10: Average Haircut on Collaterals given by Manager

A very low haircut is usually applied, which is in line with the predominant quality of government bonds.

For Gestionnaire 1, we see an increase in the haircut in October 2022, returning to its previous value at the end of October.

For Gestionnaire 2, we see a slight increase in the haircut from mid-September 2022, followed by a larger increase in November 2022.

Let us now look at the other part, where the two managers are the counterparties receiving collateral:
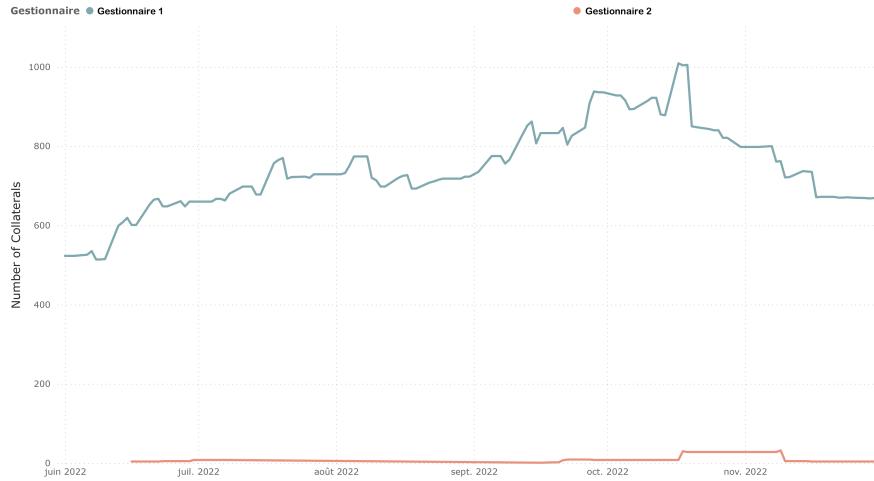
Figure 11: Number of Collaterals taken by Manager

The first thing that stands out is that Gestionnaire 2 has very few transactions in which he receives collateral. On the other hand, Gestionnaire 1 has many more transactions in which it receives collateral than in which it gives collateral, and the number of transactions in which it receives collateral increases slowly until the end of October 2022. For the following graphs, we will therefore focus only on Gestionnaire 1.
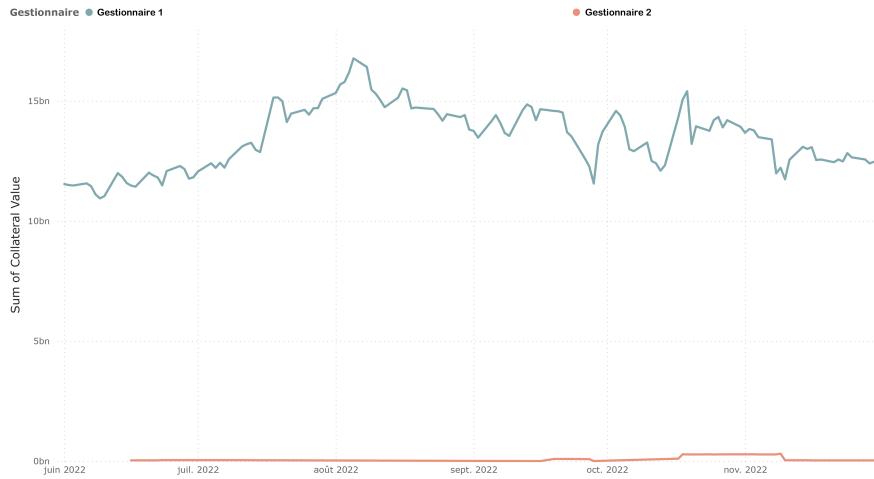
Figure 12: Total Collateral value taken by Manager

For Gestionnaire 1, the total value of collateral decreases between August and October, but is still higher than in June.
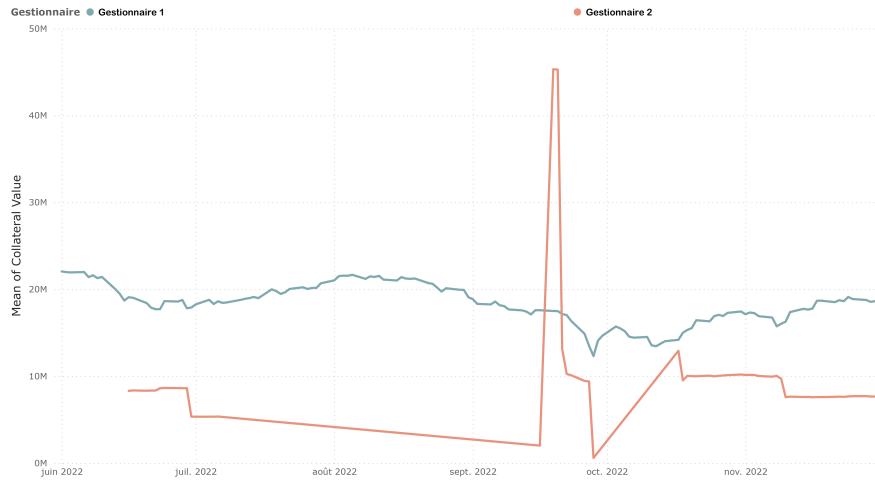
Figure 13: Average Collateral value taken by Manager

Looking at the average collateral value, Gestionnaire 1 reaches its lowest point at the beginning of October.

Let's look again at the ratio between the collateral and the loan value to see if the collateral received by Gestionnaire 1 was valuable enough to cover the loans it made:
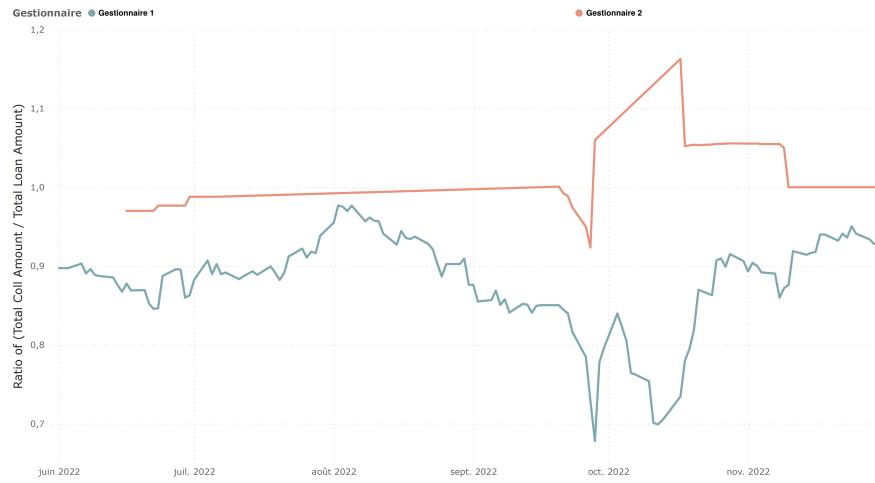
Figure 14: Coll/Loan Ratio in case of Collateral taken by Manager

For Gestionnaire 1, the relationship between the value of the collateral and the loans is similar to that where it is the collateral provider. From the beginning of August to mid-October, the ratio falls before returning to the stable value it had in June

and July. This means that the collateral received is losing value relative to the loan traded.

Finally, we can look at the countries where the securities used as collateral were issued:
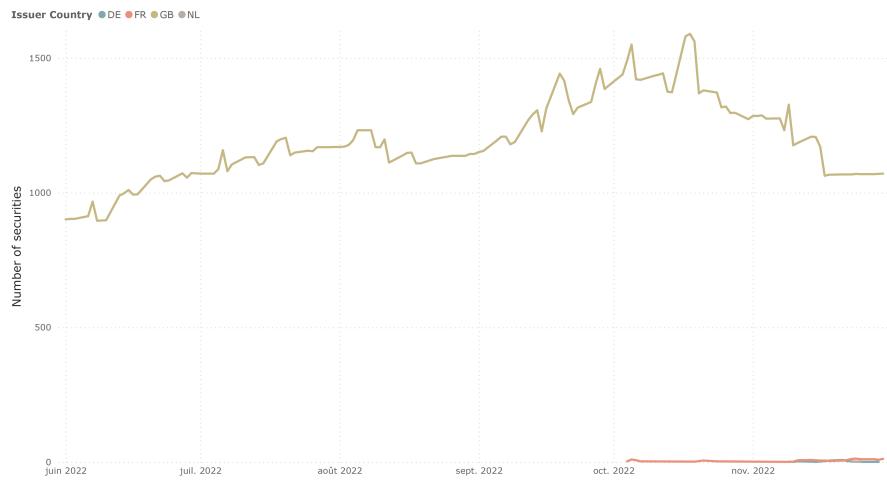
Figure 15: Countries that issued Securities used as Collateral

The securities were mainly issued in the UK, but from the beginning of October securities issued in other countries, namely Germany, France and the Netherlands, were also used as collateral.

3.4.2 US Banks

Context:

The 2023 US banking crisis was a series of bank failures and bankruptcies that occurred in early 2023, with the US federal government eventually intervening in various ways. One of the three banks we will look at in detail failed when a bank run was triggered after it sold its Treasury bond portfolio at a large loss, leading to depositor concerns about the bank's liquidity. Another bank with significant exposure to cryptocurrencies failed in the midst of turbulence in this market.

Objective:

As with the LDI crisis, the objective was to identify indicators and patterns in the

SFTR dataset that could have helped to predict US bank failures.

For the analysis, we chose a 4-month period from January 2023 to April 2023. For the 3 banks we analysed, we have a total of 14 entities representing these banks in the SFTR data.

Results:

The first thing to note is that none of the banks are directly involved in SFTs, at least not in the transactions available to the CSSF. This means that we cannot analyse transactions in which they are counterparties, but only transactions in which securities issued by them are used as collateral. Therefore, the scope of this analysis focuses only on securities issued by the US banks in question.
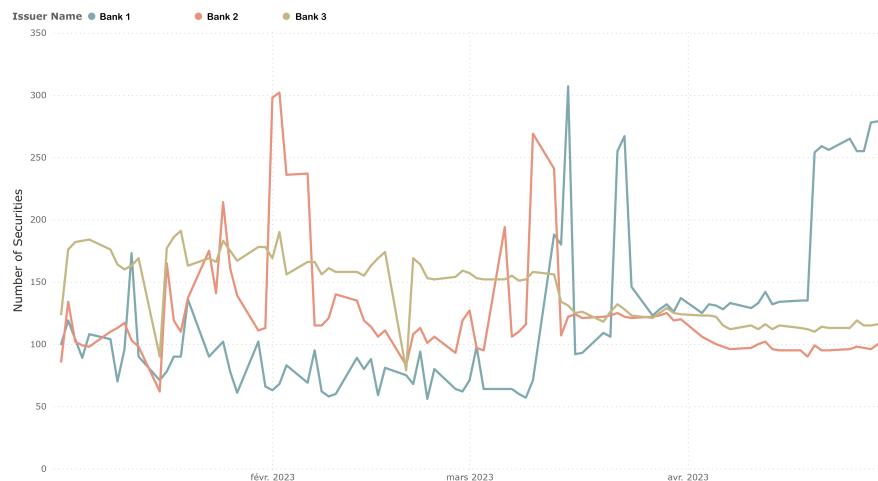
Figure 16: Number of Securities used as Collateral

Looking only at the number of securities used as collateral, there isn't a clear pattern that is similar for the three banks. The numbers are quite volatile for all the banks, but the numbers for Bank 1 peak in March and April, after the bank has already failed, the numbers for Bank 3 drop a bit and become more stable from mid-March onwards, and for Bank 2 there isn't really much of an increase or decrease in the numbers, they just become more stable around the same time as the numbers for Bank 3.
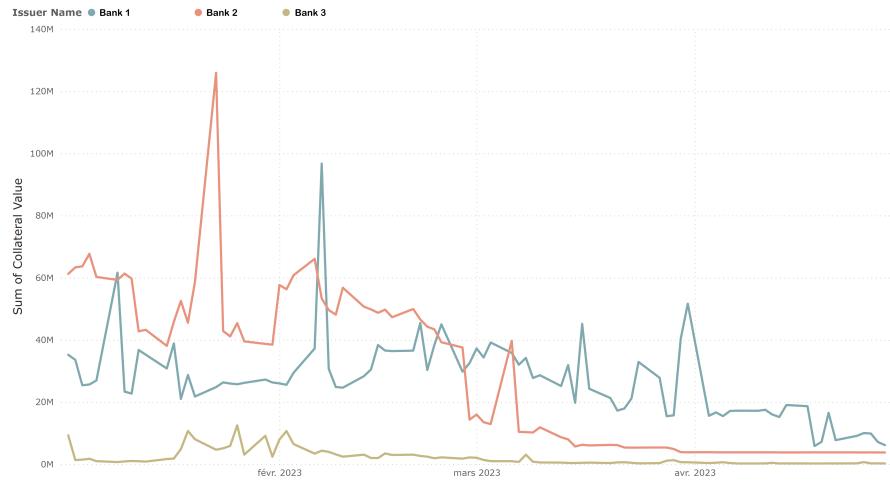
Figure 17: Total Collateral value of Securities issued

For the total value of securities issued by our three banks, we have a more consistent pattern: although the total value for Bank 3 is much lower than the amount for the other two banks, they all have their peaks in January and February, and the value begins to decline from the beginning or middle of February for Banks 2 and 3 and from the beginning of March for Bank 1.

Since the number of securities used as collateral doesn't decrease over time, but the total value of the securities decreases, this reflects the fall in the price of the securities. To check this, we also look at the average price of the securities:
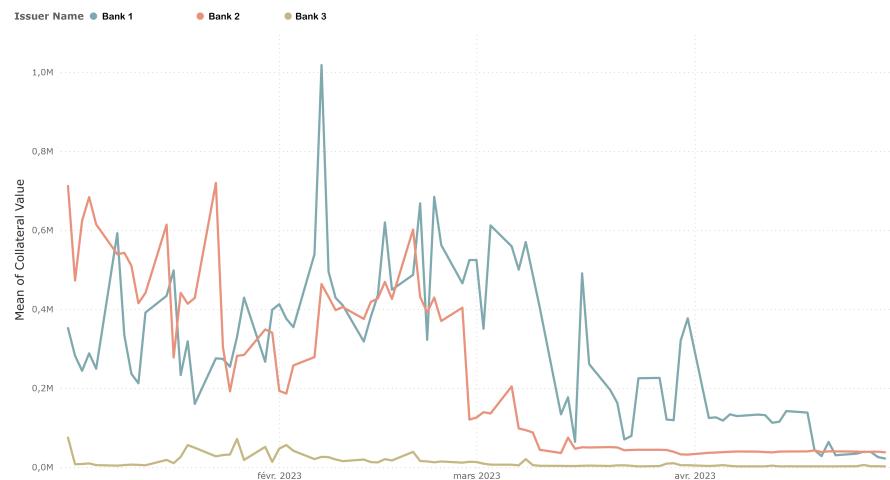
Figure 18: Average Collateral value of Securities issued

For Bank 2, it is very clear that the average value of its securities falls at the end of February. For Bank 1, the average value of its securities rises until the beginning of March, before falling to it's lowest value at that time. The average value remains quite volatile during March, with relatively large peaks and troughs, before reaching a new low at the beginning of April, from which it does not recover. As with the total value of its securities, Bank 3 also has the lowest average value of its securities. In January and February, the value is still quite volatile, with some small peaks, before reaching a low point in March and not showing much of an increase afterwards.
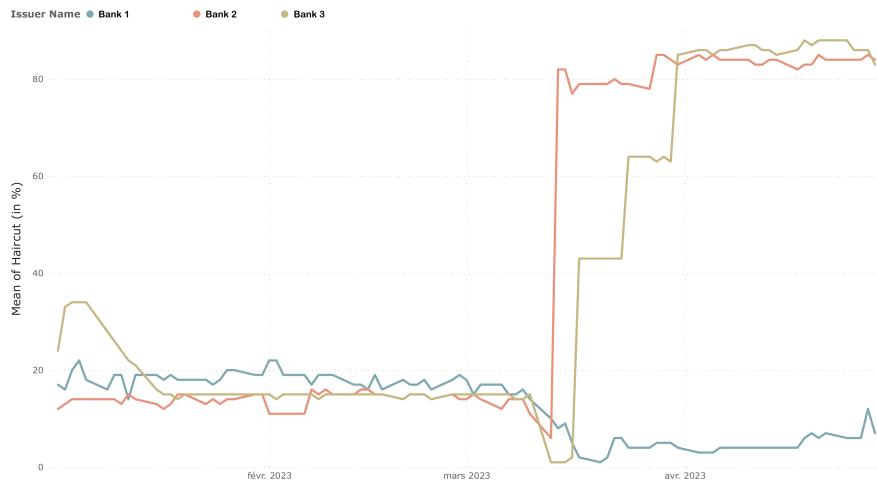
Figure 19: Average Haircut applied to Securities issued

For Banks 2 and 3, the haircut rises from around 20% to over 80% in mid-March, reflecting the higher risk of insolvency. For Bank 1, the haircut unexpectedly falls from around 20% to less than 10%. We don't really have a logical explanation for this, so it may be a data quality issue.

3.4.3 Crisis analysis conclusion

The first thing we have to acknowledge is that the number of indicators representing crises in the SFTR data is below our expectations. Apart from the collateral to loan value, the haircut and, for some entities, the total or average value of collateral, there were no other indicators that reflected the crises. Moreover, for the indicators we did find, the change in pattern occurred after the LDI funds and US banks had

already been hit by a crisis. Therefore, there is uncertainty as to whether machine learning could be applied in this context. Data quality is also sometimes a concern, especially when a value is expressed as a percentage.

3.5 Templates

The second half of the work on SFTR was dedicated to creating two templates in PowerBI, one to display information by fund and one to display information by security.

3.5.1 NOSIG Template

Context:

NOSIG is the French abbreviation for Numéro signalétique des sociétés de gestion. Each fund in the SFTR dataset has it's own NOSIG which can be used to uniquely identify it. I created a template with the aim of being able to retrieve specific information for a particular fund, given its NOSIG.

Results:

The template was created in Power BI by integrating 1 full year of SFTR data for all entities that are part of the OPC. The first page of the template allows us to select a specific entity. There are several levels and ways to select an entity: you can select it by its NOSIG or by its name. You can also display the data at the level of a manager, a fund or a subfund. To select a specific subfund, you must select the type of manager, the NOSIG of the manager, then the type and NOSIG of the fund and finally the NOSIG of the subfund.

All information for a fund is from the perspective of the reporting counterparty.
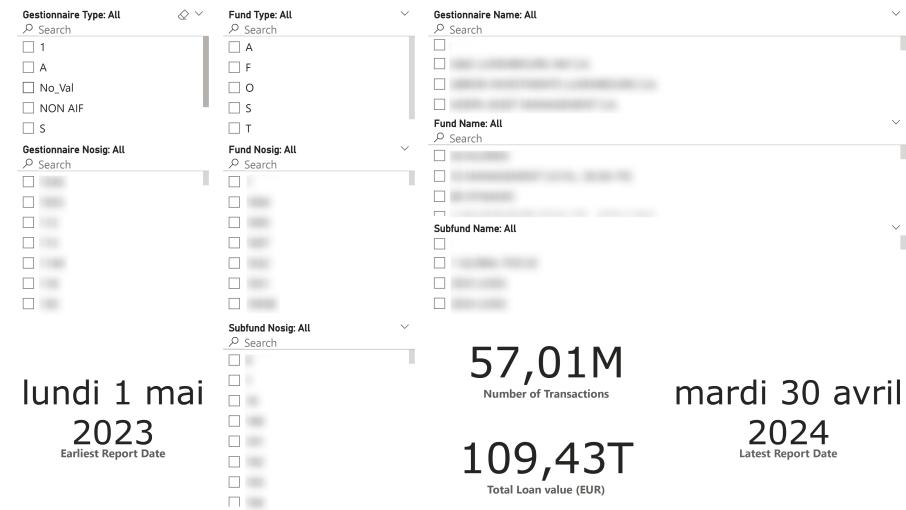
Figure 20: NOSIG Template 1st slicer

The period of data available in the template is 1 full year from May 2023 to April 2024. Once you have selected a specific fund, the first page gives you some additional information: the number of transactions carried out during the period, the sum of the value of the loans traded from all the transactions, the date of the first transaction and the date of the last transaction.

Once you have selected a specific fund, you will see 3 slides with monthly values:
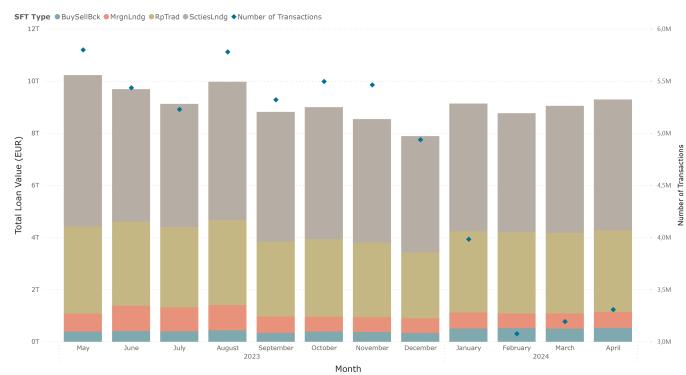
Figure 21: Number of transactions and value by SFT Type per month
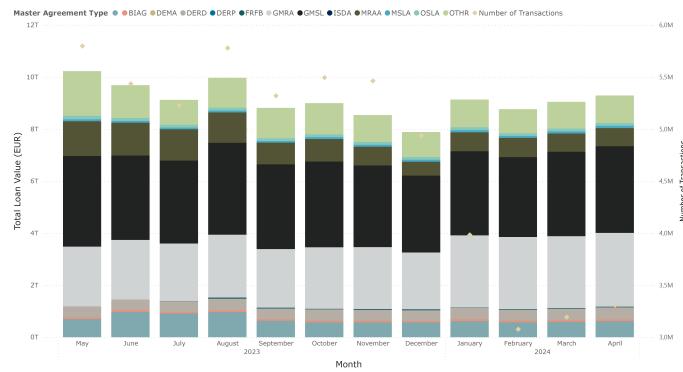
Figure 22: Number of transactions and value by Master Agreement per month
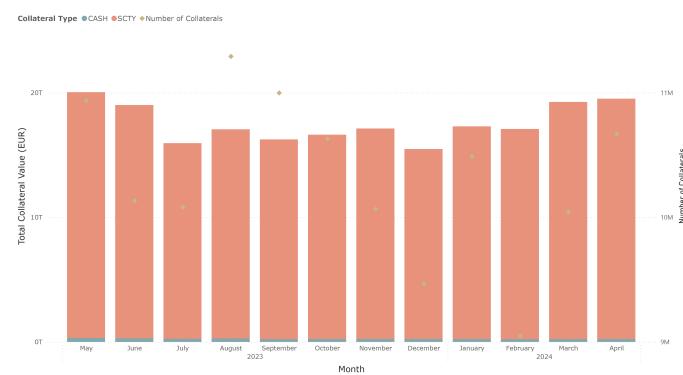
Figure 23: Number of collaterals and value by Collateral Type per month

The first 2 of these 3 pages provide information on the number of transactions and the value of these transactions per month. The first shows the distribution of value by SFT type and the second by Master Agreement type. The third gives a general overview of the collateral used in the transactions. It shows the number of collateral used and the value of each type of collaterals, i.e. cash and securities in the case of investment funds.

Following this you get another page where you can apply filters:
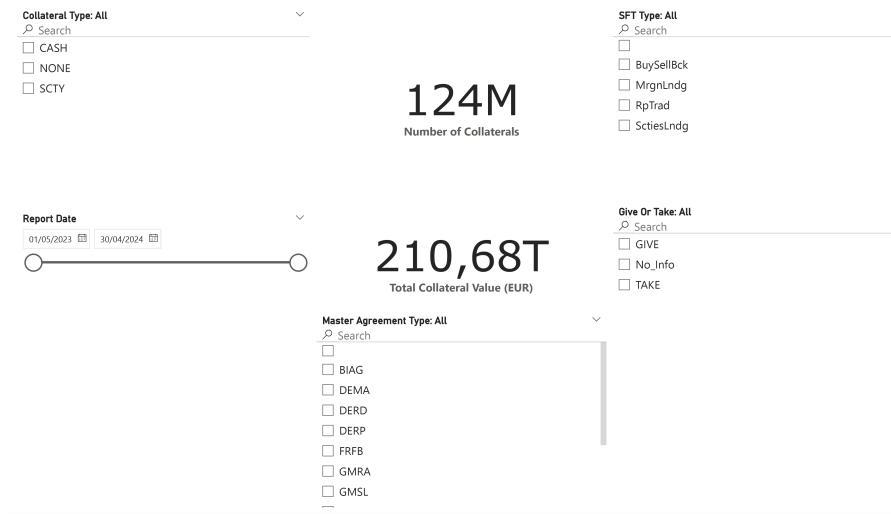
Figure 24: NOSIG Template 2nd slicer

This is where you can get more specific information about a particular type of transaction. You can select the type of SFT, the time period you want to look at in detail, the type of master agreement, whether a transaction involved cash, securities or no collateral, and finally whether the fund you're looking at received or provided the collateral used in a transaction. However, most of the time the 'GiveOrTake' field, which allows us to identify who is receiving the collateral, is empty, even if collateral was used in a transaction. This is a huge data quality problem as it is the only information that allows us to determine the direction of a transaction.

The numbers in Figure 20 represent the transactions for all funds that have transactions reported in the SFTR dataset. Comparing this graph with Figure 5, which shows the number of transactions per month grouped by SFT type, we see that REPOs account for a much larger share of the total value than the number of transactions. This suggests that, on average, the value of loans in REPO transactions is higher than the value of loans in securities lending and borrowing transactions.

Looking only at the number of transactions per month, we can see that there is a big drop between November 2023 and February 2024, where the number of transactions falls from around 5.5 million to just over 3 million. To analyse this in more detail, here are the number of transactions and the total value of loans for all available

funds:

Figure 25: Number of Transactions for all Funds

If we look at the number of transactions per day, we can see that from May 2023 to the beginning of December 2023, there are about 250 thousand transactions per day. Then, at the beginning of December, this number drops to around 220 thousand. This number remains relatively stable until January 2024, when it drops again, but this time much more, to about 140 thousand. The number of transactions increases slightly in the following months, but never again exceeds 160 thousand.

This behaviour is mainly due to 1 entity. Let's have a look at the same graph, but with only this one entity selected in our template:
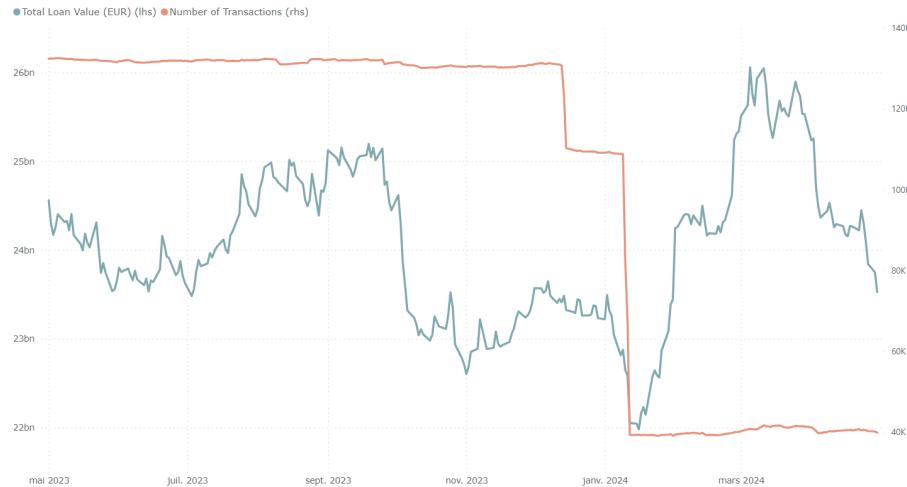
Figure 26: Number of Transactions for a Specific Entity

On the graph with all entities combined, we have first a drop of about 30 thousand and then another one of about 80 thousand in the number of transactions, making a total of 110 thousand. On the graph for the specific entity, the numbers are much more stable over the three periods, but the drops occur at the same time: in December 2023, the daily number of transactions drops from around 130 thousand to 110 thousand and then again in January 2024 to around 40 thousand. The total decrease of 90 thousand transactions per day does not represent the total number for all entities, but most of it can be attributed to this one entity.

Next, we can look at the number of transactions with collateral, this time again for all the entities:
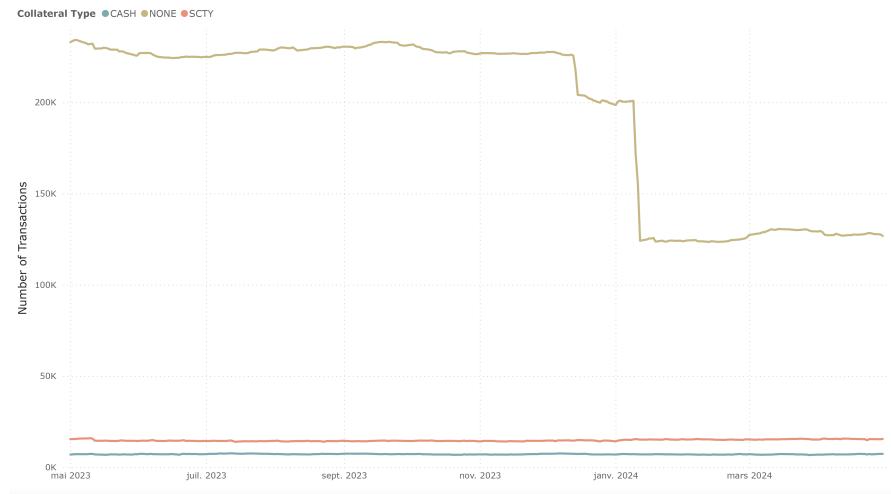
Figure 27: Number of Transactions per Collateral Type

As we can see, the majority of transactions reported under the SFTR do not involve collateral. The decline in the total number of transactions that we saw earlier is also present here for transactions without collateral. The number of transactions with cash or securities as collateral remains stable over the one-year period.

Let us take a closer look at the transactions with collateral, or more precisely all the collateral used in the transactions:
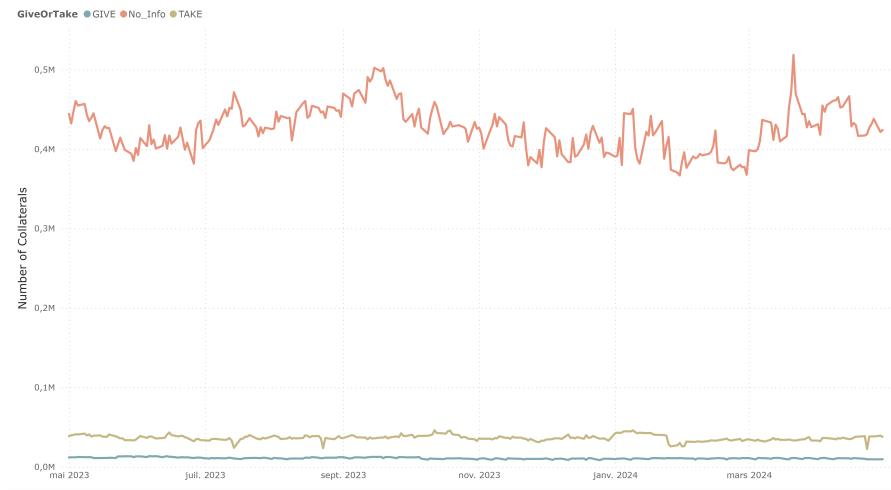
Figure 28: Number of Collaterals given or taken

Here we classify collateral into 3 categories: whether the reporting counterparty

takes the collateral (TAKE), gives the collateral (GIVE) or we have no information on which counterparty gives or receives the collateral (No Info). As we can see, by far the largest proportion of collateral is for which we do not have this information. This is a major data problem, as this information is the only one that allows us to determine the direction of a trade (i.e. who is the lender and who is the receiver).

In addition to the graphs already presented, the template also shows the following information: the total and average values of the loans, the total and average values of the collateral for both types of collateral, and the total and average values of the collateral broken down by whether the fund in question received or gave the collateral (or if we do not have this information). Finally, we have the average and weighted average haircut applied to the collateral, the standard deviation of the haircut and also the average ratio of the value of the collateral to the value of the loans.

3.5.2   ISIN Template

Context:

In addition to being able to regroup information for a single fund, we wanted to be able to collect information for a specific security that can be identified by a unique identifier called an ISIN (International Security Identification Number). So I created another template with the possibility to collect information for a specific security or security issuer.

Results:

Due to the much larger number of different ISINs compared to the number of funds (several million to just over 30,000), it was not possible to compile a dataframe larger than one month that I could use to create the template in Power BI.

To select an entity for which you want detailed information, you have two choices in the template. You can either select an issuer of securities or a counterparty that executes trades involving a security. For the issuer, you can either select a country or you can select an issuer directly, either by its name or by its LEI. For

counterparties, you can select either the manager or the fund directly by its name. You can also select a specific security by its ISIN. In addition, you can distinguish between securities used as collateral and securities that constitute the primary loan of an SFT. And in the case of a security used as collateral, you can also choose whether you want to see only the securities received or those given as collateral (from the point of view of the reporting counterparty). You can also define the period you want to look at (but only during January 2024).
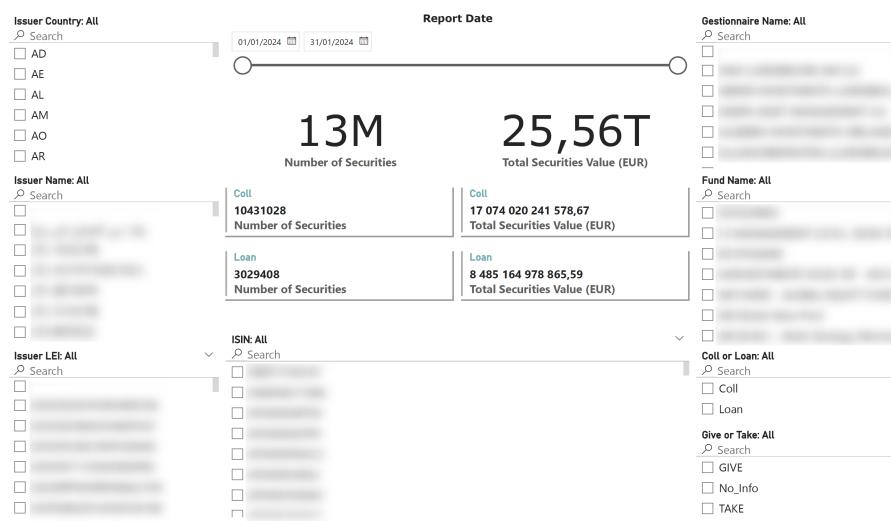
Figure 29: ISIN Template Slicers

Some additional information displayed on the first page is the number of securities and their total value used for loans and as collateral.

This template allows you to view the number of securities and their total value for the month of January 2024. You can do this for a security issuer, a specific security or an investment fund. You can also see the average value of a security per day.

However, unlike the previous template, you now have several graphs showing either the funds or issuers with the most trades. If you selected an issuer or a specific ISIN at the beginning, you will see a graph for each fund showing how many securities of the selected issuer or ISIN it has used and the total value of these securities. The same graph is also available at the level of the fund manager. If you have selected a fund or manager at the beginning, you will see a graph showing all the issuers

whose securities the selected fund has used either as loans or as collateral in its SFTs. Again, you will see the number of securities used and their total value.

The graph looks like this (the fund names are blurred):
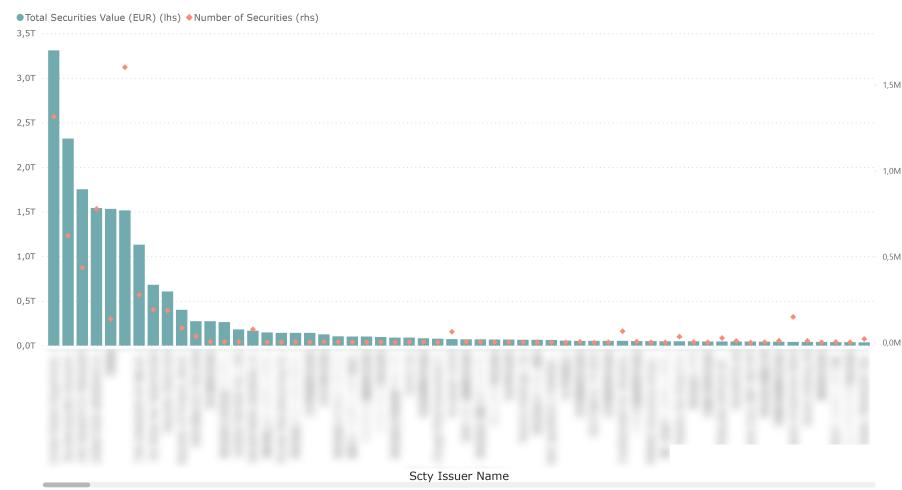
Figure 30: Security Numbers and Value by Issuer

Finally, you have an expandable table, which is basically the same as the previous graph. However, the values are aggregated for a fund or security hierarchy, which means that from an issuer perspective you get a table that first shows you the values for each country, then if you expand a country you get the values for each issuer from that country, and if you expand a specific issuer you get the values for each security (represented by their ISINs) issued by that issuer.

For funds, you have the values for each manager, which can be expanded to see the values for each fund managed by that manager.

Issuer Country	Total Securities Value (EUR)	Number of Securities
⊞ JP	6 502 990 879 457,79	1551347
⊞ US	4 882 184 311 919,18	4365476
⊞ DE	2 706 619 873 546,25	1152343
⊞ GB	2 076 044 433 118,69	977999
⊞ FR	2 023 668 949 269,50	1263293
⊞ BE	1 286 565 788 453,23	413103
⊞ NL	946 005 114 631,21	470483
⊞ KR	671 921 022 378,20	17877
⊞ AT	648 443 281 681,47	267649
⊞ IT	496 212 877 719,77	203548
⊞ FI	449 901 668 230,60	169174
⊞ ES	430 950 476 003,64	227668
⊞ CH	307 730 621 469,10	289783
⊞ CA	240 252 396 377,31	337069
⊞ KY	198 950 698 110,58	188393
⊞ IE	178 730 935 991,68	91379
⊞ LU	160 187 098 390,38	277269
⊞ DK	146 137 485 881,89	103156
⊞ CN	144 983 522 965,14	76429
⊞ AU	128 740 669 464,99	229855
⊞ SE	85 712 267 499,56	146620
⊞ NO	82 189 757 577,60	73337
⊞ CL	70 522 083 717,92	12280
⊞ VG	64 977 819 484,58	22372
⊞ HK	62 003 699 647,69	69950
⊞ ZA	49 476 525 625,02	12245
⊞ SG	34 352 744 516,81	50165
⊞ RO	28 362 844 344,72	5746
⊞ IL	26 384 988 469,23	17253
⊞ PL	24 954 156 540,40	9650
⊞ BM	23 618 978 220,32	47067
⊞ PT	22 505 514 997,16	17211
⊞ TW	22 454 362 262,49	5094
⊞ CZ	22 096 119 835,13	2722
⊞ IN	21 891 620 571,66	11231
Total	**25 559 185 220 490,29**	**13460436**

Figure 31: Expandable Table for Issuers

3.5.3   Future work on templates

The two templates can be used to evaluate the activity of a specific fund in relation to SFTs or of a specific issuer's securities used as loans or collateral in SFTs. You can look at the total activity and at the monthly (in the NOSIG template only) and daily evolution of an entity's SFT strategies.

Currently, each template is limited to one period, May 2023 to April 2024 for the first template and only January 2024 for the second. However, it is possible to analyse other periods, but to do so you would have to re-execute the notebook in which I created the data frames and re-compile the CSV files, changing the period in the existing notebook to the one you want. You would then need to integrate the newly created CSV files into the corresponding PowerBI file and you would have the same templates but with the values for the new period.

4   Greenwashing Detection

As climate change has become an increasingly important issue in recent years, and as people have become more aware of ethical issues within companies, including financial ones, sustainable investing has begun to play an important role in recent years. As a result, sustainable investing has grown in popularity, driven by demand from investors concerned with ethical investing or funding companies with intrinsic values that have a positive impact and drive change.

However, this increase in demand for sustainable investments has also led to an increase in greenwashing, where companies try to label an investment as sustainable when it is not.

4.1   Definitions

- **Sustainable Investing**

  Sustainable investing refers to a range of practices in which investors seek to achieve financial returns while promoting long-term environmental or social value. By combining traditional investment approaches with environmental, social and corporate governance (ESG) insights, investors can conduct more comprehensive analyses and make better investment decisions.

  Sustainable investing ensures that companies aren't judged solely on short-term financial returns, but on a broader picture of what and how they contribute to society. Investors need to think critically about the potential impact of investments on the environmental, political and social landscape.

- **ESG**

  ESG stands for environmental, social and governance. ESG investing refers to how companies perform on these three criteria for potential investments. Environmental criteria measure how a company protects the environment, including greenhouse gas emissions, waste, pollution, conservation of natural resources and treatment of animals. Social criteria look at how a company manages its relationships with stakeholders, suppliers, customers and employees, such

as whether it's a good workplace for employee health and safety. Governance means that a company uses accurate and transparent accounting methods, pursues integrity and diversity in selecting its leaders, and is accountable to its shareholders.

- **Greenwashing**

  Greenwashing is generally understood as the attempt by organisations to project a green or sustainable image, particularly through communications and marketing, without actually systematically implementing corresponding sustainability-oriented activities in their operations.

  In the financial sector, it is the attempt to present oneself as responsible in terms of sustainability without being able to demonstrate concrete activities and/or products. An increasingly common claim in this context is that an institution is "carbon neutral" and/or that its products and therefore its portfolios are "carbon neutral". However, it is not uncommon for this to be an approach that only 'offsets' climate-damaging emissions from its own operations and/or products, rather than preventing them in the first place.

  Greenwashing can therefore include distortion and misrepresentation of the following aspects, among others

  1. the 'green' purpose of the financing,

  2. the assessment and verification of ESG objectives,

  3. what is reported and how it is measured,

  4. the consequences of breaching ESG commitments and reporting requirements.

  One problem with the greenwashing debate, however, is that the definition of when a company or product can be accused of greenwashing is vague.

- **SFDR**

  One way the financial sector is monitoring sustainable investment is through the Sustainable Finance Disclosure Regulation (SFDR), a transparency frame-

work set up by the European Union. By setting out how financial market participants must disclose sustainability information, it helps those investors who want to put their money into companies and projects that support sustainability goals to make informed choices. In addition, the CSSF will be able to use the information provided by the SFDR to monitor whether investment funds are living up to their promises and are truly sustainable.

4.2 Role of the CSSF

The missions of the CSSF in the field of sustainable investment include:

- Organisational arrangements of IFMs, including the integration of sustainability risks by financial market participants.

- Verification of compliance with pre-contractual and periodic disclosures.

- Verification of the consistency of information in fund documentation and marketing materials.

- Verification of compliance with disclosures on product websites.

- Portfolio analysis.

4.3 Classification of funds

The SFDR requires asset managers to classify their funds as one of three types of funds depending on their level of sustainability, namely Article 6, 8 or 9.

- Article 6 requires financial market participants to disclose how sustainability risks are integrated into their investment decisions and to assess the potential impact of these risks on returns. If sustainability risks are not considered material, they must clearly explain why. This applies to all funds, regardless of their ESG or green classification.

- Article 8 applies to funds that promote environmental or social characteristics. It requires these funds to disclose how these characteristics are met and to provide information on any relevant benchmarks used. Unlike Article 9 funds,

Article 8 funds do not have sustainable investment as a core objective, but still focus on good governance and sustainability.

- Article 9 applies to funds that have sustainable investment as their primary objective. These funds must disclose how their chosen benchmark aligns with their sustainability objectives and explain any differences from broader market indices. Article 9 funds are characterised by a deeper commitment to making a positive impact on society or the environment.

4.4   Objective

One way to assess whether a fund that claims to make sustainable investments actually does so is to analyse its portfolio. However, due to the limited time remaining during the internship when I started working on SFDR, we decided to focus only on the investments that fall into the oil and coal categories.

More specifically, there are 6 types of oil investments that we distinguish between:

- Oil and Gas Reserves Production

- Oil sands production

- Arctic oil production

- Oil and gas processing, transportation and/or distribution

- Oil and gas-fired power generation

- Involvement in oilfield services

For coal investments, we have only 2 categories: production of thermal coal reserves and involvement in thermal coal-fired power generation.

The aim was to determine the number of investments in a fund's portfolio that fell into either the coal or oil category, and the total value of these investments. More specifically, we want to know how much a fund has invested in companies that generate revenue from oil and coal.

4.5   Results

Similar to the work on SFTR, I grouped all the investments for a fund to be able to look at the results for each fund in detail. We have the portfolio of all funds available in SFDR, which we use to determine the companies in which a fund has invested and the value of each investment. For each company, we know the percentage of revenue that each category represents of its total revenue (which includes the oil and coal categories). With these two tables of information, it is possible to calculate several figures: the total number of investments of a fund, and the number and percentage of investments in companies that generate revenue from oil or coal. In addition, we can calculate the total value of a fund's portfolio and the value and percentage of investments in companies that generate revenue from oil and coal.

However, most companies don't make 100% of their revenue from oil or coal, they also make revenue from other sectors. Therefore, it's not correct to say that an investment of €1 million in a company that earns 1% of its revenue from oil production means that a fund has invested €1 million in oil production. It would be more accurate to say that only 1% of the investment (i.e. 10,000 euros) is invested in oil production. I have therefore added an additional information, the weighted value of the investments in oil or coal and the percentage of this value compared to the total value of a fund portfolio.

Figure 32: Table with information on funds with Oil and Coal Investments

The top table has one row for each fund with data available in SFDR. On the left you can select specific funds to filter the table. You can filter for Article 8, 9 and other funds, whether they have investments in oil or not, and whether they have investments in coal or not. On the screenshot no filter has been applied and we can see that we have a total of 13,551 funds represented in SFDR.

If you want to have detailed information about a fund portfolio, you can select that fund in the top table and the bottom table will show you each investment in that fund portfolio. You will also get information on each company in which they have invested, whether this company makes its revenue from oil or coal, and what percentage of its revenue comes from each of these two sectors.

As you might expect, the funds that have the highest percentage of their investments in companies that make money from oil or coal are part of the "other subfunds" category, followed by the Article 8 subfunds and the Article 9 subfunds, which have the least investments in oil and coal.

4.6   Conclusion and possible future work

For now, this PowerBI page can be used to obtain detailed information on a fund's investments in companies that generate revenue from oil and coal by searching the fund by its NOSIG. You can also sort each column from lowest to highest value and vice versa. This can be used to get a general overview of the leading funds in a particular category or, for example, to identify the Article 9 funds that have the most money invested in companies that generate revenue from coal or oil.

This can be extended to any other category in the SFDR that may be relevant for detecting greenwashing or other ESG related issues. For example, revenues from alcohol production, tobacco production, uranium mining, arms trading, gambling or other activities.

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