When Data Meets the Law
Online Annex: Financial Rules Representation

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Contents

1   The example: Article 43 of the Luxemburgish UCITS Law

The example rules are based on Article 43 of the Luxembourgish UCITS* law, which states:

> **Article 43.** (1) A UCITS may invest no more than 10% of its assets in transferable securities or money market instruments issued by the same body. A UCITS may not invest more than 20% of its assets in deposits made with the same body. The risk exposure to a counterparty of the UCITS in an OTC derivative transaction may not exceed 10% of its assets when the counterparty is a credit institution referred to in Article 41(1)(f), or 5% of its assets in other cases.
>
> (2) The total value of the transferable securities and money market instruments held by a UCITS in the issuing bodies in each of which it invests more than 5% of its assets shall not exceed 40% of the value of its assets. This limitation does not apply to deposits and OTC derivative transactions made with financial institutions subject to prudential supervision. Notwithstanding the individual limits laid down in paragraph 1, a UCITS shall not combine, where this would lead to investment of more than 20% of its assets in a single body, any of the following: - investments in transferable securities or money market instruments issued by that body; - deposits made with that body; or - exposures arising from OTC derivative transactions undertaken with that body.
>
> (3) The limit laid down in the first sentence of paragraph 1 may be of a maximum of 35% if the transferable securities or money market instruments are issued or guaranteed by a Member State, by its public local authorities, by a third country or by public international bodies of which one or more Member States belong.
>
> (4) The limit laid down in the first sentence of paragraph 1 may be of a maximum of 25% for "the covered bonds (obligations garanties) as defined in point (1) of Article 3 of Directive (EU) 2019/2162 of the European Parliament and of the Council of 27 November 2019 on the issue of covered bonds and covered bond public supervision and amending Directives 2009/65/ EC and 2014/59/EU (hereinafter "Directive (EU) 2019/2162"), and for" certain bonds where they are issued "before 8 July 2022" by a credit institution which has its registered office in a Member State and is subject by law, to special public supervision designed to protect bondholders. In particular, sums deriving from the issue of those bonds "issued before 8 July 2022" shall be invested in accordance with the law in assets which, during the whole period of validity of the bonds, are capable of covering claims attaching to the bonds and which, in case of bankruptcy of the issuer, would be used on a priority basis for the reimbursement of the principal and payment of the accrued interest. Where a UCITS invests more than 5% of its assets in the bonds referred to in the first subparagraph which are issued by a single issuer, the total value of such investments may not exceed 80% of the value of the assets of the UCITS.
>
> (5) The transferable securities and money market instruments referred to in paragraphs 3 and 4 shall not be taken into account for the purpose of applying the limit of 40% referred to in paragraph 2. The limits set out in paragraphs 1, 2, 3 and 4 shall not be combined; thus investments in transferable securities or money market instruments issued by the same body or in deposits or derivative instruments made with this body carried out in accordance with paragraphs 1, 2, 3 and 4 shall not exceed in total 35% of the assets of the UCITS. Companies which are included in the same group for the purposes of consolidated accounts, as defined in accordance with Directive 83/349/EEC or in accordance with recognised international accounting rules, shall be regarded as a single body for the purpose of calculating the limits contained in this Article.

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*UCITS stands for *Undertakings for Collective Investments in Transferable Securities*

2   The Rules Extracted from Art. 43

2.1   SHACL

SHACL (Shapes Constraint Language) is a language for describing and validating RDF graphs[1]. In SHACL, validation is based on shapes, which define particular constraints and specify which nodes in a graph should be validated against these constraints. This type of validation can be used to detect different types of problems or discrepancies in the dataset.

We have literature that states the viability of SHACL for checking legal rules, and SHACL as a description logics in disguise.

In our work we used the extension SHACL-SPARQL, which allows to express more complex conditions.

SPARQL (SPARQL Protocol and RDF Query Language) is an RDF query language. SPARQL queries are as complex as SHACL gets, which implies that any rule that can be expressed in SPARQL can also be expressed in SHACL. The main advantage of SHACL consists in the possibility to attach different implications to each constraint (rule) – and to its violation (informative-warning-breach).

Note that for SHACL we have reasoners, but they do not seem to handle the full expressivity of SHACL-SPARQL (for example, SHACL Playground https://shacl.org/playground/ explicitly indicates no SHACL-SPARQL support). **For this reason, we had to build the rules as SPARQL queries and test them on SPARQL reasoners.**

The main difference is that SHACL allows to classify the (parts of) graphs that do not comply with the SHACL shapes in different ways (information-warning-breach) which is very useful to embed certain semantics in the rules, not only to e.g. distinguish applicable rules and best practices, but also to arrange information e.g. to reclassify entities or to apply exceptions. This layer would normally be implemented in a software, outside of the control of the rule creator, while SHACL allows a complete representation of the legal norm and its effects. So, once we have verified that the SPARQL query works, we just need to assume that we can attach the validation to a specific message, as SHACL would allow.

2.2   Rules of Art. 43: SPARQL Version

We note that all the queries presented in this subsection have been successfully tested against a sample model.

2.2.1   Rule 1 - Art. 43(1)

Here is the simplified text of the first sentence of the first paragraph of Article 43, which corresponds to rule 1:

> A fund shall not invest more than 10% of its assets in 'transferable securities' or 'money market instruments' issued by the same 'issuer'.
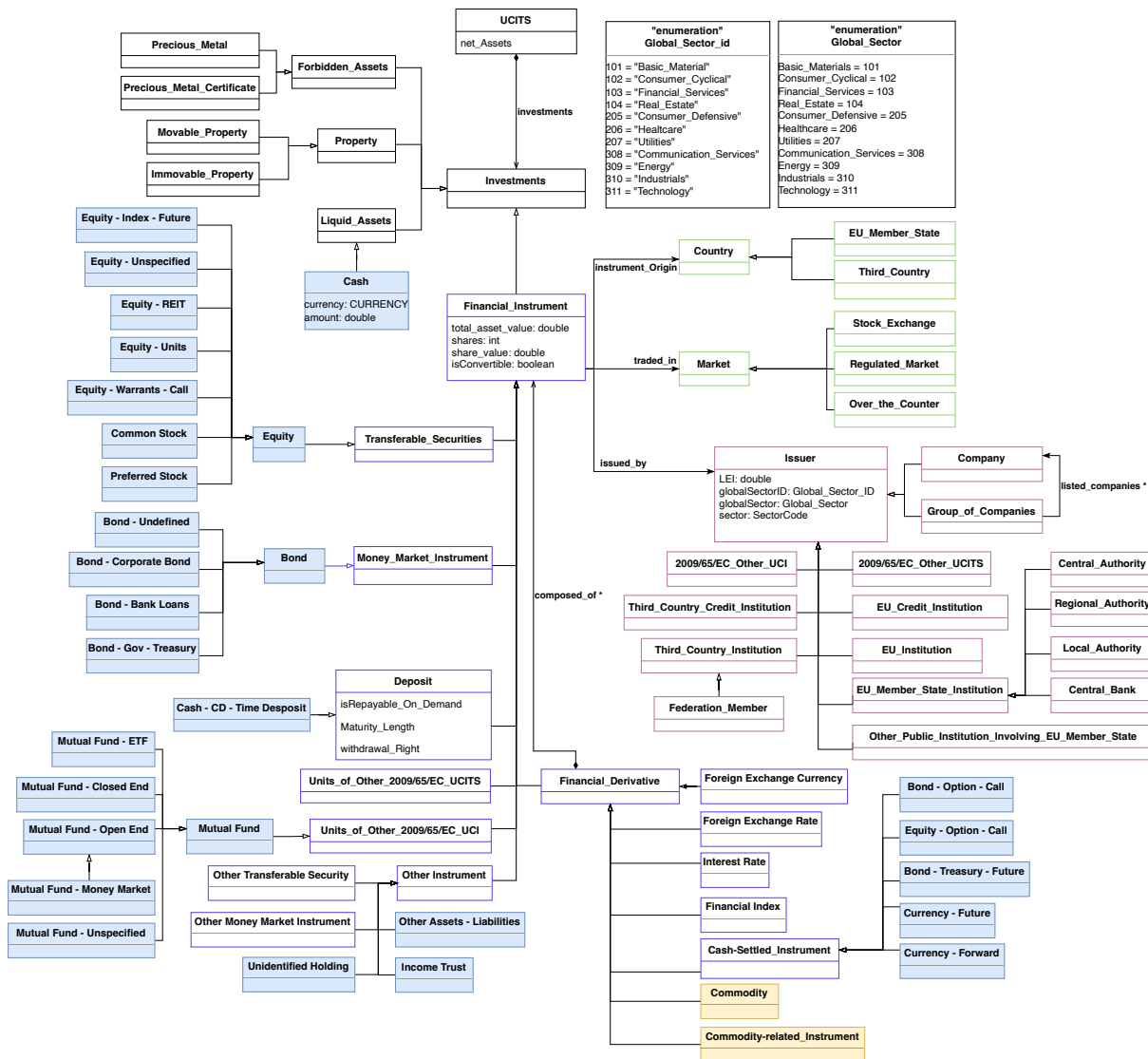
Figure 1: The conceptual and data model built from Art 43 and the dataset. Note that the concept of Issuer has to be replaced with that of Institution
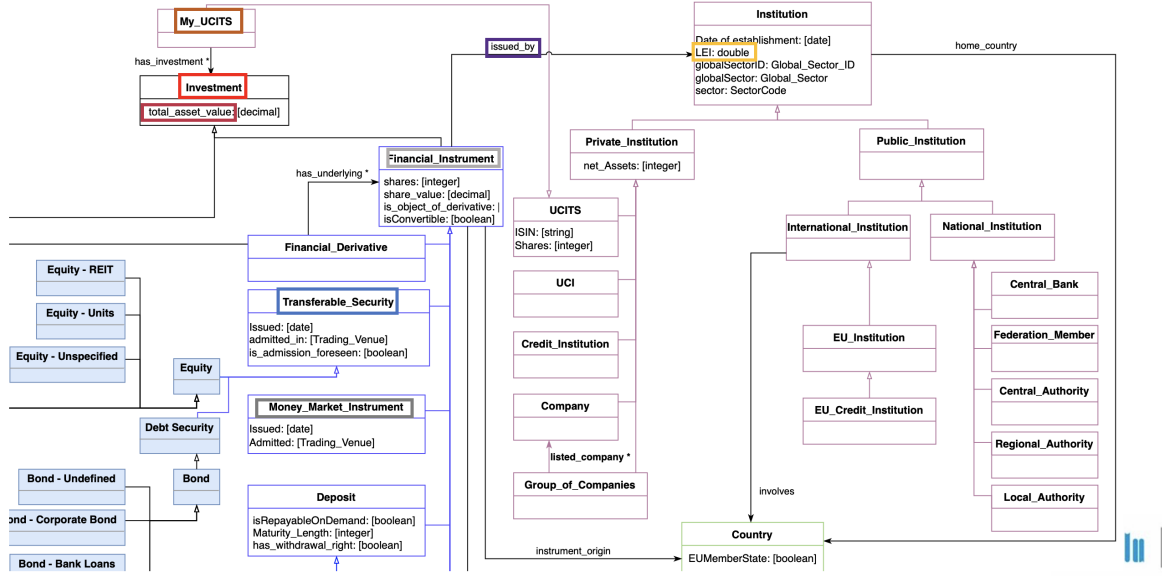
Figure 2: The elements of the conceptual model involved in Rule 1

We can identify in the conceptual and data model the elements that are involved in the representation of this rule (see Figure 2)

Here is the representation of the rule in SPARQL:

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rumofa: <http://www.semanticweb.org/marcello.ceci/ontologies/2024/6/rumofa#>

SELECT ?issuer (SUM(?investment_value) AS ?total_investment_value) ?total_value
              ((SUM(?investment_value) / ?total_value) * 100 AS ?percentage)
WHERE {
  {
    SELECT (SUM(?investment_value) AS ?total_value)
    WHERE {
      ?investment rumofa:investmentOf rumofa:MyUCITS ;
               rumofa:total_asset_value ?investment_value .
    }
  }
  ?investment rumofa:total_asset_value ?investment_value ;
            rdf:type ?type ;
            rumofa:issuedBy ?issuer .
  FILTER (?type IN (rumofa:Money_Market_Instrument, rumofa:Transferable_Security))
}
GROUP BY ?issuer ?total_value
HAVING ((SUM(?investment_value) / ?total_value) * 100 > 10)
```

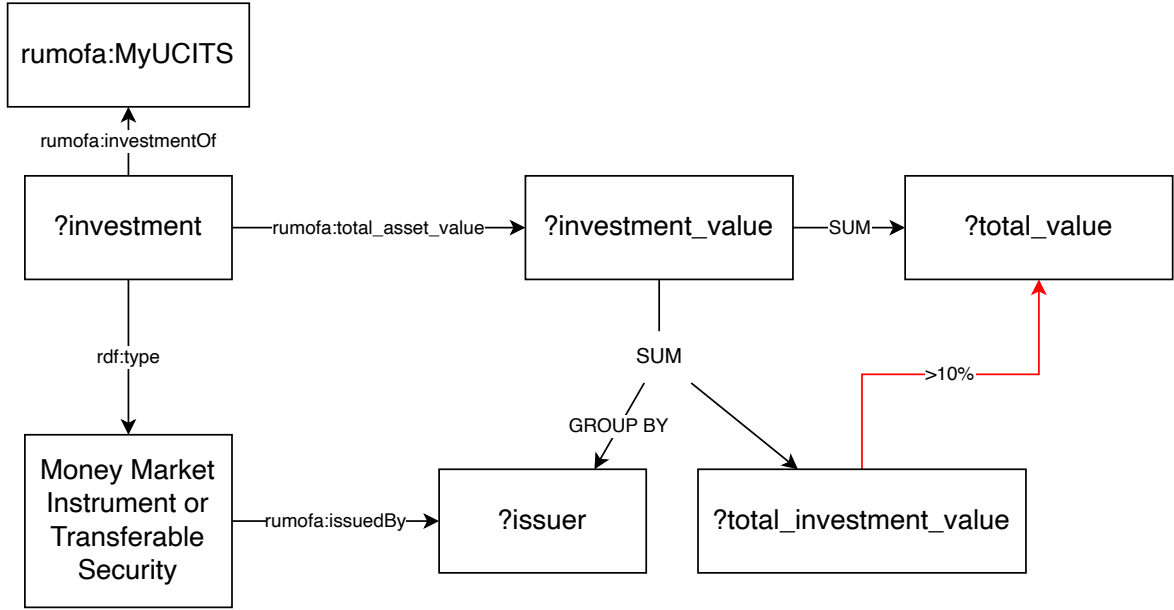Figure 3 is an attempt at visually representing the SPARQL query. Note that the literature

Figure 3: Visualization of Rule 1.

Figure 4: Mapping of elements of Rule 1 to the query results.

does not provide a standard way to visualize SPARQL queries as complex as the ones expressed in Art. 43. Since visualization could be an efficient way to grant control to the legal expert over the expressed semantics, this is a topic worth further investigation, even if more on the SHACL side. Figure 4 shows the mapping between the elements in the rules and the conceptual model built during the previous phase of RUMOFA. The mapping ensures that running the SPARQL queries we automatically obtain the correct results without need for any interpretation of the query itself (while the underlying legal norm is interpreted as part of the creation of the SPARQL query and of the model, see Section **??**). This indeed implies that the model is correctly instantiated, i.e., the facts being checked for compliance are correctly tagged.

Rule 1 with exceptions

We note that Paragraphs (3) and (4) of Article 43 explicitly introduce exceptions to Rule 1. One way to represent those exceptions is to embed them into the original rule.

Here is the simplified text of rule 1 including exceptions:

> A fund shall not invest more than 10% of its assets in 'transferable securities' or 'money market instruments' issued by the same 'issuer' unless these are covered bonds or bonds issued before 8 july 2022 by a credit institution which has its registered office in a Member State and is subject by law to special public supervision.

Here is the SPARQL query including the exceptions:

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rumofa: <http://www.semanticweb.org/marcello.ceci/ontologies/2024/6/rumofa#>

SELECT ?issuer (SUM(?investment_value) AS ?total_investment_value) ?total_value
              ((SUM(?investment_value) / ?total_value) * 100 AS ?percentage)
WHERE {
  {
    SELECT (SUM(?investment_value) AS ?total_value)
    WHERE {
      ?investment rumofa:investmentOf rumofa:MyUCITS ;
                rumofa:total_asset_value ?investment_value .
    }
  }
  ?investment rumofa:total_asset_value ?investment_value ;
              rdf:type ?type ;
              rumofa:issuedBy ?issuer .
  FILTER (?type IN (rumofa:Money_Market_Instrument, rumofa:Transferable_Security))
  FILTER NOT EXISTS {
    ?type rdf:type rumofa:CoveredBond
  }
   FILTER NOT EXISTS (
  ?issuer rumofa:MS_Guaranteed true ||
  ?issuer rdf:type rumofa:MemberStateEquivalent
)
```

```
   FILTER NOT EXISTS {
     ?investment rumofa:issue_date ?issueDate .
     ?issuer rdf:type rumofa:CreditInstitution ;
             rumofa:prudential_supervision true ;
             rumofa:hasRegisteredOffice ?office .
     ?office rumofa:locatedIn ?country .
     ?country rdf:type rumofa:MemberState .
     FILTER (?issueDate < "2022-07-08"^^xsd:date)
   }
}
GROUP BY ?issuer ?total_value
HAVING ((SUM(?investment_value) / ?total_value) * 100 > 10)
```

2.2.2 Rule 2 - Art. 43(1)

Here is the simplified text of the second sentence of the first paragraph of Article 43, which corresponds to rule 2:

A fund shall not invest more than 20% of its assets in 'deposits' made with the same 'issuer'.

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rumofa: <http://www.semanticweb.org/marcello.ceci/ontologies/2024/6/rumofa#>

SELECT ?issuer (SUM(?depositAmount) AS ?totalDeposits) ?total_value
WHERE {
  {
    SELECT (SUM(?investment_value) AS ?total_value)
    WHERE {
      ?portfolio rumofa:investmentOf rumofa:MyUCITS ;
                 rumofa:total_asset_value ?investment_value .
    }
}

  rumofa:MyUCITS rumofa:investsIn ?asset .
  ?asset rumofa:total_asset_value ?depositAmount .
  ?asset rdf:type rumofa:Deposit .
  ?asset rumofa:issuedBy ?issuer .
}
GROUP BY ?issuer ?total_value
HAVING ((SUM(?depositAmount) / ?total_value) > 0.20)
```

2.2.3 Rule 3 - Art. 43(1)

Here is the simplified text of part of the third sentence of the first paragraph of Article 43, which corresponds to rule 3:

A fund shall not invest more than 10% of its assets in an OTC 'derivative' transaction if the counterparty is a 'credit institution'.referred to in Article 50(1)(f).

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rumofa: <http://www.semanticweb.org/marcello.ceci/ontologies/2024/6/rumofa#>

SELECT ?issuer ?investment_value ?total_value ((?investment_value / ?total_value)
* 100 AS ?percentage)
WHERE {
    {
    SELECT (SUM(?inv_value) AS ?total_value)
    WHERE {
      ?portfolio rumofa:investmentOf rumofa:MyUCITS ;
               rumofa:total_asset_value ?inv_value .
    }
  }

      ?portfolio rumofa:investmentOf rumofa:MyUCITS ;
 rdf:type rumofa:OTC_Derivative;
               rumofa:total_asset_value ?investment_value ;

             rumofa:hasCounterparty ?issuer.
?issuer rdf:type rumofa:Credit_Institution.

}
GROUP BY ?issuer ?investment_value ?total_value

HAVING ((SUM(?investment_value) / ?total_value) * 100 > 10)
```

2.2.4   Rule 4 - Art. 43(1)

Here is the simplified text of part of the third sentence of the first paragraph of Article 43, which corresponds to rule 4:

A fund shall not invest more than 5% of its assets in an OTC 'derivative' transaction if the counterparty is not a 'credit institution'.

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rumofa: <http://www.semanticweb.org/marcello.ceci/ontologies/2024/6/rumofa#>

SELECT ?issuer ?investment_value ?total_value ((?investment_value / ?total_value)
* 100 AS ?percentage)
WHERE {
```

```
     {
     SELECT (SUM(?inv_value) AS ?total_value)
     WHERE {
       ?portfolio rumofa:investmentOf rumofa:MyUCITS ;
                  rumofa:total_asset_value ?inv_value .
     }
   }

   ?portfolio rumofa:investmentOf rumofa:MyUCITS ;
              rdf:type rumofa:OTC_Derivative;
              rumofa:total_asset_value ?investment_value ;
              rumofa:hasCounterparty ?issuer.

   ?issuer rdf:type ?issuer_type .

   MINUS {
     ?issuer rdf:type rumofa:Credit_Institution .
   }
}
GROUP BY ?issuer ?investment_value ?total_value

HAVING ((SUM(?investment_value) / ?total_value) * 100 > 5)
```

2.2.5 Rule 5 - Art. 43(2)

Here is the simplified text of the first and second sentences of the second paragraph of Article 43, which corresponds to rule 5:

The total value of the 'transferable securities' and the 'money market instruments' held by the UCITS in the issuing bodies in each of which it invests more than 5 % of its assets shall not exceed 40 % of the value of its assets. Exception: OTC derivative transactions made with financial institutions subject to prudential supervision.

Here is the SPARQL query:

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rumofa: <http://www.semanticweb.org/marcello.ceci/ontologies/2024/6/rumofa#>

SELECT (SUM(?total_investment_value) AS ?sum_investment_value) ?total_value
((SUM(?total_investment_value) / ?total_value) * 100 AS ?percentage)
WHERE {
  {
    SELECT ?issuer (SUM(?investment_value) AS ?total_investment_value) ?total_value
    WHERE {
      {
        SELECT (SUM(?inv_value) AS ?total_value)
        WHERE {
          ?investment rumofa:investmentOf rumofa:MyUCITS ;
                      rumofa:total_asset_value ?inv_value .
        }
```

```
        }

        ?investment rumofa:investmentOf rumofa:MyUCITS ;
                    rdf:type ?investment_type ;
                    rumofa:total_asset_value ?investment_value ;
                    rumofa:issuedBy ?issuer.

        FILTER (?investment_type IN (rumofa:Transferable_Security,
                                     rumofa:Money_Market_Instrument))
        FILTER NOT EXISTS {
        ?investment_type IN (rumofa:OTC_Derivative, rumofa:Deposit)
        rumofa:issuedBy ?issuerx.
?issuerx rdf:type rumofa:Credit_Institution ;
        rumofa:prudential_supervision true .
        }
      }
    GROUP BY ?issuer ?total_value
    HAVING ((SUM(?investment_value) / ?total_value) * 100 > 5)
  }
}
GROUP BY ?total_value
HAVING ((SUM(?total_investment_value) / ?total_value) * 100 > 40)
```

Here is the SPARQL query with the exception from Art. 43(5):

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rumofa: <http://www.semanticweb.org/marcello.ceci/ontologies/2024/6/rumofa#>

SELECT (SUM(?total_investment_value) AS ?sum_investment_value) ?total_value
       ((SUM(?total_investment_value) / ?total_value) * 100 AS ?percentage)
WHERE {
  {
    SELECT ?issuer (SUM(?investment_value) AS ?total_investment_value) ?total_value
    WHERE {
      {
        SELECT (SUM(?inv_value) AS ?total_value)
        WHERE {
          ?investment rumofa:investmentOf rumofa:MyUCITS ;
                      rumofa:total_asset_value ?inv_value .
        }
      }

      ?investment rumofa:investmentOf rumofa:MyUCITS ;
                  rdf:type ?investment_type ;
                  rumofa:total_asset_value ?investment_value ;
                  rumofa:issuedBy ?issuer .

      FILTER (?investment_type IN (rumofa:Transferable_Security,
                                   rumofa:Money_Market_Instrument))
      FILTER NOT EXISTS {
```

11

```
        ?investment_type rdf:type rumofa:OTC_Derivative, rumofa:Deposit ;
                          rumofa:issuedBy ?issuerx .
        ?issuerx rdf:type rumofa:Credit_Institution ;
                 rumofa:prudential_supervision true .
      }
      FILTER NOT EXISTS {
        ?issuer rumofa:MS_Guaranteed true .
      }
      FILTER NOT EXISTS {
        ?issuer rdf:type rumofa:MemberStateEquivalent .
      }
      FILTER NOT EXISTS {
        ?type rdf:type rumofa:CoveredBond .
      }
      FILTER NOT EXISTS {
        ?investment rumofa:issue_date ?issueDate .
        ?issuer rdf:type rumofa:CreditInstitution ;
                rumofa:prudential_supervision true ;
                rumofa:hasRegisteredOffice ?office .
        ?office rumofa:locatedIn ?country .
        ?country rdf:type rumofa:MemberState .
        FILTER (?issueDate < "2022-07-08"^^xsd:date)
      }
    }
    GROUP BY ?issuer ?total_value
    HAVING ((SUM(?investment_value) / ?total_value) * 100 > 5)
  }
}
GROUP BY ?total_value
HAVING ((SUM(?total_investment_value) / ?total_value) * 100 > 40)
```

2.2.6 Rule 6 - Art. 43(2)

Here is the simplified text of the third sentence of the second paragraph of Article 43, which corresponds to rule 6:

Notwithstanding the individual limits laid down in paragraph 1, a UCITS shall not combine, where this would lead to investment of more than 20% of its assets in a single body, any of the following: - investments in transferable securities or money market instruments issued by that body; - deposits made with that body; or - exposures arising from OTC derivative transactions undertaken with that body.

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rumofa: <http://www.semanticweb.org/marcello.ceci/ontologies/2024/6/rumofa#>

SELECT ?issuer (SUM(?investment_value) AS ?total_investment_value) ?total_value
```

```
                    ((SUM(?investment_value) / ?total_value) * 100 AS ?percentage)
WHERE {
    {
    SELECT (SUM(?inv_value) AS ?total_value)
    WHERE {
      ?portfolio rumofa:investmentOf rumofa:MyUCITS ;
                 rumofa:total_asset_value ?inv_value .
    }
  }

  ?portfolio rumofa:investmentOf rumofa:MyUCITS ;
             rdf:type ?investment_type ;
             rumofa:total_asset_value ?investment_value ;
             rumofa:issuedBy ?issuer.

  FILTER (?investment_type IN (rumofa:Transferable_Security,
                               rumofa:Money_Market_Instrument, rumofa:Deposit,
                               rumofa:OTC_Derivative))
}
GROUP BY ?issuer ?total_value
HAVING ((SUM(?investment_value) / ?total_value) * 100 > 20)
```

2.2.7 Rule 7 - Art. 43(3)

Article 43(3) introduces two exceptions to Rule 1 and also a new rule.

The exceptions are represented with the following code:

```
    FILTER NOT EXISTS (
  ?issuer rumofa:MS_Guaranteed true ||
  ?issuer rdf:type rumofa:MemberStateEquivalent
)
```

Here is the simplified text of the first sentence of the third paragraph of Article 43, which corresponds to rule 7:

A UCITS shall not invest more than 35% of its assets in TS or MMI issued or guaranteed by a Member State

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rumofa: <http://www.semanticweb.org/marcello.ceci/ontologies/2024/6/rumofa#>
SELECT ?issuer (SUM(?investment_value) AS ?total_investment_value) ?total_value
               ((SUM(?i
WHERE {
{
SELECT (SUM(?investment_value) AS ?total_value)
WHERE {
```

```
?investment rumofa:investmentOf rumofa:MyUCITS ;
rumofa:total_asset_value ?investment_value .
}
}
?investment rumofa:total_asset_value ?investment_value ;
rdf:type ?type ;
rumofa:issuedBy ?issuer .
FILTER (?type IN (rumofa:Money_Market_Instrument, rumofa:Transferable_Security))
FILTER (
  ?issuer rumofa:MS_Guaranteed true ||
  ?issuer rdf:type rumofa:MemberStateEquivalent
)
GROUP BY ?issuer ?total_value
HAVING ((SUM(?investment_value) / ?total_value) * 100 > 35)
```

2.2.8   Rule 8 - Art. 43(4)

Article 43(4) introduces two exceptions to Rule 1 and new rules.

The exceptions are represented with the following code:

```
FILTER NOT EXISTS {
    ?type rdf:type rumofa:CoveredBond
  }
  FILTER NOT EXISTS {
    ?investment rumofa:issue_date ?issueDate .
    ?issuer rdf:type rumofa:CreditInstitution ;
           rumofa:prudential_supervision true ;
           rumofa:hasRegisteredOffice ?office .
    ?office rumofa:locatedIn ?country .
    ?country rdf:type rumofa:MemberState .
    FILTER (?issueDate < "2022-07-08"^^xsd:date)
  }
```

Here is the simplified text of the first sentence of the fourth paragraph of Article 43, which corresponds to rule 8:

A UCITS shall not invest more than 25% of its assets in covered bonds or bonds issued before 8 july 2022 by a credit institution which has its registered office in a Member State and is subject by law to special public supervision.

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rumofa: <http://www.semanticweb.org/marcello.ceci/ontologies/2024/6/rumofa#>
SELECT ?issuer (SUM(?investment_value) AS ?total_investment_value) ?total_value
             ((SUM(?i
WHERE {
{
```

```
SELECT (SUM(?investment_value) AS ?total_value)
WHERE {
?investment rumofa:investmentOf rumofa:MyUCITS ;
rumofa:total_asset_value ?investment_value .
}
}
?investment rumofa:total_asset_value ?investment_value ;
rdf:type ?type ;
rumofa:issuedBy ?issuer .
FILTER (?type IN (rumofa:Money_Market_Instrument, rumofa:Transferable_Security))
FILTER (
  ?type rdf:type rumofa:CoveredBond ||
  (
    ?investment rumofa:issue_date ?issueDate .
    ?issuer rdf:type rumofa:CreditInstitution ;
            rumofa:prudential_supervision true ;
            rumofa:hasRegisteredOffice ?office .
    ?office rumofa:locatedIn ?country .
    ?country rdf:type rumofa:MemberState .
    FILTER (?issueDate < "2022-07-08"^^xsd:date)
  )
)
GROUP BY ?issuer ?total_value
HAVING ((SUM(?investment_value) / ?total_value) * 100 > 25)
```

Rule X - Art. 43(4)

Here is the simplified text of the second sentence of the fourth paragraph of Article 43:

> sums deriving from the issue of bonds issued before 8 july 2022 by a credit institution which has its registered office in a Member State and is subject by law to special public supervision shall be invested in assets are covered and guaranteed.

Note that since this is not a portfolio composition rule, it is not intended to be verified at run-time and therefore it was not included in the present research.

2.2.9   Rule 9 - Art. 43(4)

Here is the simplified text of the third sentence of the fourth paragraph of Article 43, which corresponds to rule 9:

> The total value of the covered bonds or bonds issued before 8 july 2022 by a credit institution which has its registered office in a Member State and is subject by law to special public supervision on which a UCITS invests more than 5% on those coming from the same issuer, cannot exceed 80%.

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rumofa: <http://www.semanticweb.org/marcello.ceci/ontologies/2024/6/rumofa#>
SELECT (SUM(?total_investment_value) AS ?sum_investment_value) ?total_value
       ((SUM(?total
WHERE {
```

```
{
SELECT ?issuer (SUM(?investment_value) AS ?total_investment_value) ?total_value
WHERE {
{
SELECT (SUM(?inv_value) AS ?total_value)
WHERE {
?portfolio rumofa:investmentOf rumofa:MyUCITS ;
rumofa:total_asset_value ?inv_value .
}
}
?portfolio rumofa:investmentOf rumofa:MyUCITS ;
rdf:type ?investment_type ;
rumofa:total_asset_value ?investment_value ;
rumofa:issuedBy ?issuer.
FILTER (
  ?type rdf:type rumofa:CoveredBond ||
  (
    ?investment rumofa:issue_date ?issueDate .
    ?issuer rdf:type rumofa:CreditInstitution ;
            rumofa:prudential_supervision true ;
            rumofa:hasRegisteredOffice ?office .
    ?office rumofa:locatedIn ?country .
    ?country rdf:type rumofa:MemberState .
    FILTER (?issueDate < "2022-07-08"^^xsd:date)
  )
)
}
GROUP BY ?issuer ?total_value
HAVING ((SUM(?investment_value) / ?total_value) * 100 > 5)
}
}
GROUP BY ?total_value
HAVING ((SUM(?total_investment_value) / ?total_value) * 100 > 80)
```

2.2.10   Rule 10 - Art. 43(5)

Here is the simplified text of the second sentence of the fifth paragraph of Article 43, which corresponds to rule 10:

Investments in transferable securities or money market instruments issued by the same body or in deposits or derivative instruments made with this body shall not exceed in total 35% of the assets of the UCITS.

```
    PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rumofa: <http://www.semanticweb.org/marcello.ceci/ontologies/2024/6/rumofa#>
SELECT ?issuer (SUM(?investment_value) AS ?total_investment_value) ?total_value
                ((SUM(?i
```

```
WHERE {
{
SELECT (SUM(?investment_value) AS ?total_value)
WHERE {
?investment rumofa:investmentOf rumofa:MyUCITS ;
rumofa:total_asset_value ?investment_value .
}
}
?investment rumofa:total_asset_value ?investment_value ;
rdf:type ?type ;
rumofa:issuedBy ?issuer .
FILTER (?type IN (rumofa:Money_Market_Instrument, rumofa:Transferable_Security,
                  rumofa:Deposit, rumofa:OTC_Derivative))
GROUP BY ?issuer ?total_value
HAVING ((SUM(?investment_value) / ?total_value) * 100 > 35)
```

References

[1] Paolo Pareti and George Konstantinidis. *A Review of SHACL: From Data Validation to Schema Reasoning for RDF Graphs*, pages 115–144. Springer International Publishing, Cham, 2022.