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# Common asset holdings and systemic vulnerability across multiple types of financial institutions[1]

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## Overview

- **Fire sales of commonly held assets** are one way through which systemic risk can crystallise.

- Existing work focuses on vulnerabilities due to price mediated contagion (e.g., Greenwood et al. (2015), Cont and Schaanning (2016), Cont and Wagalath (2013)), and on portfolio similarity and diversification (Delpini et al. (2015), Getmansky et al. (2016)) of asset holdings between institutions of the same type.

- In this work, we are the first to combine **granular asset holding data** for UK banks, UK insurers and European open-ended investment funds to study diversification, overlaps in asset holdings, portfolio similarity and systemic vulnerabilities across **multiple types of financial institutions**.

Key questions

Questions that we seek to answer:

- What is the level of diversification of different types of financial
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- What is the level of diversification of different types of financial institutions?
- How big is the overlap in debt and equity security holdings of different types of institutions?
- What is the degree of similarity between financial institutions' portfolios?
- What are the implications for fire sale vulnerabilities?

## Data sources

**Data** as of Q1 2016:

- **Banks**: COREP Large Exposures (CRD IV reporting rules apply) and FINREP for 24 banks (regulatory data).
- **Insurance companies**: Solvency II (new regulatory data) for PRA regulated insurance companies not subject to exemptions; 139 solos and 52 groups in total.
- **Open-ended investment funds**: Morningstar (private data) representing the top 1260 open-ended funds (in terms of total assets) domiciled in Europe.

Granularity and scope of the analysis were driven by consideration of quality and completeness of the data available as well as theoretical basis.

## Data preparation

Building up from the most common granular level, through pre-processing and data cleansing it was possible to obtain a consistent dataset of debt and equity security holdings at issuer level across all three datasets.

**Coverage**:

|  | IC | B | F | Total |
|---|---|---|---|---|
| Number of FI | 139 | 24 | 1260 | 1423 |
| Tot debt holdings (£bn) | 643.7 | 1509.7 | 1100.9 | 3254.3 |
| Mapped debt holdings/ tot debt holdings | 0.90 | 0.86 | 0.73 | 0.82 |
| Tot equity holdings (£bn) | 582.8 | 68.6 | 925.3 | 1576.73 |
| Mapped equity holdings/ tot equity holdings | 0.81 | 0.93 | 0.78 | 0.80 |
| Total Assets* (£tr) | 1.6 | 6.5 | 10.2 | |

*UK insurance companies as of Q4 2015 from the Association of British Insurers; UK banks as of Q4 2015 from the PRA; European open-ended investment funds as of Q1 2016 from EFAMA.

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# Study of diversification

*Comparison of diversification estimated as degree in the network of common asset holdings and using a standard measure of diversification (HHI)*



- Debt holdings appear less diversified than equity holdings.
- All sectors appear far from full diversification.

- Investment funds seem to be almost fully diversified in their equity holdings.

# Analysis of overlaps in asset holdings

**Analysis of the network of common asset holdings**
Bipartite network following Delpini et al. (2015)

**Debt holdings**

**Equity holdings**



Vertices correspond to both financial institutions and securities. Vertex sizes represent total holdings (financial institutions) and total amount held (securities). Different colours correspond to different communities.

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# Quantifying overlaps in asset holdings

*Overlaps in asset holdings in terms of communities in the common asset holding network*

**Debt holdings** - **Communities**



**Equity holdings** - **Communities**



- Very large community both in terms of volumes and number of securities securities dominated by banks.

- Second largest community is composed by all other sectors.

- Remaining communities are dominated by funds or banks.

- 4 very large communities both in terms of volumes and number of securities. Investment funds and unit-linked insurance companies dominate these large communities.

# Portfolio similarity

**Analysis of the network of portfolio similarity**

Similarity defined following Getmansky et al. (2016).

Num of portfolios= 1464

**Debt**

Density= 0.29;
Sub-network densities:

|        | ICnonL | ICL  | B    | F    |
|--------|--------|------|------|------|
| ICnonL | 0.72   | 0.59 | 0.51 | 0.37 |
| ICL    |        | 0.58 | 0.46 | 0.31 |
| B      |        |      | 0.31 | 0.24 |
| F      |        |      |      | 0.26 |

**Equity**

Density=0.16;
Sub-network densities:

|        | ICnonL | ICL  | B    | F    |
|--------|--------|------|------|------|
| ICnonL | 0.05   | 0.20 | 0.05 | 0.09 |
| ICL    |        | 0.62 | 0.22 | 0.34 |
| B      |        |      | 0.03 | 0.07 |
| F      |        |      |      | 0.18 |

- **Some institution types are more similar than others**. Both unit-linked and non-unit linked insurance company debt holdings are very similar to debt holdings of other insurance companies, banks and investment funds. Unit-linked insurance company equity holdings are similar to those of other institution types.

# Liquidity and fire sale vulnerabilities



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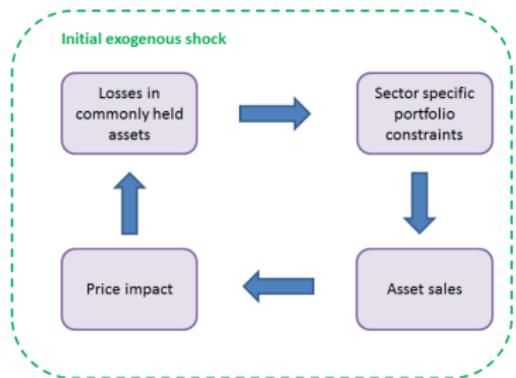
Simple assumptions (Cont and Wagalath (2013),Cont and Schaanning (2016)):

- 'proportional sales'
- linear price impact

$\Rightarrow$ second-round losses $\propto$ **liquidity weighted portfolio network**

**Stylised Portfolio**

| Asset class | IC (£bn) | B (£bn) | F (£bn) |
|---|---|---|---|
| Central Government bonds | 232.35 | 75.15 | 44.28 |
| General governments | 64.24 | 493.88 | 345.50 |
| Corporate bonds | 279.41 | 182.46 | 349.65 |
| Other bonds | 72.66 | 5.90 | 361.44 |
| Equity | 360.53 | 15.09 | 925.28 |
| Illiquid assets | 779.08 | 2838.4 | 199.7 |
| Cash | 61.19 | 391.12 | 249.54 |

# Liquidity and fire sale vulnerabilities

**Centrality measures**
average by institution type

|            | IC nonL | IC L  | B      | F     |
|------------|---------|-------|--------|-------|
| Overlap (£mn) | 0.31 | 0.29 | 0.81 | 0.24 |
| Holdings (£bn) | 18.65 | 43.98 | 171.95 | 12.89 |
| Eigenvector | 0.05 | 0.04 | 0.15 | 0.04 |
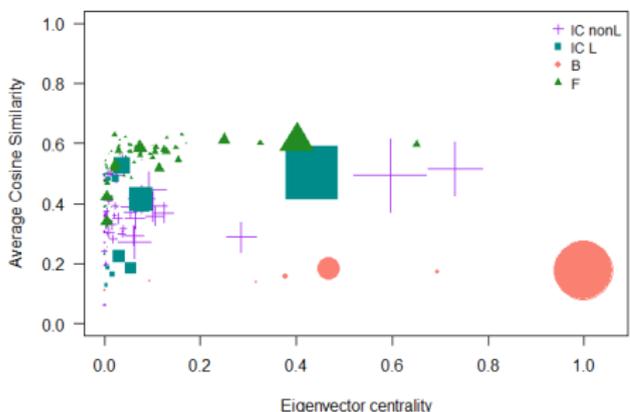


- Banks are the 'most central' institutions on average in the liquidity weighted portfolio network.

- Comparison of two indicators of fire sales vulnerabilities: average cosine similarity of Getmansky et al. (2016) and eigenvector centrality of Cont and Schaanning (2016).

- The two measures are complementary: average cosine similarity can be big for institutions with low eigenvector centrality, while eigenvector centrality assign relevance to big institutions.

# Key findings

Summary:

- Most financial institutions are far from complete diversification, only investment funds appear to be fully diversified in their equity holdings.

- There are large overlaps (communities) in debt and equity security holdings. Vulnerabilities might arise if overlapping securities were to be sold at discounted prices.

- Some institution types are more similar than others. Non-unit linked insurers have debt holdings more similar to all other institution types; unit-linked insurers have equity holdings more similar to all other institution types.

- When considering liquidity of assets and under simple assumptions in a fire sale framework, banks appear to be the most important ('central') on average.

- Both portfolio similarity and liquidity weighted portfolio overlap can be useful tools for understanding vulnerabilities due to fire sales.

References

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Annex

# Approach

- **Network of asset holdings**, in which one financial institution is 'linked' to a security if it holds it directly.

- **Network of portfolio similarity**, in which one financial institution is 'linked' to another financial institution if their securities portfolios are similar (in a well-defined way).

Both networks have two layers describing respectively debt and equity holdings.

## Methodology

- **Degree**: number of links attached to a given vertex.
- **Density**: number of existing links with respect to the number of all possible links.
- **Eigenvector centrality**: measure of the extent to which a vertex is connected to important vertices.
- **Communities**: clusters of vertices densely connected internally.
- **Herfindhal-Hirschman index (HHI)**: index of diversification of the portfolio of securities held by each financial institution, equal to 1 in absence of diversification and to $1/degree$ in case of full diversification

$$HHI_i = \sum_{k=1}^{K} \left( \frac{H_{ik}}{V_i} \right)^2.$$

where $H_{ik}$ represents holdings of security $k$ by $i$ and $V_i$ is total holdings of $i$.

# Pre-processing for asset holdings and portfolio similarity

Pre-processing I – Granular asset holdings
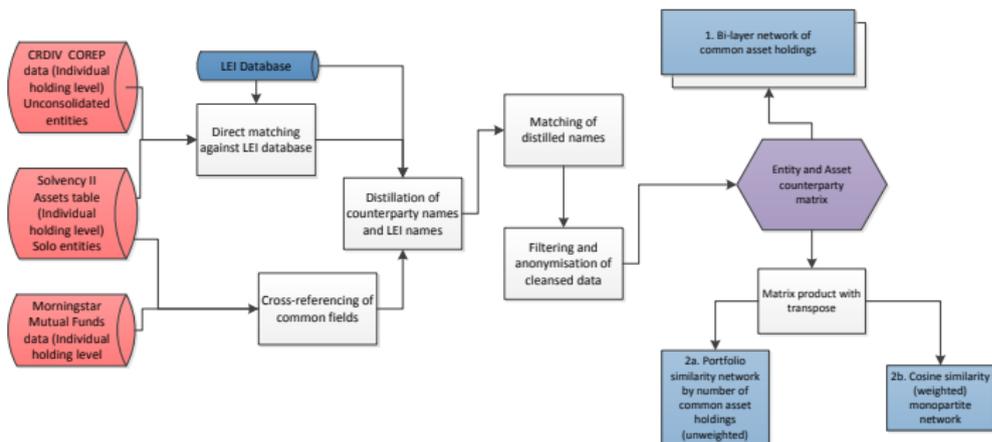
# Pre-processing for liquidity weighted network

Pre-processing II – Liquidity weighted portfolio similarity

# Portfolio Similarity

*Heatmap of portfolio similarity for the debt and equity holdings.*
Financial institutions are grouped by communities



**Centrality measures**
average by institution type

| | Debt | | | | Equity | | | |
|---|---|---|---|---|---|---|---|---|
| | ICnonL | ICL | B | F | ICnonL | ICL | B | F |
| Cosine Similarity | 0.07 | 0.05 | 0.03 | 0.04 | 0.01 | 0.02 | 0.00 | 0.02 |
| Holdings (£bn) | 2.76 | 4.74 | 53.97 | 0.64 | 0.53 | 9.67 | 2.66 | 0.57 |