

Macroprudential due-diligence framework for shadow banking entities

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Abstract

Addressing the need for greater transparency and control over the shadow banking system, this paper designs a macroprudential tool that serves to ensure greater financial stability through identifying and managing systemic risk posed by the shadow banking investment funds. In particular, the paper investigates potential crisis contagion channels within the shadow banking system by analysing the interconnectedness of the shadow banking investment funds and highlighting the links within the internal structures of the investment funds and securitisation vehicles, as well as external relationships with credit institutions. The paper proposes a due-diligence tool for monitoring and controlling the build-up of systemic risk posed by any shadow banking investment fund. This macroprudential tool serves as an early warning system against the growing systemic vulnerabilities of the shadow banking entities. Finally, the paper advises on efficient ways of sourcing, managing and reporting shadow banking data that ultimately address the issues of limited transparency of the shadow banking system.

Keywords: shadow banking, systemic risk, interconnectedness, due-diligence, investment funds

JEL: G01, G21, G24, G28

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1 Introduction

In the aftermath of the global financial crisis, the shadow banking system has undergone a rapid change in its composition to act as a buffer for the real economy (Adrian, Ashcraft 2012). The report of Nassr and Wehinger (2015) explains that the significant growth of the shadow banking system has been stimulated by the post-crisis phenomenon of credit disintermediation with a shift to market-based funding. According to Gola et al. (2017), more rigorous banking regulation also contributed to the expansion of the shadow banking system. However, the use of leverage, growth of maturity and liquidity mismatch as well as credit intermediation of the shadow banking entities create concerns regarding the vulnerabilities of the system. Recognising these concerns, European regulators enforced the shadow banking regime in January 2017 (Prorokowski 2017). The shadow banking regime is applicable to banks that have credit exposures to specific institutions deemed to be shadow banking entities. At this point, the impacted institutions are required to identify shadow banking clients and implement specific credit limits to such entities together with demonstrating sufficient knowledge of their clients.

In the ESRB Strategy Paper for 2016 (ESRB 2016), the European Systemic Risk Board points to the data and instruments gaps arising from the non-banking sectors and highlights the priority for extending the macroprudential policy over the shadow banking system in order to ensure financial stability. The need for greater control over the shadow banking entities was also put on the agenda by the ECB (2016), arguing that the expansion of the investment funds poses systemic risks arising from the funds' bank-like activities that need to be identified and monitored by regulators. However, due to the aforementioned data gaps and the interconnectedness of the shadow banking system, there is a need for a clear decision tree for identification and measurement of the risky shadow banking investment funds. This paper aims to address this need by the following:

Investigating potential crisis contagion channels with the shadow banking system and highlighting the issues centred on the interconnectedness: the paper provides practical insights into the problems of identifying interconnected investment funds and securitisation vehicles (SPVs).

Designing a framework for on-going monitoring and supervision of the systemically risky shadow banking entities: the paper introduces a macroprudential due-diligence tool for monitoring and mapping the risks of shadow banking investment funds.

Advising financial institutions and regulators on technological and data management solutions to address systemic risk posed by the shadow banking system and ensure adequate identification and monitoring of the shadow banking entities: the paper outlines the key features of an ideal technological solution for sourcing, managing and reporting shadow banking data, ensuring compliance with the shadow banking regime.

Advising regulators on ways of ensuring greater transparency of the shadow banking sector: the paper provides recommendations for macroprudential tools and policies to better understand the shadow banking system.

Summarising the aims of the paper, in a logical flow of designing a macroprudential due-diligence tool for shadow banking entities, the study first discusses the interconnectedness of the shadow banking system and shows how the shadow banking entities are linked to the core banking system. Hereto, the paper is limited to discussing issues revolving around the relationships of credit institutions with investment funds and special purpose vehicles. Given the umbrella structures of many funds,

interconnectedness is the key aspect of determining whether other sub-funds and investment managers are exposed to the shadow banking sub-fund. In the second step, the paper designs a due-diligence tool that flags the build-up of systemic vulnerabilities and financial risks that can spread across the interconnected shadow banking entities and through the contagion channels to the credit institutions. Having specified the due-diligence tool, the third step involves discussing adequate data management solutions that would serve as implementation platforms for the tool proposed in the paper.

The paper introduces several ideas related to the assessment of shadow banking entities and risk data management. Thus, individual sections of this paper can be treated as standalone contributions to the body of knowledge about the shadow banking system. The next section (Section 2) introduces the scope of the study that encompasses investment funds and securitisation vehicles (SPVs) as potentially systemically risky shadow banking entities that are linked to the core banking system. Section 3 shows how the shadow banking investment funds and SPVs are connected to credit institutions and points to the specific risk contagion channels. This section also describes the interconnectedness of the shadow banking entities by researching their structures, investment scope and legal frameworks. Section 4 introduces the due-diligence tool assessing the risk profiles of these entities and mapping the systemic vulnerabilities. This section also discusses the sources of information about the riskiness of shadow banking entities. Section 5 advises on the risk data management solutions in relation to the shadow banking system. This section offers high-level recommendations for the treatment of the shadow banking data that can benefit credit institutions, financial regulators and policymakers. Section 6 provides general conclusions summarising various contributions of this paper.

2 Scope of the study

There are different views on what constitutes the shadow banking universe. The recent research by Pellegrinia, Meolib and Urgac (2017) points to money market funds excluding other investment funds from the classification as shadow banking entities. The studies of Gennaioli, Shleifer and Vishny (2013) and Pozsar et al. (2012) regard securitisation vehicles (SPVs) as the systemically risky shadow banking entities that are interconnected with the banking system. Elliot, Golub and Jackson (2014) classifies the shadow banking system as an international debt cross-holding network that may cause systemic network failures. Reconciling the above studies, this paper classifies the shadow banking entities based on the European Banking Authority's guidelines (EBA 2015). Therefore, the paper treats both the investment funds and securitisation vehicles as potential shadow banking entities of increased systemic risk to the stability of the financial system.

Claessens and Ratnovski (2015) expand the scope of the shadow banking system to include institutions that offer banking products without access to central bank liquidity or credit guarantees (e.g. personal loan firms). The study adopts a broader definition of the shadow banking system to include credit institutions and investment firms from jurisdictions that do not apply prudential regulations, as these pose the risk of cross-border financial crisis contagion (Prorokowski 2013). This paper's definition is in line with the assumptions made by the FSB (2011a), which states that shadow banking entities are not regulated and fall outside the prudential requirements under the EU or EU-equivalent legislation.

As far as systemically risky shadow banking entities are concerned, the paper points to the special purpose vehicles and all investment funds with certain exemptions for qualifying Undertakings for Collective Investment in Transferable Securities (UCITS) and Alternative Investment Funds (AIF). As it transpires, reliance on short-term wholesale funding, maturity transformation, lack of transparency and operating with high leverage levels are the key characteristics of the investment funds (Doyle et al. 2016; BCBS 2014).

Summing up, the scope of this study is limited to the analysis of investment funds and securitisation vehicles as examples of systemically risky shadow banking entities.

3 Interconnectedness and contagion channels

A number of academics and practitioners (Claessens et al. 2012; FSB 2011b) argue that systemic risk is embedded in the interconnectedness of shadow banking entities and credit institutions, as well as within the links in the shadow banking system. Prorokowski (2017), Fisher (2015) and Bengtsson (2013) state that the interconnectedness is in a form of specific activities performed by the shadow banking entities, such as maturity transformation (investment funds) or securitisation (SPVs), which ultimately constitute the crisis contagion channels. The study of the ESRB (2017) points to the fact that the interconnectedness should be described from an EU bank's perspective, acknowledging the level of exposure to a shadow banking entity. This paper contributes to the study of the ESRB (2017) by providing insights into the links between the EU credit institutions and shadow banking entities. Furthermore, this paper complements the ESRB's existing study by analysing the interconnectedness beyond the individual exposure levels. In doing so, the paper provides additional input into the ESRB's questions on the shadow banking interconnectedness:

- which types of credit institutions are most exposed to shadow banking entities?
- what types of shadow banking entities are credit institutions exposed to?
- where are the shadow banking entities domiciled?

In addition, the extended analysis of the interconnectedness issues enables this paper to complement the ESRB's recent study by addressing the following questions:

- how are the shadow banking entities interconnected within the shadow banking system?
- what types of contagion channels exist from the shadow banking system?
- what technologies can be used to identify and monitor the shadow banking system?
- what data management solution can be used to increase the transparency of the shadow banking system?

Under the shadow banking regime, credit institutions are required to implement robust processes for determining the interconnectedness of shadow banking entities. The EBA's guidelines state that the processes should resolve any situation where the interconnectedness cannot be determined resulting in proposals for the mitigation actions (EBA 2015). Therefore, based on Article 4(45) of Directive 2006/48/EC, the paper suggests analysing the interconnectedness of the shadow banking system on two distinct levels. This is due to the fact that the shadow banking regime, pursuant to the CRR requirements, is an evolution of the large exposure regime (EBA 2016):

1) control relationship:

- credit institution has direct/indirect control over the shadow banking entity,

- shadow banking entity has control over other entities in a group;
- 2) economic relationship:
 - credit institution is affected by problems of the shadow banking entity (e.g. repayment difficulties),
 - shadow banking entity is affected by problems experienced by other entities in a group.

3.1 Investment funds

The starting point at measuring the interconnectedness of credit institutions to the shadow banking investment funds is to recognise institutions that are transacting with these entities. Since the paper is focused on the assessment of investment funds and SPVs, the paper specifically targets credit institutions whose clients consist of potential shadow banking entities. With this in mind, the study assumes that custodians providing alternative investment services, asset servicing, and depository and custody services for various funds are particularly exposed to investment funds that are identified as systemically risky shadow banking entities. In the case of custodians and depository banks, the exposure takes the form of intraday or overnight overdrafts granted to the serviced funds.

On a more granular level, this paper recognises that not all accounts of the shadow banking investment funds would serve as contagion channels to a custodian. With this in mind, the paper discusses the characteristics of common accounts of the funds serviced by credit institutions with an indication of their role as contagion channels for systemic risk posed by the shadow banking entities:

Expense accounts. Investment funds do not usually draw significant amounts of cash on these accounts, as they serve to cover minor expenses only. There is also no trading made through these accounts by the funds. Therefore, the credit institution's exposure to the funds' risk profiles is negligible in this case.

Collateral accounts. Financial instruments with trading limits are held in these accounts. Although a collateral-specific margin is applied, these accounts can serve as crisis contagion channels connecting the systemically risky shadow banking investment funds with credit institutions.

Subscription accounts. Cash moved to these accounts is irrevocable and owned by the specific trading account of an investment fund. There are also restrictions that prevent automatic overdrafts on these accounts. Thus, the overall exposure of the credit institution is minimised in this case.

Redemption accounts. Investment funds cannot make withdrawals or overdrafts on these accounts unless there has been cash moved from the trading accounts. Furthermore, cash on the subscription and redemption accounts is owned by the funds contributing to the liabilities of the funds. If the fund has no liquidity to cover specific cash demands by investors on these accounts, credit institutions are not concerned.

Managed accounts. There are various structures of these accounts and credit institutions have direct exposures to the shadow banking investment funds through the managed accounts.

Trading accounts. There are direct exposures to the shadow banking investment funds in the form of overdrafts and credit facilities. These accounts should be monitored at least on a daily basis (Alcarria et al. 2018) with the overdrafts being limited for the systemically risky shadow banking entities.

Having assessed the types of accounts as direct connections between credit institutions and investment funds, the paper argues that the analysis of the materiality of the interconnectedness

should be based on measuring the potential overdraft limits that are usually larger than the actual daylight credit extensions to investment funds. This argument is in line with the recommendations made by the EBA in the guidelines on setting the limits for shadow banking entities (EBA 2015). The paper proposes the following formula to calculate the materiality of systemic risk arising from shadow banking investment funds:

$$SR_i = \frac{\sum E_i}{C_j} \quad (1)$$

where SR denotes systemic risk posed by an investment fund i to the credit institution j expressed as a ratio of the sum of all potential overdrafts and credit lines E_i immediately available to the entity, and the eligible capital reported by the credit institution C_j under the Internal Capital Adequacy Assessment Process (ICAAP).

Thus, the formula is aligned to the EBA's guidelines on calculating limits on exposures to shadow banking entities (EBA 2015). The difference between the formula (1) and the EBA's guidelines relates to the fact that the paper views the strength of contagion through the prism of potential exposures rather than the actual credit facilities. This paper argues that looking at the potential increase in systemic risk better reflects a scenario of financial crisis contagion. According to the study of Prorokowski (2012) measuring spillover effects within a financial market caused by financial and economic shocks, in the event of a financial shock triggered either under the stressed or normal business conditions, an investment fund would draw on its available credit facilities and overdraft limits for liquidity purposes.

As far as the interconnectedness of investment funds within the shadow banking system is concerned, the paper sheds some explanatory light on the structure of umbrella funds. At this point, the paper argues that there is no interconnectedness where the sub-funds have limited liability against each other under the local corporate laws, despite sharing the same fund manager or administrator. Hereto, contractual segregation of the sub-funds is not sufficient to treat them as separate (not-connected) entities. Therefore, under the economic relationship, the sub-funds with the corporate limited liability and contractual segregation are not interconnected within the umbrella fund structure. Table 1 shows the interconnectedness aspects within the investment fund structures.

Additional interconnectedness issues within the umbrella structure relate to the master-feeder structure, where one sub-fund invests predominantly in another sub-fund. The paper argues that such investment funds should be viewed as interconnected on the economic relationship basis. This is due to the fact that one sub-fund assumes the risks of another sub-fund through direct investments. Furthermore, in the case where the feeder fund that is not identified as a shadow banking entity but invests significantly in the master fund that is classified as a shadow banking entity (e.g. due to high leverage and origination of loans), a question arises whether the feeder should also be flagged as a shadow banking entity. A working example of this case is the master-feeder structure of the BNY GLG EUR Alpha Blend fund presented in Table 2. A visual inspection of Table 2 informs how a feeder fund becomes a shadow banking entity through the interconnectedness with the master fund that, due to its activities, is classified as a shadow banking entity.

Summing up, crisis contagion can occur within the umbrella fund structure if there is no contractual and legal segregation of assets between the sub-funds. On the other hand, there is no interconnectedness and contagion between the fund manager and the investment fund, unless the

fund manager provides guarantees or any other form of economic relationship to the fund. Moreover, the crisis contagion within the investment fund structures can emerge in the master-feeder setup. At this point, the status of the feeder fund would change to 'shadow banking' if the master fund is involved in shadow banking activities (e.g. origination of loans by an AIF) or displays shadow banking characteristics (e.g. excessive leverage by an AIF).

3.2 Securitisation vehicles (SPVs)

Credit institutions providing a wide range of issuer and investor services are particularly exposed to SPVs. At this point, corporate trust services often involve large and complex deals connecting SPVs, investors and banks (Ashman 2000). According to Coval, Jurek and Stafford (2009), these deals have complicated transaction structures that involve SPVs as intermediaries providing asset repackaging, securitisation and channel services that reduce the overall clarity of systemic risks rooted in the activities of the SPVs.

This paper argues that the interconnectedness of SPVs can be captured on two distinct levels that have two different materiality outcomes for systemic risk. This is due to the fact that there is a number of SPVs linked to the parent company with each SPV having multiple series assigned to specific groups of assets. This paper suggests two approaches to measuring contagion channels of SPVs that are based on the following interconnectedness assumptions (Figure 1).

Undertaking level. EBA (2015) defines SPVs as undertakings carrying out credit intermediation activities. Since the EBA's emphasis is placed on the corporate status (see: "undertaking"), all series of a given SPV are treated as interconnected. Nonetheless, two different SPVs of the same parent would not be viewed as interconnected. This is due to the fact that the two SPVs would be separate undertakings that are ring-fenced and default-remote from each other, but only sharing the same parent without being consolidated in the banking group.

Asset level. SPV series can be viewed as separate undertakings that have crisis contagion links with each other. Under this assumption, the interconnectedness is linked to investing in the same assets by an SPV. This approach is appropriate for SPV series that, unlike the SPV, are not ring-fenced, consolidated and default-remote from each other.

Complementing Figure 1, it should be noted that, at the undertaking level, all series of SPV 1 are viewed as interconnected, as they are originated by the same SPV. At this point, despite being identified as shadow banking entities, SPV 1, SPV 2 and SPV 3 are not connected and do not have crisis contagion channels to each other because they are not consolidated in a banking group.

Under the asset level assumptions of interconnectedness, only Series 1 and Series 3 of SPV 1, as well as Series 1 of SPV 2 are regarded as interconnected, because of sharing the same assets. SPV 3, having individual and separate assets, would not be connected to SPV 1 and SPV 2. Furthermore, in contrast to the undertaking level assumptions, Series 2 of SPV 1 is treated as a separate entity with no crisis contagion channels to Series 1 and Series 3 of SPV 1.

4 Monitoring of the shadow banking system

This section introduces a due-diligence tool for monitoring the build-up of systemic risk embedded in the activities of shadow banking entities. The due-diligence framework is aligned to the ECB's guidelines on setting limits on exposures to the shadow banking system (EBA 2015) and involves the input of subject matter experts to identify the riskiness of specific activities displayed by shadow banking entities and to address the lack of data availability on the shadow banking system.

As indicated by the ECB (2013), there is limited data for the shadow banking entities to adequately assess and monitor systemic risk. In this context, the paper proposes a due-diligence framework that enhances the transparency of the shadow banking system. In particular, the proposed framework is designed from the perspective of an impacted credit institution that has exposures to shadow banking investment funds and SPVs.

The importance of monitoring the shadow banking system is underscored by the reports of the FSB (2015) and the EBA (2015), arguing that the shadow banking activities have direct and indirect links to the stability of the financial system by amplifying fluctuations in credit risk. This is explained by the high leverage levels of the shadow banking investment funds, which put the financial system at risk of rapid deleveraging. Addressing the need for a macroprudential monitoring tool of the shadow banking system to prevent the build-up of systemic risk, this paper introduces a detailed due-diligence tool with a scorecard model that can be adopted by any institution dealing with shadow banking entities.

The proposed tool, combined with the scorecard model, aims at flagging and mapping the build-up of systemic vulnerabilities and various financial risks posed by the shadow banking entities to the credit institutions and the financial system. The monitoring tool is designed to aid the assessment of shadow banking investments funds and SPVs. Therefore, the due-diligence framework is aligned to the EBA's guidelines on monitoring the shadow banking system, which require obtaining insights into the characteristics of the shadow banking entities specified below:

Regulatory oversight. It remains pivotal to understand the degree of regulatory oversight of the analysed shadow banking entities. Unregulated investment funds, for instance, are more likely to apply excessive leverage and launch unsustainable investment activities (Brown, Goetzmann 2003).

Financial strength. Analysing the financial viability is key to discerning whether a shadow banking entity can meet its debt commitments or continue its operations without disruptions.

Distressed assets. The main investment policy of some shadow banking funds and SPVs is to invest in distressed assets. Accumulating non-performing loans, bad bonds and illiquid assets contributes to the overall risk profile of a shadow banking entity.

Credit process. It is important to gain insights into the credit risk management processes employed by the analysed shadow banking entities. Shadow banking investment funds often lack control mechanisms that monitor the use of highly risky financial instruments (EBA 2015; Hsu, Li, Qin 2013). There are also evidenced failures in ensuring regular assessments of the underlying exposures by shadow banking entities that increases their systemic risk profile (ECB 2016).

Sensitivity. Shadow banking activities are characterised by an increased sensitivity to uncertainty and shocks propagated in the financial markets. Thus, it is important to identify shadow banking entities that are especially vulnerable to asset price or credit deterioration.

Credit intermediation. According to the FSB (2011) and Smaga (2014), credit intermediation without holding a banking license is the main source of systemic risk generated by shadow banking

entities. Thus, it remains key to establish the proportion of bank-like activities to other activities displayed by an analysed shadow banking entity.

Interconnectedness. As shown in the previous section, systemic risk is also embedded in the interconnectedness of the shadow banking entities. Thus, it is important to gain a broader picture of the group that includes the analysed shadow banking entity and other interconnected institutions.

Considering the aforementioned risk characteristics of the shadow banking investment funds and SPVs, Table 4 outlines the due-diligence tool for monitoring the overall systemic risk of a shadow banking entity. The monitoring tool has been designed for the systemically risky shadow banking entities, namely certain investment funds and SPVs that fall under the scope of this paper. The tool assigns risk points for the vulnerabilities in the key risk areas that propagate systemic risk across the financial system. The higher the score, the more systemically risky an entity becomes to the stability of the financial system. The risk points are summed up along the questionnaire tree of the due-diligence tool. Therefore, entities of different risk profiles obtain different scores that are translated into the risk scale using the following formula:

$$M_i = \frac{\sum X_n^i}{\max(X_n)} \quad (2)$$

The risk score M for an entity i is the sum of all risk points obtained from the n due-diligence questionnaire trees for the entity divided by the maximum score X_n that could be achieved by employing the due-diligence tool. Hereto, the denominator X_n equals 30 risk points as the maximum number of points that any assessed entity can achieve. The numerator is the actual number of points summed up from all decision trees, where n corresponds to the number of specific decision trees, and in this case $n = 7$ reflecting the distinct decision trees of the ‘regulatory oversight’, ‘financial strength’ etc. M_i takes a value from 0 to 1, where 0 indicates no systemic risk from shadow banking activities and 1 warns about a high degree of systemic risk posed by the entity with strong crisis contagion channels.

The individual risk points have been derived from the recommendations made by the panel of subject matter experts who formed a working group tasked with assigning specific risk points to each due-diligence question. As a result, each category of the due-diligence tool does not produce an equal amount of risk points, with the credit process, distressed assets and credit intermediation being the main drivers of the systemic risk build-up. The regulatory oversight and sensitivity have not been regarded by the subject matter experts as key risk areas that propagate systemic risk. This is due to the fact that the EU credit institutions are exposed to the shadow banking funds and SPVs that are domiciled within the European Union and indirectly regulated by the AIFMD or local regulations that meet the required prudential standards. At this point, it is worth noting that this paper analyses the systemic risk of shadow banking entities from the perspective of its impact on an EU financial market. The paper acknowledges that the risk points would be different for a non-EU region. Table 3 shows the details of the subject matter experts with an indication of their expertise in the field of risk management and shadow banking. To protect their personal data, all names have been assigned a unique code and the institutions of employment are only described by the indication of the type with no specific names provided.

Using the questionnaire tree outlined in Table 4 allows the paper to highlight the specific areas and characteristics of the shadow banking entities that are particularly risky. For instance, a UCITS

fund that is a money market fund would not pose significant systemic risk through the failures in the regulatory oversight, as the entity is sufficiently regulated by the UCITS Directive. However, the UCITS fund would propagate systemic risk by its bank-like activities (maturity transformation) and being interconnected under the large umbrella fund with other sub-funds.

For the regulatory oversight, it is important to find out the level of regulatory supervision for a given entity. At this point, the lack of investment restrictions or leverage limits pose significant systemic risk. Similarly, being not equivalently regulated to the prudential standards of the EU regulations allows for systemic risk to be freely propagated. Finally, the due-diligence also considers the frequency of regulatory reporting. The following documents are required for the due-diligence assessment of the regulatory oversight:

- Prospectus (investment fund): informs about the regulatory and authority jurisdiction;
- Annual report (parent/SPV): informs about the consolidation under the prudential regulations.

For the financial strength, it is important to have access to the latest financial statements. Shadow banking entities that do not produce financial statements are penalised for the lack of transparency. Furthermore, the due-diligence emphasises the importance of the audit and specific procedures in place to track leverage by an analysed shadow banking entity. Entities that produce audited financial statements either by themselves or by their parent companies should also have clearly defined liquidity management processes. The following documents are required for the due-diligence assessment of the financial strength:

- Annual report (parent/fund manager/SPV): provides information about the audit and risk mitigation processes, as well as informs about the ability to liquidate portfolio holdings;
- Prospectus (investment fund): informs about the procedures to track leverage, as well as the management solutions to track anticipated redemptions.

For the distressed assets, the starting point is to establish whether an entity invests or accumulates non-performing loans, as these are the primary drivers of defaults (Mommel, Gunduz, Raupach 2015). Then, in the next step of mapping systemic risk, the due-diligence tool reviews the entity's investments/portfolio for bad bonds, distressed assets priced at 20% below their initial values, highly risky equities and other assets that expose the entity to financial and economic shocks. The following documents are required for the due-diligence assessment of the distressed assets:

- Annual report (parent/fund manager/SPV): informs about the existence of non-performing loans and other distressed assets, as well as the portfolio composition.

For the credit process, it is important that clearly defined credit risk management processes exist within an entity. Shadow banking entities with automated credit systems that escalate breaches and monitor overdrafts are better shielded against credit deterioration. The due-diligence tool penalises entities whose credit risk teams have no representation at a senior level. Without the reporting lines to the board, credit risk cannot be adequately managed, which increases the overall riskiness of the shadow banking entity (Krivogorsky 2006). The following documents are required for the due-diligence assessment of the credit process:

- Credit risk policy document (investment fund/parent/SPV): presents the guidelines for monitoring and approving trading counterparties, credit exposures and investments.

For the sensitivity analysis, the due-diligence tool looks at the degree of correlation risk within the asset side of the balance sheet of an entity. In doing so, specific sensitivities to asset price volatility, credit deterioration and liquidity shocks are captured. It is also important that the entity does

not implement highly risky investment strategies that allow for a high degree of concentration or correlated risks. The following documents are required for the due-diligence assessment of the sensitivity:

- Annual report (parent/fund manager/SPV): informs about the portfolio composition;
- Prospectus (investment fund): provides insights into the investment strategies and other ways of accumulating permissible assets.

For the credit intermediation, it is important to see what shadow banking activities are the primary activities of an entity. Moreover, the due-diligence tool also investigates shadow banking characteristics (e.g. use of excessive leverage) that propagate systemic risk. The following documents are required for the due-diligence assessment of the credit intermediation:

- Key investor information document (investment fund): outlines the investment strategy and informs about the key activities of an entity;
- Prospectus (investment fund): informs about the leverage limits and borrowing policies of an entity;
- Annual report (parent/SPV): lists main activities of an entity.

For the interconnectedness, it is important to see the crisis contagion by investigating the size and systemic importance of the group to which an entity belongs (e.g. banking group, umbrella fund). The following documents are required for the due-diligence assessment of the interconnectedness:

- Annual report (parent/SPV): informs about the controlling interest in an entity of its parent and shows the size of the entire group;
- Prospectus (investment fund): informs about the umbrella fund structure and possible master-feeder relationships within the umbrella fund.

Summing up, this paper proposes three risk buckets for the overall score of an entity M_i . However, individual credit institutions and regulators are advised to modify the risk buckets to suit their needs of the desired level of conservatism. Furthermore, the impacted credit institutions are advised to use the due-diligence tool in order to gain detailed insights into specific risk areas of shadow banking entities. The paper argues that the classification of shadow banking entities into three risk buckets provides only a summary of their risk profiles to easily identify systemically risky entities. This classification should be always supported by the detailed risk analysis provided by the due-diligence tool. The proposed systemic risk categories derived from the due-diligence tool are presented in Figure 2.

As shown in Figure 2, the classification of the riskiness of a shadow banking entity is assigned to three basic risk buckets based on the final score M_i :

: overall, the entity does not pose significant systemic risk to a credit institution and the stability of the financial market;

: overall, the entity has vulnerabilities that can impact a credit institution and the stability of the financial market;

: overall, the entity poses significant systemic risk to the stability of the financial system.

5 Managing shadow banking data

This section advises on technological and data management solutions to address the systemic risk build-up identified by the application of the due-diligence tool and measurement of the interconnectedness

of the shadow banking system. Although the shadow banking system was found to undermine the stability of the financial market a decade ago (Pozsar 2008; Adrian, Shin 2009), the studies on technological solutions to identify, monitor and manage shadow banking entities are sparse. Therefore, this paper aims to address the existing scholarly gap by delivering practical solutions for aggregating, managing and reporting shadow banking data in order to empower regulators and credit institutions in their attempt to mitigate the systemic risk posed by the shadow banking system.

This paper acknowledges that there is no uniform way of monitoring the shadow banking system and different criteria for identifying shadow banking entities can be implemented across various regulatory jurisdictions. However, the study of Gorton and Metrick (2010) points to the fact that there are core principles associated with managing shadow banking data that all credit institutions should utilise.

This paper complements the study of Gorton and Metrick (2010) by arguing that credit institutions and regulators should be flexible enough to utilise the existing innovative technologies in their efforts to monitor the shadow banking system. Against this backdrop, the paper suggests the following high-level principles for handling the shadow banking data by impacted credit institutions and regulators:

Scope. According to the FSB (2016), an appropriate system-wide oversight framework should be established to map the systemic risk of shadow banking entities beyond investment funds and SPVs. For clarity, the paper follows the suggestions made by the FSB (2016) to narrow down the scope to those shadow banking entities that are involved in credit intermediation outside the core banking system. At minimum, credit institutions should be able to review all their clients and counterparties for shadow banking flags and perform the due-diligence on the systemically risky entities. In doing so, the paper advises credit institutions to embark on enterprise-wide credit monitoring systems.

Process. According to the FSB (2011), systemic risk posed by the shadow banking entities should be monitored on a regular basis. The paper backs this suggestions with an example stating that the portfolio composition of an investment fund can change over time to include distressed assets and increase the sensitivity of the fund to stock price volatility and credit deterioration. On the other hand, certain jurisdiction can be promoted to the regulatory equivalence status for investment firms making qualifying investment funds not shadow banking entities on the regulatory grounds.

Information. Credit institutions should be empowered by regulators to request relevant documentation from shadow banking entities in order to conduct due-diligence processes. Currently, a shadow banking client can refuse to provide information about its credit process (e.g. credit policy document) to the credit institution. With a view to increase the transparency of the shadow banking system, the regulatory perimeter should be extended to cover the minimum disclosure for the purpose of the shadow banking due-diligence. The principle of providing minimum information does not exert burden on the shadow banking entities. The paper agrees with the assumptions made by Hakkarainen (2014) that the shadow banking system should not be heavily regulated, in order to remain efficient in allocating resources to the real economy. However, the paper indicates room for improvement in increasing the transparency of the shadow banking system.

Collaboration. Building on the recommendations made by IOSCO (2010), Prorokowski (2013) and Allen et al. (2011) for international collaboration and mutual coordination of regulations, this paper argues that regulators from different jurisdictions should collaborate on sharing shadow banking data. This is especially important given the interconnectedness of the shadow banking systems that often spans different regulatory regimes. The report of IOSCO (2010) indicates that shadow banking

investment funds and SPVs operate across borders. Therefore, information exchange among regulators should be facilitated on a regular basis in order to capture the build-up of systemic risk and crisis contagion within the shadow banking system.

As far as the technological solutions for processing shadow banking information are concerned, there are several data management platforms that can be used by credit institutions to source, import, validate, aggregate and report the risk data from the shadow banking system. At this point, managing shadow banking data remains a challenge for credit institutions and regulators that do not introspect how risk data is organised and what execution capabilities are at their disposal (Prorokowski, Prorokowski 2015). There is an emergent need for an effective normalisation of the shadow banking metadata, so that analysis and reporting of systemic risk posed by the shadow banking entities is possible with meaningful results that allow for decisive actions (Royan 2014).

This paper argues that credit institutions and regulators will struggle to mitigate systemic risk posed by the shadow banking system if they do not utilise up-to-date technologies that allow for the shadow banking due-diligence to be conducted. Against this backdrop, the impacted credit institutions have a range of technological solutions at their disposal: from scalable enterprise data management platforms to open source solutions for managing Big Data.

Reviewing the broad range of existing technological tools for risk data management and reporting, this paper sets the minimum standards for any technological solution utilised to handle the shadow banking data. Therefore, credit institutions and regulators are empowered to make informed decisions about exposures to the shadow banking system by implementing more responsive and flexible tools. Figure 3 presents the main requirements for the technological solution that can be utilised to manage and report shadow banking risk data.

For global credit institutions with an international presence, shadow banking data is available from numerous sources that range from internal systems to external data providers and vendors. Furthermore, in the case of the shadow banking entities, the core risk data often includes non-risk data. To this end, the ideal technological solution should involve consolidating different datasets and reformatting, reorganising and adding value to the available information for risk management purposes (Prorokowski 2019). Thus, risk managers are provided with the ability to combine global analysis of disparate risk data to better view systemic risks at an operational level. However, to build a unified framework for risk data that eliminates the existing data silos and increases the overall consistency of risk management and supervision, credit institutions and regulators need to understand the aforementioned principles of handling the shadow banking data.

Summing up, it remains important that credit institutions and regulators approach the systemic risk mitigation starting with a revision of their shadow banking data capabilities. With this in mind, credit institutions and regulators should understand that the prevailing problems with addressing the build-up of systemic risk in the shadow banking system boil down to the lack of transparency and poor maintenance of the shadow banking data. In order to get the value out of the risk data and to gain insights into the riskiness of shadow banking entities, credit institutions are advised to invest in a solution that delivers fully audited work, and hence allows for a complete data lineage to be conducted. Furthermore, as shown in Figure 6, the ideal technological solution should support every stage of the data cycle from the data discovery to empowering end-users.

6 Conclusion

This paper investigates potential crisis contagion channels, showing how systemic risk can be spread within the shadow banking system and transmitted to the credit institutions. In doing so, this paper complements the study of the ESRB (2017) into mapping the interconnectedness between credit institutions and shadow banking entities by analysing the crisis contagion channels within the shadow banking system and investigating the links of credit institutions to systemically risky entities. This paper argues that certain investment funds and unconsolidated SPVs are systemically risky shadow banking entities to which custodians and credit institutions providing asset servicing are particularly exposed.

This paper sheds some explanatory light on the umbrella fund structures and the legal set-ups of investment funds, as well as the master-feeder structures as potential crisis contagion channels under the interconnectedness rule. The paper highlights the existence of two different levels of the crisis contagion for SPVs: the undertaking level and the asset level. Finally, the paper details the accounts that serve as the direct risk transmitting links between the shadow banking system and the credit institutions exposed to the systemically risky shadow banking entities.

Having defined clear shadow banking identification rules and provided insights into the interconnectedness of the shadow banking entities, this paper proposes a due-diligence tool that acts as a heat-map for monitoring the build-up of systemic risk arising from various characteristics and activities of the shadow banking entities. The proposed due-diligence tool addresses the problem of limited shadow banking data availability, and hence increases the transparency of the shadow banking system. In particular, the suggested due-diligence framework aids credit institutions and regulators in a process of mitigating systemic risk by becoming an early warning system and a macroprudential tool against specific risk concentrations displayed by the shadow banking entities.

Finally, the paper addresses the challenges of managing shadow banking data and capturing systemic risk accurately. The aspects of handling the shadow banking data are especially challenging due to the lack of transparency of the shadow banking system. Therefore, the paper delivers high-level principles of managing the shadow banking data that can be adopted by both the regulators and credit institutions in order to leverage the existing technologies to monitor the shadow banking system. In doing so, the paper outlines the key characteristics of a technological solution that can be employed to source, validate, manage and report the shadow banking data. The designed solution empowers regulators and credit institutions to make informed decisions about the systemic risk posed by the shadow banking entities.

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Appendix

Figure 1
Interconnectedness of SPVs

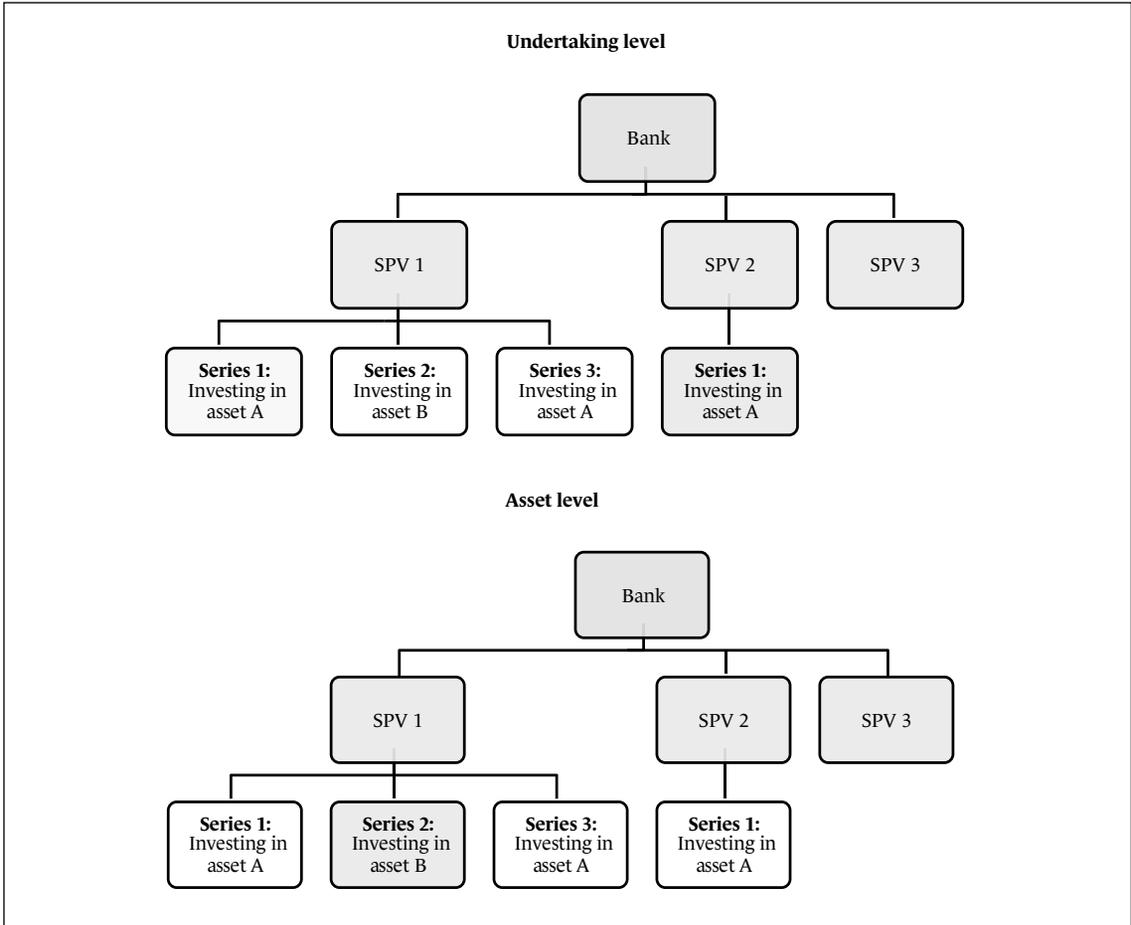


Figure 2
Risk buckets

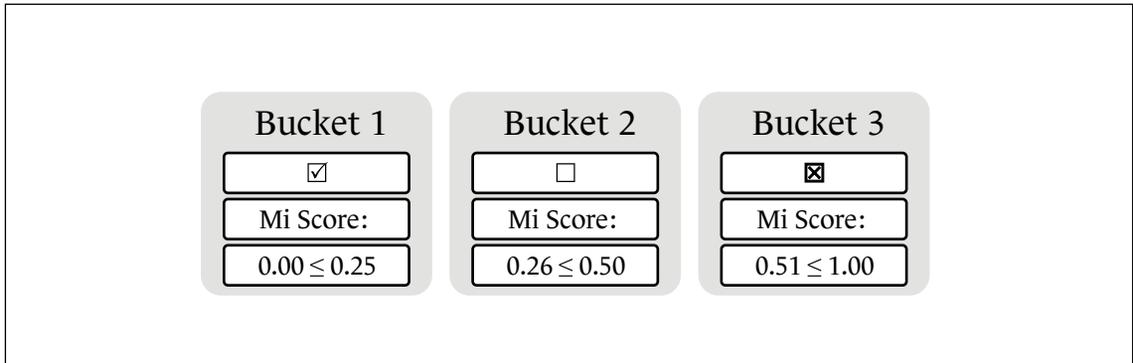


Figure 3
Technological solution for shadow banking data

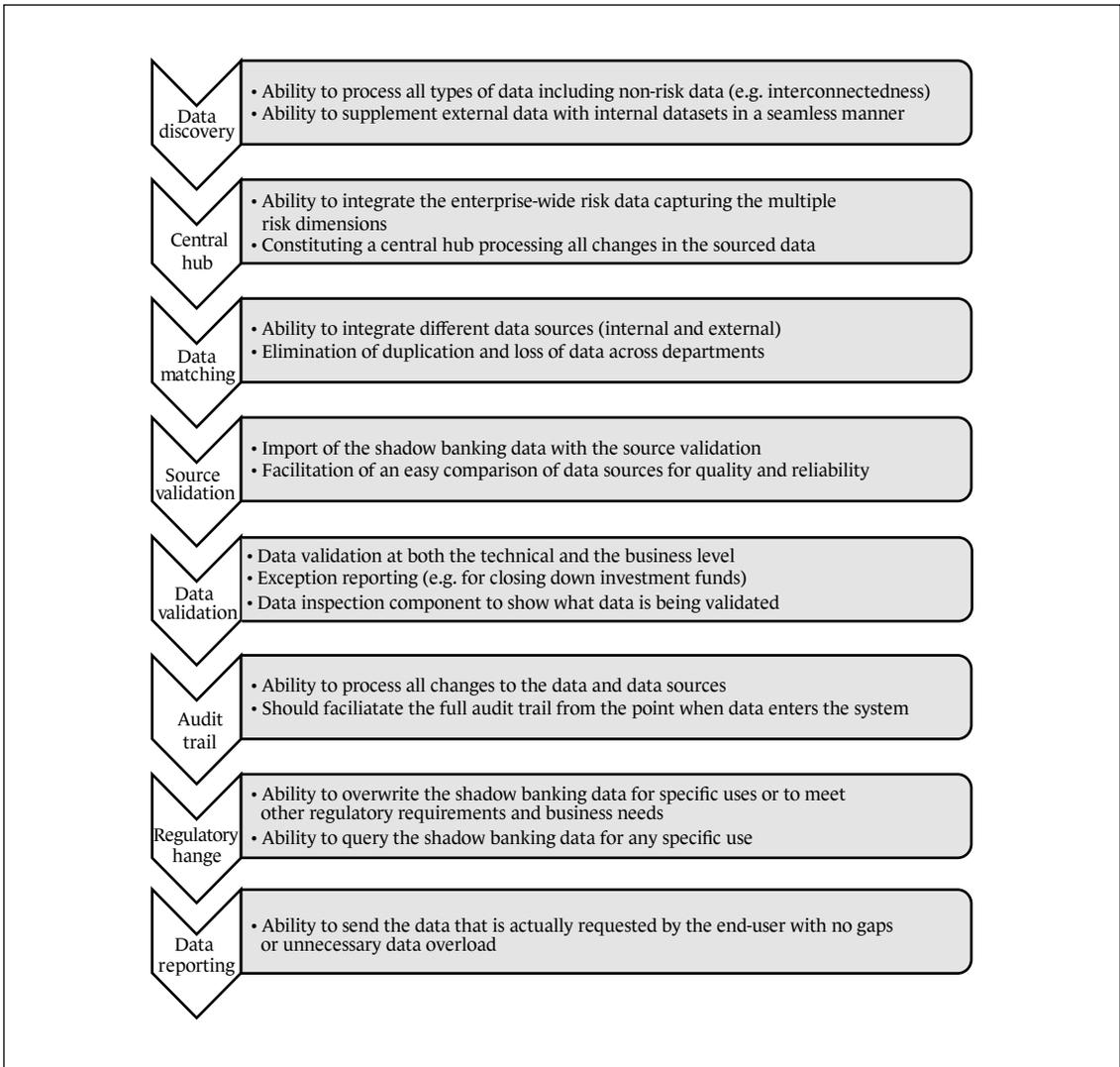


Table 1
Interconnectedness of investment funds

NO CONTRACTUAL SEGREGATION AND NO CORPORATE LIMITED LIABILITY				
Investment manager				
No connection				
Umbrella fund				
Connected	Connected	Connected	Connected	Connected
Sub-fund 1	Sub-fund 2	Sub-fund 3	Sub-fund 4	Sub-fund 5
CONTRACTUAL SEGREGATION AND NO CORPORATE LIMITED LIABILITY				
Investment manager				
No connection				
Umbrella fund				
Connected	Connected	Connected	Connected	Connected
Sub-fund 1	Sub-fund 2	Sub-fund 3	Sub-fund 4	Sub-fund 5
CONTRACTUAL SEGREGATION AND CORPORATE LIMITED LIABILITY				
Investment manager				
No connection				
Umbrella fund				
Not connected	Not connected	Not connected	Not connected	Not connected
Sub-fund 1	Sub-fund 2	Sub-fund 3	Sub-fund 4	Sub-fund 5

Table 2
Master-feeder structure

Not shadow banking entity	Initial fund classification ←	FEEDER FUND	Status change →	Shadow banking entity
		Investments in master fund ↓		↑ Interconnectedness and crisis contagion ↓
Shadow banking entity	Initial fund classification ←	MASTER FUND	Fund activities →	Shadow banking activities

Table 3
Subject matter experts (SMEs) panel

Expert	Gender	Institution	Domicile	Function	Expertise
SME-1	F	Tier-1 Custody bank	Europe	Regulatory oversight manager	Asset servicing
SME-2	F	Tier-1 Universal bank	Europe	Senior risk analyst	Credit risk
SME-3	M	Tier-1 Custody bank	Europe	Managing director	Operational credit risk
SME-4	F	Tier-1 Investment bank	Europe	Senior relationship manager	Investment funds
SME-5	F	University	Europe	Professor; team leader in the shadow banking project for the local central bank	Information systems and digital economy
SME-6	M	Global risk consultancy	Europe	Senior manager	Risk management
SME-7	M	Global risk consultancy	Europe	Regulatory change consultant	Credit risk; operational risk
SME-8	M	Central bank	Europe	PhD internship	FinTech; financial engineering
SME-9	M	Global risk consultancy	USA	Head of research	Shadow banking identification
SME-10	F	Tier-1 Universal bank	Europe	Regulatory reporting manager	Firm data submission framework

Table 4
Due-diligence tool for monitoring systemic risk

	Regulatory oversight
Is the entity regulated by the EU or EU-equivalent jurisdiction? YES = 0 →	NO = 3
Does the entity submit regular regulatory reports? YES = 0 →	NO = 1 → NO = 1 Does the entity submit ad hoc regulatory reporting? YES = 0 NO = 1
Does the entity have a high risk investment strategy? YES = 0	NO = 1
Financial strength	
Are the latest financial statements of the entity available? YES = 0 →	NO = 4 NO = 1.5 NO = 1.5
Are these financial statements audited? YES = 0 →	NO = 1 → YES = 0 Does the entity have systems or procedures to track its leverage? YES = 0 NO = 1.5 Does the entity have a liquidity risk management programme in place? YES = 0
Does the entity have systems or procedures to track its leverage? YES = 0 →	NO = 1

Table 4, cont'd

		Financial strength	
Does the entity have a liquidity risk management programme in place? YES = 0		NO = 1	
Distressed assets			
Does the entity have any non-performing loans? NO = 0 →	YES = 1 →	Is it the main strategy to invest in non-performing loans? NO = 0 →	YES = 0.5 → Continue to the next question on distressed assets
Does the entity have distressed assets?*	YES = 0.5 →	Is it the main strategy to invest in distressed assets? NO = 0 →	YES = 0.5 → Continue to the next question on bad bonds
Does the entity have bad bonds? NO = 0 →	YES = 0.5 →	Is it the main strategy to invest in bad bonds? NO = 0 →	YES = 0.5 → Continue to the next question on non-blue-chip equities
Does the entity have equities from non-blue-chip companies? NO = 0 →	YES = 0.5 →	Is it the main strategy to invest in non-blue-chip equities? NO = 0 →	YES = 0.5 → Are there any other risk concentrations in the portfolio of the entity? NO = 0
Is the entity exposed to the concentration risk due to the characteristics of its portfolio? NO = 0	YES = 0.5 →	Is there a concentration within the asset portfolio by a specific sector, asset type or geographic region? NO = 0	YES = 0.5

Table 4, cont'd

		Credit process	
Are there any credit risk management processes embedded within the entity or its manager in relation to asset portfolio? YES = 0 →	NO = 2 →	Continue to the next question on a set of specific credit risk or credit policies and procedures	
Is there a set of specific credit risk or credit policies and procedures? NO = 3 →	YES = 0 →	Does the entity have automated credit systems? YES = 0 →	NO = 0.5 → NO = 1.5
Continue to the question on a credit risk team with reporting lines to the board		Are credit breaches and overdrafts automatically monitored and escalated? YES = 0 →	NO = 0.5 → NO = 1
NO = 1		Is the use of high risk instruments automatically monitored and controlled? YES = 0 →	NO = 0.5 → NO = 0.5
Does credit or similar department have any representation at a senior level? YES = 0	NO = 1 ←	Is there a credit risk team with reporting lines to the board YES = 0 →	YES = 0 ← NO = 2

Table 4, cont'd

Credit process			
	Can this team decline counterparties or trades based on credit concerns?	NO = 1	
		YES = 0	
Sensitivity			
Is the entity particularly vulnerable to asset price volatility?	YES = 1 →	Is there a high degree of correlation risk within the asset side of the balance sheet? NO = 0 ↓	Does the entity have a high risk investment strategy? NO = 0
		YES = 1	YES = 1
Is the entity particularly vulnerable to credit deterioration?	YES = 1 →	Does the entity have a high risk investment strategy? NO = 0 ↓	
		YES = 1	
Does the entity have a high risk investment strategy?	YES = 1		
	NO = 0		
Credit intermediation			
Does the entity undertake bank like activities?	NO = 1 →	Is the entity employing excessive leverage? NO = 0	YES = 1
		YES = 1 ↓	
Is its maturity transformation?	NO = 0 →	Is it liquidity transformation? YES = 1 ↓	Is it credit risk transfer? NO = 0 →
			Is the entity employing excessive leverage? YES = 1

Table 4, cont'd

Credit intermediation			
Is it liquidity transformation? YES = 1 ↓	NO = 0 →	Is it credit risk transfer? YES = 1 ↓	NO = 0 → Is the entity employing excessive leverage? YES = 1 NO = 0
Is it credit risk transfer? YES = 1 ↓	NO = 0 →	Is the entity employing excessive leverage? YES = 1	NO = 0
Is the entity employing excessive leverage? YES = 1	NO = 0		
Interconnectedness			
Does the entity belong to a larger group under the interconnectedness rule?*** YES = 0.5 ↓	NO = 0 →	Is the entity connected to other shadow banking entities under the interconnectedness rule? NO = 0	YES = 0.5
Is this a large/significant group? YES = 1 ↓	NO = 0		
Is the entity connected to other shadow banking entities under the interconnectedness rule?*** NO = 0	YES = 0.5 →	Are the interconnected shadow banking entities correctly identified? YES = 0	NO = 1

* A distressed asset is priced 20% below its initial price as the issuer is expected to default on its obligations.

** The interconnectedness rule refers to the control relationship and economic relationship as described in Section 3.