# Asset Management and Systemic Risk*

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**Abstract**

The sweeping scope of global prudential reforms to address systemic risk touches areas and actors of the financial markets, such as asset managers, not previously perceived as systemically important and warrants detailed examination to shape adequate policies. In this paper, after an overview of the definition of systemic risk for banks and insurers, we examine the FSB-IOSCO proposal for an assessment methodology for the identification of non-bank non-insurance systemically important financial institutions (SIFIs). We compare how the methodology fairs empirically against what the literature and the 2007-2008 crisis reveal about the role of asset managers in contributing to systemic risk. We find the current proposal in part fails to identify natural candidates for the SIFI designation and perhaps confuses large institutions with systemically strategic institutions giving wealth loss greater weight over the potential for "real" economic disruption and market dislocation. Finally, we propose a more risk-sensitive approach to identifying SIFIs.

**Keywords:** Systemic risk, SIFI, asset managers, asset owners, interconnectedness, liquidity risk, reputational risk, business risk, counterparty credit risk, market risk, liquidation period, index funds, money market funds, exchange traded funds, hedge funds.

**JEL classification:** G01, G18, G23.

## 1 Introduction

The 2007-2008 financial crisis that precipitated the Great Recession can be seen as the superposition of the subprime crisis, affecting primarily the mortgage and credit derivative markets and by extension the global banking system, and a liquidity funding crisis following the demise of Lehman Brothers, which affected the credit market and more broadly the shadow banking system. The strength of this crisis led to government interventions around the world to prop up failing financial institutions, seen as "too big too fail" (for example, AIG's bailout by the U.S. government in late 2008), and eventually government debt markets (across Europe in particular). Public concern that mounted over the negative externalities

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of such interventions, and over the moral hazard and the disruption to market discipline created by these precedents[1] called pressingly for structural reforms to prevent whenever possible future similar events. The crisis further brought to light, among other key factors, the failure of regulation to keep up with the complexity of the activities of global banks and financial institutions. In particular, calls for prudential reforms were made around the world to create mechanisms to monitor, prevent and resolve the liquidation of financial institutions without the need for government intervention (e.g., Bernanke, 2008, 2009).

Consequently, a vast program of financial and institutional reforms was undertaken around the world. Significant changes to the prudential regulations of banks was agreed upon at the end of 2010 to strengthen banks' resilience in the face of sudden shocks. Crucially, Basel III introduced the idea of monitoring systemically important institutions. This idea was subsequently expanded to all financial institutions by the Financial Stability Board (FSB), an international oversight institution created in April 2009 to monitor the stability of the global financial system. In Europe, the Capital Requirements Directive implementing Basel III came into force in July 2013. In the U.S., the Federal Reserve announced in December 2011 that it would implement substantially all of Basel III rules, albeit with some differences. As of the end of 2014, most requirements of Basel III have come into force in the U.S. with a gradual implementation set to be completed by end of 2016. Reforms of the financial regulatory framework were also attempted around the world in order to protect the consumers and end financial bailouts. Thus, the Dodd-Frank act was signed into law in the U.S. in July 2010. In Europe, directives on the regulations of markets in financial instruments (MiFID 1 and 2) from 2007 to 2014 as well as regulations on packaged retail and insurance-based investment products (PRIIPS) with the introduction of the key information document (KID) in 2014 came to reinforce the regulation and transparency of financial markets and the protection of investors.

The 2007-2008 financial crisis also highlighted the increasing reliance of large firms and institutions on the shadow banking system, a broad range of short-term financing products and activities performed by non-bank actors in the financial markets and therefore historically not subject to the same regulatory supervision as banking activities. This expansion of the short-term credit market to non-bank entities shed light on the increasingly important role of non-bank institutions in the functioning of markets (as providers of essential services such as liquidity) and called for the inclusion of these companies in the set of systemically important institutions (FSB, 2010). In 2011, and again in 2013, the G20 nations tasked the FSB and the International Organization of Securities Commissions (IOSCO) with the development of an assessment methodology for non-bank non-insurance systemically important financial institutions (NBNI SIFIs) principled around the ideas that, first, identification of SIFIs is of overarching importance; and, second, that the principles governing identification should be broadly consistent with the indicator-based measurement approach developed for banks and insurance companies. Completion of these identification methodologies is expected for the end of 2015 (Phase 1). Subsequent steps involve the development of incremental policy measures to limit and address the systemic risk and the moral hazards created by these NBNI SIFIs (Phase 2). The final step (Phase 3) will consist in the creation of an International Oversight Group to conduct and oversee the constitution of the list of NBNI SIFIs on an ongoing yearly basis.

The combined FSB-IOSCO proposal for a methodology for the identification of NBNI-SIFIs in January 2014 and its revision in March 2015 expanded the idea of systemically

[1] Cf. in particular the American public outrage at the announcement of AIG's executives bonuses after the company was bailed out by the U.S. Federal Reserve.

important to several sectors of the financial landscape – including for example finance companies, market intermediaries (securities broker-dealers) and, of particular interest to us, asset managers and theirs funds. It must be pointed out that, first, the targeted sectors cover widely different business models and kinds of activities, each contributing in very different ways to the functioning of financial markets. Consequently, preserving a coherent approach to the identification of systemically important institutions is a tall order. Second, related to a general lack of understanding of these markets, in the case of systemically important asset managers or investment funds, the distinction is, as we will explain, perhaps artificial and certainly problematic when it comes to policy measures (such as capital requirements). While only concerned with identification at this stage, the kind and shape of the policies that will ultimately be implemented to address these issues can be tremendously important in defining what constitutes a systemically important institution[2]. For banks and insurers, one major tool to address systemic risk was the establishing of capital and liquidity requirements. One questions the feasibility of this approach for institutions such as asset managers or investment funds where there is on the one hand a clear distinction between the assets under management and the capital of the company and on the other hand no (or little) data on their activities. Certainly, one must discuss carefully, and with some empirical applications, what constitutes the best unit to address systemic risk in the asset management industry.

Finally, conversely to the banking sector, contagion and network effects in the asset management industry have not been described and studied in as much detail and are not as well understood. Yet, any incremental policy measure will likely change substantially the functioning of some of these markets and their actors on which academics and regulators alike have studied little. In particular, when one considers the range and breadth of financial instruments available to some investment funds, or the complexity of the strategies pursued by some asset managers, little is known of the importance of portfolio size compared to the possibilities of non-linear and threshold effects due to the strategic situation of the institutions involved. One should not simply assume as is the case for banks or insurers that size of an institution is an adequate proxy for the amplitude of risk created for the system. If one includes as part of the definition of systemic risk the possibility for disruption to the "real" economy and the dislocation of markets, then potential direct wealth loss may fade in importance besides the interconnectedness and substitutability of an institution. Unfortunately, while those characteristics grow somewhat with size, the effects first depend on the asset classes (if only for considerations of liquidity); and, second, the complexity of assessing the reach of these dimensions of systemic risk depends on the instruments used, and the spread to different markets on the way they are combined. This paper therefore contributes to bridging the gap in our understanding of the ways in which the asset management industry contributes globally to systemic risk. Importantly, it is a closer look at the definition of what constitutes a systemically important asset management entity. We hope thus to help shape adequate regulations to address the issue of systemic risk that we consider primordial.

The plan of this paper proceeds as follows. First, we discuss how systemic risk is defined and measured in section 2. In section 3, we look at the ways in which the asset management industry contributes to the transmission of systemic risk. We also succinctly review the March 2015 FSB-IOSCO proposal. In section 4, we look in more details at the asset management industry using empirical data for asset management companies and then breaking them down in the major types of investment funds (including mutual funds, money market funds, exchange traded funds, and hedge funds). In section 5, we discuss the viability and

[2] Or what contributes to systemic risk.

the adequacy of the FBS-IOSCO framework for the asset management industry in light of our empirical applications. We also propose an amended and more robust scoring system to improve on the FSB-IOSCO materiality threshold methodology.

# 2 Defining systemic risk

## 2.1 Systemic risk versus idiosyncratic risk

In financial theory, systemic and idiosyncratic risks are generally opposed. Systemic risk refers to the system whereas idiosyncratic risk refers to an entity of the system. For instance, the banking system may collapse, because many banks may be affected by a severe common risk factor and may default at the same time. In finance, we generally make the assumption that idiosyncratic and common risk factors are independent. However, there exists some situations where idiosyncratic risk may affect the system itself. It is the case of large institutions, for example the default of big banks. In this situation, systemic risk refers to the propagation of a single bank distressed risk to the other banks.

This distinction between common and idiosyncratic factors is present in the Basel III reforms. Indeed, the Basel Committee on Banking Supervision (BCBS) has introduced a countercyclical capital buffer in order to increase the capital of banks during excessive credit growth and to limit the impact of common factors on the systemic risk. This macroprudential approach is completed by a microprudential requirement on some specific banks, which are known as global systemically important banks (or G-SIBs).

G-SIBs are part of a larger group of institutions corresponding to systemically important financial institutions (or SIFIs). According to the Financial Stability Board (2010), SIFIs are institutions whose "*distress or disorderly failure, because of their size, complexity and systemic interconnectedness, would cause significant disruption to the wider financial system and economic activity*". By defining and monitoring SIFIs in a different way than other financial institutions, the objective of the supervisory authorities is obviously to address the "too big too fail" problem (FSB, 2013). FSB distinguishes between three types of G-SIFIs[3]:

1. G-SIBs correspond to global systemically important banks.
2. G-SIIs designate global systemically important insurers.
3. The third category is defined with respect to the two previous ones. It incorporates other SIFIs than banks and insurers (non-bank non-insurer global systemically important financial institutions or NBNI G-SIFIs).

In Appendix B on page 43, we provide the list of G-SIBs and G-SIIs published by FSB (2014). Lists of domestic SIFIs (D-SIBs) and SIIs (D-SIIs) are also available from national supervisory authorities.

## 2.2 Systemic risk measures of financial institutions

They are generally two ways of measuring the systemic risk of SIFIs. The first one is proposed by supervisors and considers firm-specific information that are linked to the systemic risk, such as the size or the leverage. The second approach has been extensively used by academics and considers market information to measure the impact of the firm-specific default on the entire system.

[3]FSB also makes the distinction between domestic (D-SIFI) and global (G-SIFI) SIFIs.

### 2.2.1 The supervisory approach

In order to measure the systemic risk of a bank, the Basel Committee considers 12 indicators across five large categories. For each indicator, the score of the bank (expressed in basis points) is equal to the bank's indicator value divided by the corresponding sample total[4]

$$\text{Indicator Score} = \frac{\text{Bank Indicator}}{\text{Sample Total}} \times 10^4$$

The indicator scores are then averaged to define the category scores and the final score. The scoring system is summarized in Table 1.

Table 1: Scoring system of G-SIBs

| | Category | Weight | | Indicator | Weight |
|---|---|---|---|---|---|
| 1 | Size | 1/5 | 1 | Total exposures | 1/5 |
| 2 | Interconnectedness | 1/5 | 2 | Intra-financial system assets | 1/15 |
| | | | 3 | Intra-financial system liabilities | 1/15 |
| | | | 4 | Securities outstanding | 1/15 |
| 3 | Substitutability/financial institution infrastructure | 1/5 | 5 | Payment activity | 1/15 |
| | | | 6 | Assets under custody | 1/15 |
| | | | 7 | Underwritten transactions in debt and equity markets | 1/15 |
| 4 | Complexity | 1/5 | 8 | Notional amount of OTC derivatives | 1/15 |
| | | | 9 | Trading and AFS securities | 1/15 |
| | | | 10 | Level 3 assets | 1/15 |
| 5 | Cross-jurisdictional activity | 1/5 | 11 | Cross-jurisdictional claims | 1/10 |
| | | | 12 | Cross-jurisdictional liabilities | 1/10 |

An example of the score computation is given in Table 14 in Appendix B. It concerns BNP Paribas, whose final score is equal to 407 bps. Depending on the score value, the bank is then assigned to a specific bucket, which is used to calculate its specific higher loss absorbency (HLA) requirement. The thresholds used to define the buckets are 530-629 for Bucket 5 (+3.5% CET1), 430-529 for Bucket 4 (+2.5% CET1), 330-429 for Bucket 3 (+2.0% CET1), 230-329 for Bucket 2 (+1.5% CET1) and 130-229 for Bucket 1 (+1.0% CET1). For instance, BNP Paribas belongs to Bucket 3, implying an additional buffer of 2% common equity tier 1. According to BCBS (2014), the two most systemically important banks are HSBC and JPMorgan Chase, which are assigned to Bucket 4. They are followed by Barclays, BNP Paribas, Citigroup and Deutsche Bank[5].

**Remark 1** *The Basel Committee considers a relative measure of the systemic risk. It first selects the universe of the 75 largest banks and then defines a G-SIB as a bank which has a total score which is higher than the average score[6]. This procedure ensures that there are always systemic banks. Indeed, if the score are normally distributed, the number of systemic banks is half the number of banks in the universe. This explains that the Basel Committee found 30 G-SIBs among 75 banks.*

In the case of insurers, the International Association of Insurance Supervisors (IAIS) has developed an approach similar to the Basel Committee's to measure global systemically

[4]The sample consists of the largest 75 banks defined by the Basel III leverage ratio exposure measure.

[5]See Table 12 on page 43 for the comprehensive list of G-SIBs.

[6]It is equal to $10^4/75 \simeq 133$.

important insurers (or G-SIIs). The final score is an average of five category scores: size, interconnectedness, substitutability, non-traditional and non-insurance activities and global activity. The list of G-SIIs is given in Table 13 on page 44.

### 2.2.2 The academic approach

Academics propose various methods to measure the systemic risk (Bisias *et al.*, 2012). Even if they are heterogenous, most of them share a common pattern. They are generally based on publicly market data[7]. Among these different approaches, two prominent measures are particularly popular[8]:

- The marginal expected shortfall (MES) of Acharya *et al.* (2010).
- The delta conditional value-at-risk ($\Delta$ CoVaR) of Adrian and Brunnermeier (2011).

**MES** Let $x_i$ and $L_i$ be the exposure of the system to the bank $i$ and the corresponding random loss. We note $x = (x_1, \ldots, x_n)$ the vector of exposures. The loss of the system is equal to

$$L(x) = \sum_{i=1}^{n} x_i L_i$$

The expected shortfall $\mathrm{ES}_\alpha(x)$ with confidence level $\alpha$ is the expected loss conditional that the loss is higher than the value-at-risk $\mathrm{VaR}_\alpha(x)$

$$\mathrm{ES}_\alpha(x) = \mathbb{E}\left[L \mid L \geq \mathrm{VaR}_\alpha(x)\right]$$

Tasche (2002) shows that the expected shortfall is a convex risk measure meaning that we can decompose this risk measure as a sum of the exposure times the marginal expected shortfall

$$\mathrm{ES}_\alpha(x) = \sum_{i=1}^{n} x_i \frac{\partial\, \mathrm{ES}_\alpha(x)}{\partial\, x_i}$$

Tasche (2002) also demonstrates that

$$\mathrm{MES}_\alpha(i) = \frac{\partial\, \mathrm{ES}_\alpha(x)}{\partial\, x_i} = \mathbb{E}\left[L_i \mid L \geq \mathrm{VaR}_\alpha(x)\right]$$

**$\Delta$ CoVaR** The CoVaR corresponds to the VaR of the system conditional on some event $\mathcal{E}_i$ of bank $i$

$$\Pr\left\{L(x) \geq \mathrm{CoVaR}_\alpha(\mathcal{E}_i) \mid \mathcal{E}_i\right\} = \alpha$$

Adrian and Brunnermeier (2011) define the risk contribution of bank $i$ as the difference between the CoVaR conditional on the bank being in distressed situation and the CoVaR conditional on the bank being in normal situation

$$\Delta\,\mathrm{CoVaR}_\alpha(i) = \mathrm{CoVaR}_\alpha(\mathcal{D}_i = 1) - \mathrm{CoVaR}_\alpha(\mathcal{D}_i = 0)$$

where $\mathcal{D}_i$ indicates if the bank is in distressed situation or not. Adrian and Brunnermeier (2011) use the value-at-risk to characterize the distress situation

$$\mathcal{D}_i = 1 \Leftrightarrow L_i = \mathrm{VaR}_\alpha(L_i)$$

[7]The reason is that academics do not have access to regulatory or private data.

[8]Other approaches include the systemic risk measure (SRISK) of Brownlees and Engle (2012), the marginal contribution to the distress insurance premium (Huang *at al.*, 2012), etc.

whereas the normal situation corresponds to the case when the loss of the bank is equal to its median

$$\mathcal{D}_i = 0 \Leftrightarrow L_i = m\left(L_i\right)$$

Finally, we obtain

$$\Delta\,\mathrm{CoVaR}_\alpha\left(i\right) = \mathrm{CoVaR}_\alpha\left(L_i = \mathrm{VaR}_\alpha\left(L_i\right)\right) - \mathrm{CoVaR}_\alpha\left(L_i = m\left(L_i\right)\right)$$

In practice, losses are approximated by stock returns. Empirical results show that the two previous systemic risk measures may give different rankings (Benoit *et al.*, 2011). This can be easily explained in the Gaussian case. Indeed, measuring systemic risk with MES is equivalent to analyze the beta of each bank whereas the CoVaR approach consists of ranking banks by their beta divided by their volatility. If the betas are very close, the CoVaR ranking will be highly sensitive to the volatility of the bank's stock.

## 2.3 The multifaceted nature of systemic risk

The supervisory and academic approaches have the same goal, namely to measure the interconnectedness between a single entity and the system[9]. This is the objective of the MES and CoVaR academic measures, but also the aim of the different categories of the supervisory approach. For instance, we here report the average rank correlation (in %) between the five categories for the G-SIBs as of End 2013[10]:

$$\begin{pmatrix} 100.0 & & & & \\ 84.6 & 100.0 & & & \\ 77.7 & 63.3 & 100.0 & & \\ 91.5 & 94.5 & 70.1 & 100.0 & \\ 91.4 & 90.6 & 84.2 & 95.2 & 100.0 \end{pmatrix}$$

In particular, notice the high correlation coefficients between the first, second, fourth and fifth categories. However, even if these categories are related, it is obvious that no single measure can satisfactorily capture the whole picture of systemic risk.

Furthermore, the third and fourth categories are particularly interesting since:

- the substitutability category implies that the strategic function of a single entity in the financial landscape is another component of systemic risk;
- and the complexity category attempts to complement the size measure by accounting for the riskiness of the exposures.

In fact, the high correlation between the five measures masks the multifaced reality of systemic risk. This is explained by the homogeneous nature of global systemically important banks in terms of their business model. Indeed, almost all these financial institutions are universal banks mixing both commercial and investment banking.

[9]It is no coincidence that the survey paper of Billio *et al.* (2012) is entitled "*Econometric Measures of Connectedness and Systemic Risk in the Finance and Insurance Sectors*".

[10]Data are available on the following web site: `https://www.ffiec.gov/nicpubweb/nicweb/Y15SnapShot.aspx`.

## 3 How is asset management related to systemic risk?

The asset management industry is essentially a service industry providing its investors access for a fee to professional investment management. Asset managers enable their customers to participate in markets in which they would not otherwise participate in, or at least not to the same extent, by providing access to expertise and opportunities that would otherwise remain the privilege of a few. Most asset managers are able to perform that service by taking advantage of economies-of-scale that come from:

1. pulling assets from many investors together;
2. sharing some essential "back office" or research functions between several managers.

The idea that the asset management industry can be a channel for systemic distress is new. Indeed, systemic risk is generally associated with banks and insurers because of their maturity transformation activities. As a result, banks and insurance companies face market, credit, operational and liquidity risks to their own account. Conversely, asset managers provide investment services as fiduciary agents for their clients. Hence, asset managers do not own most of the assets they manage[11]. Any financial risk associated with the investment of assets is thus borne by the client and not the asset manager. Hence, theoretically, asset managers do not face the same risks as banks and insurers except for operational risks. Moreover, the separation between the custody and the management of assets protect investors from the risk of default of the asset manager. The distinctions between own and third-party accounts and between principal and fiduciary agent are critical to understand the current regulatory proposal by the Financial Stability Board (FSB) and the International Organization of Securities Commissions (IOSCO) since they represent core differences in the roles played by asset managers and investment funds in the transmission of systemic risk.

While one could argue over the merits of the services provided by the asset management industry for the overall financial system and society at large, it appears that, at first glance, the asset management industry does not partake in two of the major channels of transmission of systemic risk, namely: the exposure/counterparty channel and the asset liquidation/market channel. Nonetheless, one must acknowledge that the links and opportunities created by the activities of asset managers (through the running of their funds) can potentially become a functional source of systemic risk. This functional source of systemic risk will arise whenever cessation of activity by an asset manager can disrupt significantly the financial system. One example of this source of risk runs parallel to the "suspension of convertibility" mechanism that has been discussed by academics as a possible deterrent to runs, either on a bank or on a fund[12]. It is in this instance intrinsically connected to a fund's redemption risk, and can be considered the system-wide equivalent to a fund's redemption risk. Another example would be how some funds can come to play such an important role in the functioning of specific markets that there is no possible substitute to the funds in order to keep the market running. In this instance, the functional source of systemic risk is connected to the liquidity risk of the assets in the market. It will be exacerbated and amplified for the whole system by the interconnectedness of the fund with the rest of the financial system.

In practice, however, not all financial risks are borne by the asset manager' clients. Because of its fiduciary obligation, the asset manager is also exposed to some financial

[11] In some particular cases, especially for alternative investment products such as hedge funds, the manager may invest some of her own money in the portfolio she manages, but it rarely represents the majority of the wealth in the portfolio.

[12] E.g., Diamond and Dybvig (1983) and Wermers (1999).

risks, in particular counterparty, credit and liquidity risks. A key question is whether the individual risks faced by a single asset management institution can become systemic because of the function performed by specific managers and crucially what unit of measure should be used to assess this possibility: funds, family of funds, asset managers or funds and their asset managers combined.

In the following, we succinctly review a brief history of financial institutions' failures and look at the roles the asset management industry played in these events. We then further discuss the role of asset management in becoming a source of systemic risk along each of its recognized transmission channel.

## 3.1 Asset management and financial crises

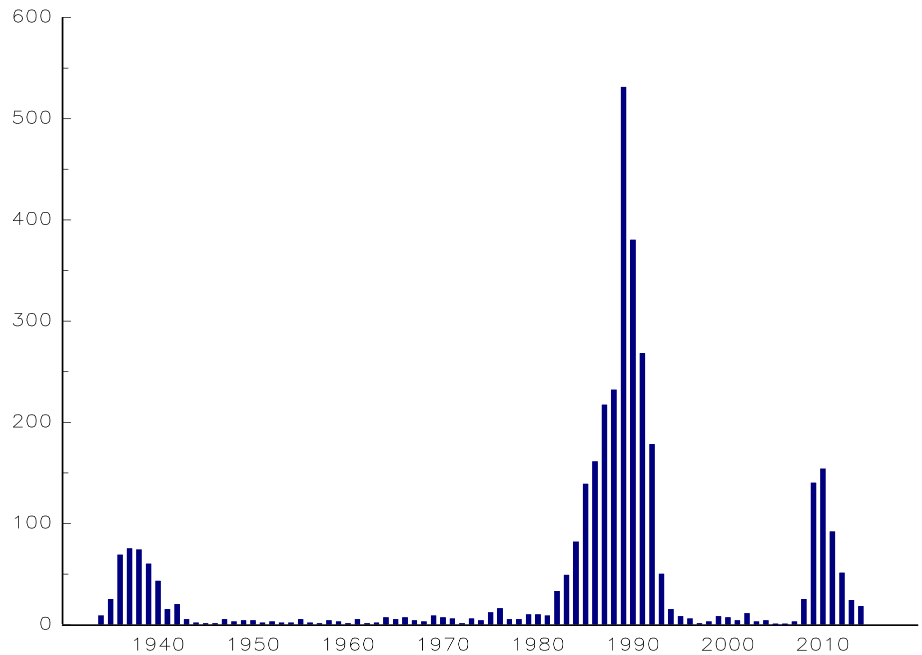
In the financial sector, the list of bankruptcies is long including, for example: Barings Bank (1995); HIH Insurance (2001); Conseco (2002); Bear Stearns (2008), Lehman Brothers (2008); Washington Mutual (2008); DSB Bank (2008). The number of banking and insurance distresses is even more impressive, for example: Northern Rock (2007); Countrywide Financial (2008); Indy Mac Bank (2008); Fannie Mae/Freddie Mac (2008); Merrill Lynch (2008); AIG (2008); Wachovia (2008); Depfa Bank (2008); Fortis (2009); Icelandic banks (2008-2010); Dexia (2011). In Figure 1, we report the number of bank failures computed by the Federal Deposit Insurance Corporation (FDIC), the organization in charge of insuring depositors in the US. We can clearly identify three periods of massive defaults: 1930-1940, 1980-1994 and 2008-2014. Each period corresponds to a banking crisis[13] and lasts long because of delayed effects. Whereas the 1995-2007 period is characterized by a low default rate, with no default in 2005–2006, there is a significant number of bank defaults these last years (517 defaults since 2008).

While the interconnection between the banking system and financial crises is well documented (Reinhart and Rogoff, 2009), the same cannot be said for the asset management industry. There are few studies on its role in financial crises. Moreover, existing studies generally focus on hedge funds and do not address the role of the entire asset management industry.

A typical example is the study of the 1998 LTCM crisis (Jorion, 2000). LTCM was a successful US hedge fund founded in 1994 by John W. Meriwether. It was specialized in long/short arbitrage on instruments that are not highly liquid. In order to achieve very good performance[14], the fund took leveraged positions. At the beginning of 1998, its assets under management and overall exposure totaled about USD 5 and 125 billion respectively, representing a leverage ratio of 25. LTCM's most substantial bets concerned convergence and carry strategies, in which the long exposure is generally riskier than the short exposure in order to capture a risk premium due to liquidity or credit risk. This type of strategies generates good performance in normal regimes, but is particularly risky in a flight-to-quality environment. That is exactly what happened during the East Asian and Russian financial crises in 1997 and 1998. In the end, the Federal Reserve Bank of New York organized LTCM's bailout in September of 1998 with the contributions of 14 banks. The LTCM story is not an isolated one. Other examples include: the large losses of the Tiger and Soros Funds during the Internet bubble (Brunnermeier and Nagel, 2004; Ferguson and Laster, 2007); the implosion of Amaranth Advisors in 2006 (Stulz, 2007); and the Madoff Fraud in 2009 (Clauss *et al.*, 2009).

[13] They are the Great Depression, the savings and loan crisis of the 1980s and the subprime crisis.
[14] Net performance was 20% in 1994, 43% in 1995, 41% in 1996 and 17% in 1997.

Figure 1: Number of bank defaults in the US




*Source*: Federal Deposit Insurance Corporation (2014), Historical Statistics on Banking – Failures & Assistance Transactions, `https://www.fdic.gov/bank/individual/failed/`.

These major events all concern hedge funds. In the case of mutual funds, there are few situations of stress, except during the subprime crisis (Calomiris, 2009). During 2007-2008 financial crisis, money market funds (MMF) were notably impacted, forcing some unprecedented measures. For instance, European asset managers belonging to banking or insurance groups were given support to manage the liquidity of these money market and credit funds by their parent company which in some instances absorbed the losses incurred by these funds. Another exceptional measure was the temporary guarantee the U.S. Treasury provided to money market funds against losses:

> "*Following the bankruptcy of Lehman Brothers in 2008, a well-known fund – the Reserve Primary Fund – suffered a run due to its holdings of Lehman's commercial paper. This run quickly spread to other funds, triggering investors' redemptions of more than USD* 300 *billion within a few days of Lehman's bankruptcy. Its consequences appeared so dire to financial stability that the U.S. government decided to intervene by providing unlimited deposit insurance to all money market fund deposits. The intervention was successful in stopping the run but it transferred the entire risk of the USD* 3 *trillion money market fund industry to the government*" (Kacperczyk and Schnabl, 2013).

Collectively, these episodes show that even if the impact of the asset management industry on financial crises cannot be compared to the impact of the banking industry, some questions are worth investigating. These questions can be organized around three transmission channels that have been identified in the literature. In the following section, we

discuss these channels and the role the asset management industry can inadvertently play in promoting the spread of risk.

## 3.2 Transmission channels of systemic risk and the role of the asset management industry

Academics and regulators have identified three major types of systemic risk associated with different transmission channels: exposures/counterparty channel (linked to counterparty and credit risks and network effects), asset liquidation/market channel (linked to liquidity risk and market effects), critical function or service/substitutability channel (and its connection with reputational risk). These sources of risk and channels are often activated simultaneously by systemic shocks, albeit to different levels and to different extents. It is the interplay between these that make measuring systemic risk comprehensively extremely difficult. We use the LTCM and MMF stories and other well known examples of systemic shocks to illustrate how the asset management industry can contribute to systemic risk.

First, it is worth remembering that, as fiduciary agents, the asset managers' impact on general market returns is indirect, at least from a theoretical point of view. Indeed, financial markets are more influenced by investors' decisions, such as redemptions and subscriptions, and their risk appetite than by the decisions made by the asset managers. Nonetheless, market returns are also directly influenced by the security picking, allocation methods and strategies defined by asset managers. However, it is difficult to establish a direct link between these and systemic risk, except perhaps for strategies.

### 3.2.1 Exposures/counterparty channel

Network effects stem from the interconnectedness of financial institutions and can be seen as the system-wide counterpart of an institution's counterparty risk. Network effect is a general term describing the transmission of a systemic shock from one particular entity and market to several entities or markets. In the case of LTCM, systemic risk stemmed from the interconnection between LTCM and the banking system combined with the high leverage strategy pursued by the hedge fund thereby creating an over sized exposure for the banking system to counterparty credit risk from one single entity. Hence, LTCM's idiosyncratic risk was transferred to the entire financial system and became a source of systemic risk. More generally, however, the default of an asset manager affects not only its counterparts, but also its investors — asset management firms act as a link between participants (cf. "functional effect" below).

The early and influential work of Allen and Gale (2000) showed that this source of financial contagion is highly contingent on the network's structure and on the size of the shock[15]. Inasmuch as asset managers are part and fabric of the financial network, they therefore directly impact systemic risk. Nonetheless, the magnitude and the saliency of this transmission channel depends on the kind of investment fund involved. For instance, in the case of long-only mutual funds, an investor will retrieve her assets because of separation between portfolio management and asset custody. In the case of other funds, such as for example some hedge funds, an investor may loose a large part of her wealth.

[15] Allen and Gale's (2000) model suggests that a fully connected network might be more resilient than an incomplete network, contradicting the idea that systemic risk increases with average interconnectedness. However, interconnectedness of an individual entity is central to the notion of it being "systemically important"(e.g. Cont *et al.*, 2013). Furthermore, echoing several academic researchers, Janet Yellen, current Chair of the Board of Governors of the U.S. Federal Reserve System, publicly stated that a network's complexity often increases opaqueness and renders systemic risk assessment more difficult (Yellen, 2013).

Since the first systemic shock originated in asset management practices (the LTCM's 1998 failure), regulators around the world have made a concerted effort to better measure systemic risk and understand the appropriate responses to the failure of large players on financial markets. However, while the US authorities organized LTCM's bailout, they did not intervene in later cases of hedge fund losses. A possible motivation behind the original intervention could be the high counterparty risk due to the large number of OTC contracts involved. This would certainly explain why 14 financial institutions, including Barclays, Deutsche Bank, Goldman Sachs, JP Morgan and UBS, participated in LTCM's bailout. Another possibility is that US authorities over-estimated the risk of LTCM's failure. It is uncertain what their reaction would be nowadays. Are counterparty risk and over-exposure of asset managers' portfolios sources of systemic risk or simply part of the financial markets where risks to other financial institutions (such as banks, insurance companies or pension funds) should be measured and controlled for by these institutions' internal risk controlling procedures and not an overarching governing authority?

### 3.2.2 Asset liquidation/market channel

The case of money market funds opens a more interesting issue. Like the LTCM story, it concerned forced liquidations in an hostile environment, but the context is different. Indeed, the issue was not related to idiosyncratic risk at risk of spreading through the financial system, but conversely was explained by a common risk shared by all the asset managers who hold commercialized money market funds. The lack of liquidity of some fixed-income instruments implies a premium for the first investors who unwind their positions on money market funds[16]. In this case, one can observe a run on such funds exactly like a bank run because investors lose confidence in such products and do not want to be the lasts to move. Risk was transmitted here to a host of institutions which are only connected through their common holdings of a suddenly particularly stressed asset class.

Another transmission mechanism of systemic risk is in play during a liquidity dry-up event. Brunnermeier and Pedersen (2009) demonstrated that a demand shock can create a flight-to-quality environment in which liquidity and loss spirals can arise simply due to funding requirements on speculators such as call-to-margins and repo haircuts. In some instances, a liquidity dry-up event resulting from a flight-to-quality environment can result in runs, fire sales, and asset liquidations in general transforming the market into a contagion mechanism. This is particularly true if the market size of the early players affected by the shock is large enough to induce a large increase in price pressure such as was the case with the Flash Crash of May 6, 2010. The likelihood and stringency of these spirals is exacerbated by high leverage ratios, and therefore the role of asset managers using highly leveraged strategies is particularly important when assessing the impact on systemic risk transmitted and created this way. The liquidity issue is aggravated when the asset management industry performs liquidity transformation activities. It is tempting to offer some liquidity facilities on non highly-liquid assets (high yield, emerging markets bonds, loans) or complex exotic trading strategies. However, in a period of stress, demand for illiquid assets may disappear, impacting asset prices and causing fire sales contagion on other markets or funds.

The example of MMFs illustrates well this mechanism. As concerns and mistrust mounted on the composition of prime MMFs (which hold a mix of Treasury issues and commercial papers) because of a sudden lack of liquidity of some debt instruments (esp. Lehman Brothers' commercial papers and asset-backed securities), institutional demand shifted from this

[16] See Schmidt *et al.* (2014) for the relationship between the "first mover advantage" and runs on money market funds.

sector of the short-term debt market to government MMFs (which hold only government debt) (Kapeczyk and Schnabl, 2013; Schmidt *et al.*, 2014). This created a massive run on MMFs, characterized by a huge amount of redemptions and fire sales, that disrupted significantly the organization of the money market by creating funding restrictions on banks and therefore transmitting the shock from one institution to the entire banking system.

While transmission of systemic risk through the market channel is undeniable, a delicate distinction must however be made. Financial markets act in essence as vehicles for the transmission of information in the form of (positive or negative) shocks from one end of the economy to the other. Large financial institutions, which can be large players on certain sectors of the financial sectors, can therefore be involved in this transmission mechanism. However, not every shock to an economy is "systemic" or at least not to the extent that it originated with the activities of a specific institution such as an asset manager. Crucially, the directionality of risk transmission through the market is an important factor to whether an institution contributes to or only incurs systemic risk.

Two recent episodes can help shed light on this specific issue. First, the earthquake and tsunami that struck Japan on March 11, 2011 wreaked havoc on the Japanese economy. Financial markets reacted and consequently, Japanese equity indices lost major ground. Following suit, asset managers, and specifically exchange-traded funds that tracked these indices, saw the value of their funds reverberate the loss[17]. It is difficult however to blame the Japanese's financial slump and their economic difficulties on the activities of the asset management industry. Second, the Greek debt crisis of Summer 2010 is another example of an exogenous shock affecting financial markets and leading some asset managers to troubled waters. In this particular instance, differences between the construction methodologies of leading Eurozone bond indices created even more difficult times for some index funds after Standard & Poor's and Moody's downgraded the Greek-issued government debt. On the one hand, Greece's downgrade subsequently disqualified Greek debt instruments from some indices' pool of 'eligible bonds'. Consequently, Greek debt instruments had to be offloaded from portfolios which as part of their contractual construction agreements were then barred from holding these securities. On the other hand, funds tracking for example the EuroMTS indices, which conversely to other comparable Eurozone bond indices did not filter on the investment grade status of the bonds included in their construction, suffered even further as the downgrade led to a further deterioration of the Greek bond market. The asset liquidation that followed this episode of the Greek debt crisis certainly contributed to a momentary decrease in the value of these instruments. However, the asset management industry was here only one of the chosen instruments of market correction rather than the cause and origin of a systemic shock.

### 3.2.3 Critical function or services/substitutability channel

The third identified transmission channel for systemic risk relates to the specific function a financial institution may come to play in a specific market, either because of its size relative to the market or because of its ownership of a specific skill which makes its services essential to the functioning of that market. As we noted above, this source of systemic risk is the only direct source that can theoretically be tied to the asset management industry. It should be noted however that because of the separation between asset management and asset custody as well as the high level of competition between asset management firms, there is overall very high substitutability between asset management companies.

[17] Japanese equity indices came down by about 10% in the week after the earthquake and tsunami.

The problem of critical function or services performed by an asset manager seems therefore to be limited to cases of large separate managed accounts or of large funds commercialized on the name and the skill of a particular manager rather than a specific strategy. This particular source of risk can hence be tied to the reputational risk of an asset manager. An adverse event affecting a specific asset management company such as the departure of a particular fund manager can lead to massive outflows of assets under management from the funds (private or public) the manager oversaw. In this instance, the case of PIMCO and its co-founder Bill Gross is telling. The *Bond King*'s departure on September 26, 2014 from the firm he founded and had become an emblematic figure of its reliability, skill and performance of its bond market's mutual funds led to wide-spread redemptions from investors. By April 2015, the flagship PIMCO Total Return Fund had lost about 50% of its AUM (or about USD 110 billion) from September 2014 while the firms total AUM had shrunk to USD 1.68 trillion as of December 31, 2014 compared to USD 1.97 trillion as of June 30, 2014. More interestingly, however, is the effect of the announcement of Bill Gross's departure on the bond market as well as on the stock prices of PIMCO and its parent company, Allianz[18].

While each of the three transmission channels of systemic risk is well identified, the difficulty of assessing the potential amplitude of systemic shock comes from the interplay between these channels. Hence, while the example of MMFs illustrate well the market channel for spreading risk through the system, it is also an illustration of the role of the strategic functions of the institutions affected: in this case, a host of mutual funds which liquidity and maturity transformation activities have made natural investment products for a large section of the financial markets. Another example is the case of the sudden departure of Bill Gross from PIMCO which represents a reputational event for this investment company. Yet, the ensuing redemptions had an impact beyond the financial health of PIMCO's funds to the markets in which Bill Gross has been an emblematic and influential investor for decades and in which the PIMCO funds were large players in part because of Mr. Gross's reputation.

## 3.3 The FSB-IOSCO framework

The Financial Stability Board (FSB) and the International Organization of Securities Commission (IOSCO) published jointly several consultative documents (2014, 2015) which aim at delineating the methodology to identify Non-Bank Non-Insurer Global Systemically Important Financial Institutions (NBNI G-SIFIs). It should be noted that emphasis is put on identifying the largest potential sources of systemic sources (in terms of shock amplitude) due to the failure of an institution, no matter how unlikely, rather than identifying the likelihood of a systemic shock originating with a particular institution.

The methodology therefore proceeds in progressively more refined steps to identify the institutions that could be the source of a systemic shock. The starting point of the methodology is to establish per geographical region or jurisdiction a reference list in each of the institutional categories by setting a materiality threshold. Subsequently, each institution listed on the reference list should be subjected to a detailed assessment looking at the five dimensions of systemic risk (cf. Table 1). This process will result in a confidential "Narrative Assessment" document to the relevant national authorities. The efforts of the national authorities are coordinated by an International Oversight Group (IOG) which will be set up to ensure consistency in assessment across jurisdictions and will make the final determination based on the Narrative Assessments of whether an institution falls into the NBNI G-SIFI category on an annual basis.

[18] On September 26, 2014, Allianz shares dropped by 6.2% whereas Janus shares gained 43%.

Asset managers fall under the Non-Bank Non-Insurer Global Systematically Important Financial Institution (NBNI G-SIFI) category (cf. Section 2.1). The FSB-IOSCO framework proposed in January 2014 for NBNI G-SIFI (FSB-IOSCO, 2014) attempts to provide consistency with the frameworks developed for SIBs and SIIs across the different SIFIs' categories by establishing the same five categories of indicators[19] for the three categories of participants in the financial sectors that it identifies as potential NBNI SIFIs:

1. finance companies (purview of FSB);
2. market intermediaries, esp. securities broker-dealers (purview of IOSCO);
3. investment funds: collective investment schemes (CIS) and hedge funds (purview of IOSCO).

### 3.3.1 Assets, products or firms?

The FSB-IOSCO framework identifies four possibilities to define a SIFI in the investment funds category:

- funds;
- family of funds managed by the same asset manager;
- asset managers on a stand-alone entity basis;
- asset managers and their funds collectively.

The FSB-IOSCO January 2014 framework propose to focus on the fund level because "*economic exposures are created at the fund level [...], a fund is a separate legal entity from its manager, certain data is available to supervisors in a per entity format*". In response to their consultative document, FSB and IOSCO received about 50 public responses[20]. Among them, 31 came from asset managers, hedge funds and representative associations for investment management. Most answers disagreed with FSB and IOSCO that asset management can produce systemic risk, but among the four possibilities, all responses except one agreed that funds are the most appropriate choice to assess the systemic risk of the asset management.

This position of FSB and IOSCO contrasted with the report published by the Office of Financial Research (OFR) at the request of the U.S. Financial Stability Oversight Council (FSOC) (cf. OFR, 2013). Indeed, OFR (2013) does not mention that individual fund may be a systemically important financial institutions. Rather, the paper focuses on asset managers, on their activities, on some products like ETFs or family of funds like bond funds.

A second iteration of the FSB-IOSCO framework was proposed in March 2015 in an attempt to provide further details regarding the general procedure to identify NBNI G-SIFIs and most importantly to answer the concerns raised by the original proposal regarding the exclusive focus on funds in the asset management industry (FSB-IOSCO, 2015). To the original framework, the second FSB-IOSCO proposal adds a "separate methodology focused on activities that if conducted by a particular asset manager may have the potential to generate systemic risk"(FSB-IOSCO, 2015, p.8). The document further refines the investment fund category's identification methodology by focusing on leverage as a potential source of systemic risk.

[19] Cf. Table 1: Size, Interconnectedness, Substitutability, Complexity and Cross-jurisdictional activities.

[20] They are available on the web page of the FSB: `http://www.financialstabilityboard.org/2014/04/r_140423`.

Currently, as of the March 2015 proposal, the materiality threshold criteria considered for the investment funds and asset managers categories are (FSB-IOSCO, 2015, page 11)

- For investment funds
  - (i) Option 1: USD 30 billion in net asset value (NAV) and balance sheet financial leverage of 3 times NAV *or* net assets under management (AUM) greater than USD 100 billion.
  - (ii) Option 2: Gross AUM (GAUM) greater than USD 200 billion unless it can be demonstrated that the investment fund is not a dominant player in its markets (for example by considering measures such as substitutability ratio below 0.5% or fire sale ratio below 5%).
- For asset managers (either in combination or exclusively)
  - (i) Option 1: A particular value (e.g. USD 100 billion) in "balance sheet total assets" for determining the entities that will be assessed in detail by the assessment methodology.
  - (ii) Option 2: A particular value (e.g. USD 1 trillion) in AUM for determining the entities that will be assessed in detail by the relevant assessment methodology.

### 3.3.2 The FSB scoring system

In Table 2, we report the indicators proposed by FSB-IOSCO (2015).

Table 2: The FSB scoring system

| Category | | Investment funds | | Asset managers |
|---|---|---|---|---|
| Size | 1.1 | Assets under management | 1.1 | Assets under management |
| | 1.2 | Gross notional exposure | 1.2 | Balance sheet assets |
| Interconnectedness | 2.1 | Balance sheet financial leverage | 2.1 | Leverage Ratio |
| | 2.2 | Leverage ratio | 2.2 | Guarantees and other off-balance sheet exposures |
| | 2.3 | Ratio of GNE to NAV | | |
| | 2.4 | Ratio of collateral to NAV | | |
| | 2.5 | Counterparty credit exposure | | |
| | 2.6 | Intra-financial system liabilities to G-SIFIs | | |
| | 2.7 | Nature of investors | | |
| Substitutability | 3.1 | % of trading volume | 3.1 | Market share measured by revenues |
| | 3.2 | % of holdings per certain asset classes | 3.2 | Market share measured by AUM |
| | 3.3 | Ratio of NAV to the size of the underlying market | | |
| Complexity | 4.1 | % of non-centrally cleared derivatives | 4.1 | Impact of the organisational trade volume structure |
| | 4.2 | % of re-used collateral | 4.2 | Difficulty in resolving a firm |
| | 4.3 | % of HFT strategies | | |
| | 4.4 | Liquidity profile | | |
| | 4.5 | Ratio of unencumbered cash to GNE | | |
| | 4.6 | Ratio of unencumbered cash to NAV | | |
| | 4.7 | Amount of less liquid assets | | |
| Cross-jurisdictional activity | 5.1 | Number of jurisdictions in which a fund invests | 5.1 | Number of jurisdictions |
| | 5.2 | Number of jurisdictions in which the fund is sold or listed | | |
| | 5.3 | Number of jurisdictions where the fund has counterparties | | |

Definition of some indicators:

- Investment funds
  - 3.1 Daily trading volume of certain asset classes of the fund compared to the overall daily trading volume of the same market segment
  - 3.2 Fund holdings per certain asset classes compared to the overall daily trading volume of the same asset class
  - 4.1 Non-centrally cleared derivatives trade volumes of the fund / Total trade volumes of the fund
  - 4.2 Ratio (%) of collateral posted by counterparties that has been re-used by the fund
- Asset managers
  - 3.1 Substitutability, measured by a percentage of the asset manager's revenues as compared to the total revenues attributable to the relevant business
  - 3.2 Market share, measured by a percentage of the asset manager's AUM in a particular strategy as compared to the total AUM invested in the same strategy for all managers

# 4 Some empirical results

In this section, we present some empirical results related to systemic risk in the asset management industry. First, we focus on asset managers and try to understand what their business risk is. Second, we analyze the universe of large mutual funds above the materiality threshold of USD 100 billion that determines the initial assessment pool of FSB-IOSCO. Finally, we consider three fund families (money market funds, exchange traded funds and hedge funds) which have been decried in recent years, justifiably or not, as sources of systemic risk.

## 4.1 The case of asset managers

According to BCG (2014), the global assets under management grew to a record USD 68.7 trillion in 2013. Half of these assets concern mutual funds and ETFs (ICI, 2015) while the US market plays a dominant role[21].

### 4.1.1 Some asset managers are already under a SIFI regulation

In Table 3, we report the list of the 15 largest asset managers excerpted from the *Special Report on the Largest Money Managers* published by Pensions & Investments Magazine and Towers Watson. These figures differ (and are generally higher) than those reported in the *Top 400 Asset Managers* report edited by Investments & Pensions in Europe (IPE). Nevertheless, the two rankings are mostly consistent[22]. If we consider a USD 1 trillion materiality threshold in AUM, the assessment pool of systemic asset managers is composed of 12 asset managers[23].

Among these 15 asset managers, eight belong to a parent financial institution that is a SIFI (6 G-SIBs & 2 G-SIIs), one is affiliated to a non-SIFI banking group (Northern Trust Asset Management), five are private companies (Vanguard, Fidelity, Capital Group, Franklin Templeton and Wellington), and only one is a publically listed company (BlackRock). Except for Amundi and Deutsche AWM, they are all US-based. This rapid overview thus reveals the disparity in the supervisory framework for systemic risk already in place surrounding the activities of these top asset management firms. In order to reduce these competitive inequalities, it would therefore be valuable to harmonize the regulatory framework between these different asset managers which face different constraints in terms of risk management and capital requirements.

### 4.1.2 Comparing the income risk of asset managers and banks

At first sight, we expect the income risk of asset managers to be lower than banks'. To validate this common idea, we consider the quarterly pre-tax income of a sample of banks and asset managers. For banks, we use as a sample the twelve most important G-SIBs (FSB, 2014): HSBC, JPMorgan Chase, Barclays, BNP Paribas, Citigroup, Deutsche Bank, Bank of America, Credit Suisse, Goldman Sachs, Mitsubishi UFG, Morgan Stanley and Royal Bank of Scotland. For asset managers, our sample consists of twelve asset managers with listed

[21] It represents 49% of the global market (BCG, 2015) and 53% of mutual funds' assets (ICI, 2015).

[22] In the IPE ranking, Natixis Global Asset Management (NGAM) replaces Goldman Sachs Asset Management (GSAM).

[23] Using the IPE data, only the first seven asset managers are above the materiality threshold.

Table 3: Largest asset managers (in USD BN)

| Asset manager | AUM | SIFI | |
|---|---|---|---|
| BlackRock Inc. | 4,324.0 | | |
| Vanguard Group Inc. | 2,752.9 | | |
| State Street Global Advisors | 2,344.7 | ✓ | State Street |
| Fidelity Investments | 2,159.8 | | |
| JP Morgan Asset Management | 1,598.0 | ✓ | JPMorgan Chase |
| BNY Mellon Investment Management | 1,582.9 | ✓ | Bank of New York Mellon |
| PIMCO | 1,535.0 | ✓ | Allianz SE |
| The Capital Group Cos. Inc. | 1,338.8 | | |
| Deutsche Asset & Wealth Management | 1,289.0 | ✓ | Deutsche Bank |
| Prudential Financial | 1,107.0 | ✓ | Prudential Financial, Inc. |
| Amundi | 1,071.7 | ✓ | Group Crédit Agricole |
| The Goldman Sachs Group Inc. | 1,042.0 | ✓ | Goldman Sachs |
| Northern Trust Asset Management | 884.4 | | |
| Franklin Templeton Investments | 879.1 | | |
| Wellington Management Co. LLP | 834.4 | | |

*Source*: Pensions & Investments Magazine, Special Report on the Largest Money Managers, May 2014.

stocks[24]: BlackRock, Invesco, T.Rowe Price, Legg Mason, Aberdeen Asset Management, Affiliated Managers Group, AllianceBernstein, Schroders, Federated Investors, Eaton Vance Management, Janus Capital Group and GAM. We report the historical data in Appendix C on page 46.

Let $\Pi_{t,i}$ be the pre-tax income of stock $i$ for the period $t$. We define the income dispersion ratio as the standard deviation of $\Pi_{t,i}$ divided by the expected value of "normal" income

$$\mathrm{IDR}_i = \frac{\sigma\left(\Pi_{t,i}\right)}{\mathbb{E}\left[\Pi_{t,i} \mid \Pi_{t,i} > 0\right]}.$$

$\sigma\left(\Pi_{t,i}\right)$ measures the time dispersion of income of stock $i$ while $\mathbb{E}\left[\Pi_{t,i} \mid \Pi_{t,i} > 0\right]$ is a normalization factor. To calculate "normal" income, we only consider periods of positive pre-tax income as negative income periods generally correspond to stressed periods of business. Estimates[25] are reported in Figure 2. For each category (banks/asset managers), the income dispersion ratios are then ranked in ascending order to compare the distributions. Except for the largest income dispersion ratio, we do not observe a fundamental difference between asset managers and banks. This result is confirmed by the statistics reported in Table 4.

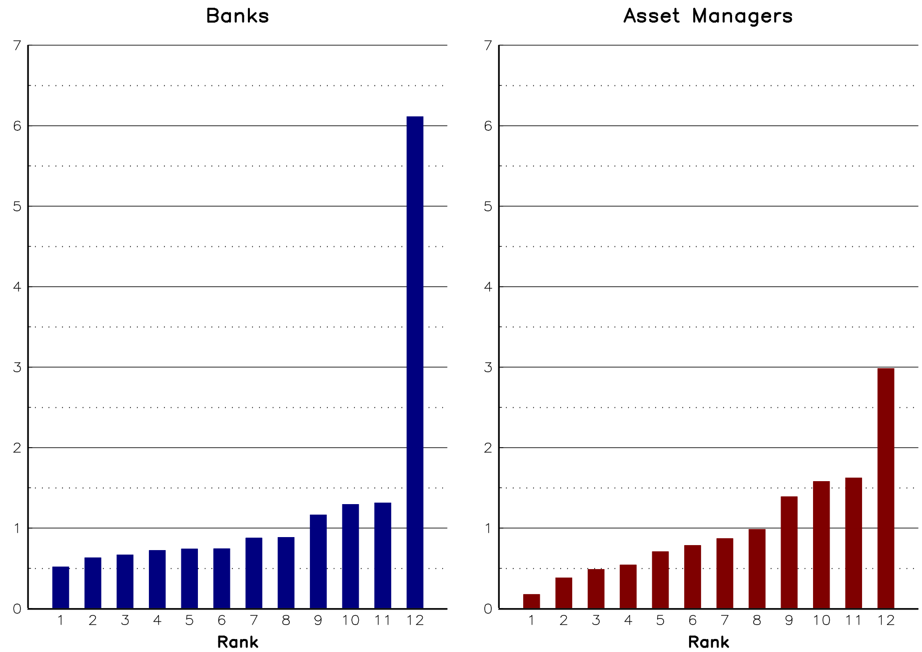
We define as well the loss magnitude ratio as

$$\mathrm{LMR}_i = \frac{\max_t L_{t,i}}{\mathbb{E}\left[\Pi_{t,i} \mid \Pi_{t,i} > 0\right]}$$

[24]They are few companies listed on stock markets in the asset management industry because most asset managers are bank or insurance subsidiaries or private companies. The list here represents the most important listed stocks according to our knowledge of the asset management industry.

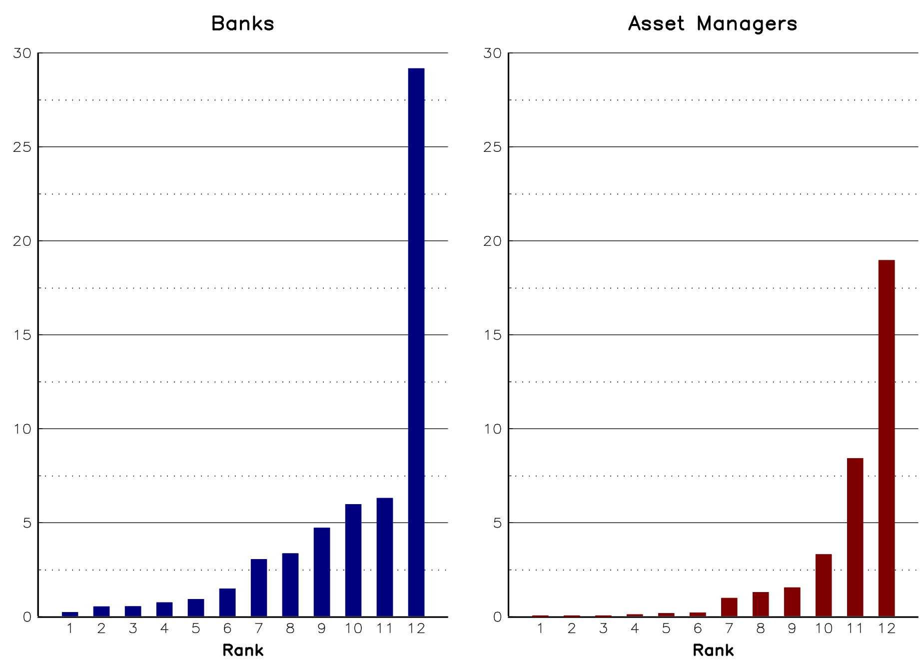
[25]Using the available data, we estimate the income dispersion ratio by dividing the empirical standard deviation of quarterly pre-tax income by its arithmetic mean keeping only positive values of quarterly pre-tax income. For four stocks (BNP Paribas, Aberdeen Asset Management, Schroders and GAM), we only have the data of semi-annual pre-tax income. In this case, we multiply the estimate of the semi-annual ratio by $\sqrt{2}$ in order to convert it into a quarterly ratio.

Figure 2: Comparison of the income dispersion ratio between banks and asset managers




*Source*: Bloomberg & Authors' calculation.

Figure 3: Comparison of the loss magnitude ratio between banks and asset managers




*Source*: Bloomberg & Authors' calculation.

where $\max_t L_{t,i}$ is the maximum loss observed for a given period $[0, T]$. This ratio therefore measures the magnitude of loss with respect to the expected value of "normal" income. Results[26] are reported in Figure 3 and in Table 4. Contrary to the income dispersion, we observe significant differences between banks and asset managers regarding the magnitude of losses. On average, losses are larger for banks than for asset managers. This empirical finding illustrates that banks are more risky than asset managers and explains why the observed default rate of banks is larger than the one observed for asset managers.

Table 4: Statistics of income dispersion and loss magnitude ratios

| Statistic | Income Dispersion | | Loss magnitude | |
|---|---|---|---|---|
| | Banks | Asset managers | Banks | Asset managers |
| Median | 0.81 | 0.82 | 2.26 | 0.59 |
| Mean | 1.30 | 1.04 | 4.75 | 2.91 |
| Standard deviation | 1.54 | 0.77 | 7.99 | 5.60 |

*Source*: Bloomberg & Authors' calculation.

#### 4.1.3 Understanding the business risk of asset managers

To understand the previous results, one must look into the business risk of asset managers. Let's introduce some notations. The evolution of the assets under management $A_t$ is described by the following equation

$$\mathrm{d}A_t = \mu_t A_t \,\mathrm{d}t + F_t$$

where $\mu_t$ is the return of the fund and $F_t$ corresponds to asset flows, which are the difference between subscriptions $F_t^+$ and redemptions $F_t^-$. We assume that subscriptions and redemptions are proportional to the value of the fund: $F_t^+ = \delta_t^+ A_t \,\mathrm{d}t$ and $F_t^- = \delta_t^- A_t \,\mathrm{d}t$. We can interpret $\delta_t^+$ and $\delta_t^-$ as instantaneous intensity rates. It follows that

$$\mathrm{d}A_t = \mu_t A_t \,\mathrm{d}t + \delta_t A_t \,\mathrm{d}t$$

where $\delta_t = \delta_t^+ - \delta_t^-$ represents the intensity rate of net flows. Because $\mu_t$ is the difference between the gross return $R_t$ of the assets and the management fees $m_t$, we finally obtain

$$\mathrm{d}A_t = (R_t - m_t + \delta_t) A_t \,\mathrm{d}t.$$

The revenue $\mathbb{R}_t$ of the fund manager corresponds then to the collected fees

$$\mathbb{R}_t = m_t A_t.$$

Let $\mathbb{E}_t$ denote expenses. Generally speaking, $\mathbb{E}_t$ has two components: $\mathbb{E}_t = C_t + L_t$. The first component is the operating cost $C_t$ that includes fixed costs and salaries, while the second component corresponds to exceptional costs $L_t$ due mainly to operational risk losses. The net income $\pi_t$ of the fund manager is the difference between revenues and expenses

$$\begin{aligned}\pi_t &= \mathbb{R}_t - \mathbb{E}_t \\ &= m_t A_t - C_t - L_t \\ &= m_t A_0 e^{\int_0^t (R_s - m_s + \delta_s)\,\mathrm{d}s} - C_t - L_t \end{aligned} \quad (1)$$

where $A_0$ is the assets under management at time $t = 0$.

[26] We estimate $\max_t L_{t,i}$ by the largest loss observed in the sample.

**Remark 2** *This model corresponds to the case of one investment fund, but it can be applied at the asset manager's level. In this case, the net income of the asset manager is simply the sum of the net income of the different investment funds*

$$\pi_t = \sum_{i=1}^{n} m_{i,t} A_{i,0} e^{\int_0^t (R_{i,s} - m_{i,s} + \delta_{i,s})\,\mathrm{d}s} - C_t^{\mathrm{AM}} - L_t^{\mathrm{AM}}$$

*where* $C_t^{\mathrm{AM}}$ *and* $L_t^{\mathrm{AM}}$ *are the total operating and exceptional costs of the asset manager.*

If we examine Equation (1), we observe that the net income of a fund manager depends on five key parameters:

- The management fee $m_t$
  We generally observe a positive relationship between $m_t$ and $\pi_t$: the larger the fee, the higher the profitability. However, two elements can mitigate this effect. First is the negative *direct* impact of fees on AUM[27]. The second element is the negative *indirect* impact on net flows[28]. While the first effect can be considered marginal, the second effect can be substantial in particular when competition between asset managers increases (BCG, 2014).

- The gross performance of the fund manager $R_t$
  Gross performance is positively related to net income through two channels: the mechanical growth of AUM due to positive fund returns (performance effect) and the indirect positive impact on flows (attractiveness effect).

- The intensity of net flows $\delta_t$
  This parameter is not exogenous and depends on several factors: the performance of the fund (Berk and Green, 2004), the fund rating (Guercio and Tkac, 2008), the expense ratio, the attractiveness of the asset class, the talent of the salespersons, the distribution channels, etc. By construction, this parameter has a positive impact on the net income.

- The operating cost $C_t$
  We know little about the evolution of the cost structure of asset managers. Generally, it is assumed to be a slow-moving parameter. However, the figures reported in BCG (2014) contradict this assumption. For instance, they report that the average costs (expressed in percents of AUM) were 20.2 bps in 2007 and 17.9 bps in 2008.

- The operational losses $L_t$
  This corresponds to exceptional losses such as workers compensation, termination benefits, commercial litigation, guarantees, etc. Historically, these exceptional losses were generally low and rare.

Let us consider a simple case where the parameters are constant. We have

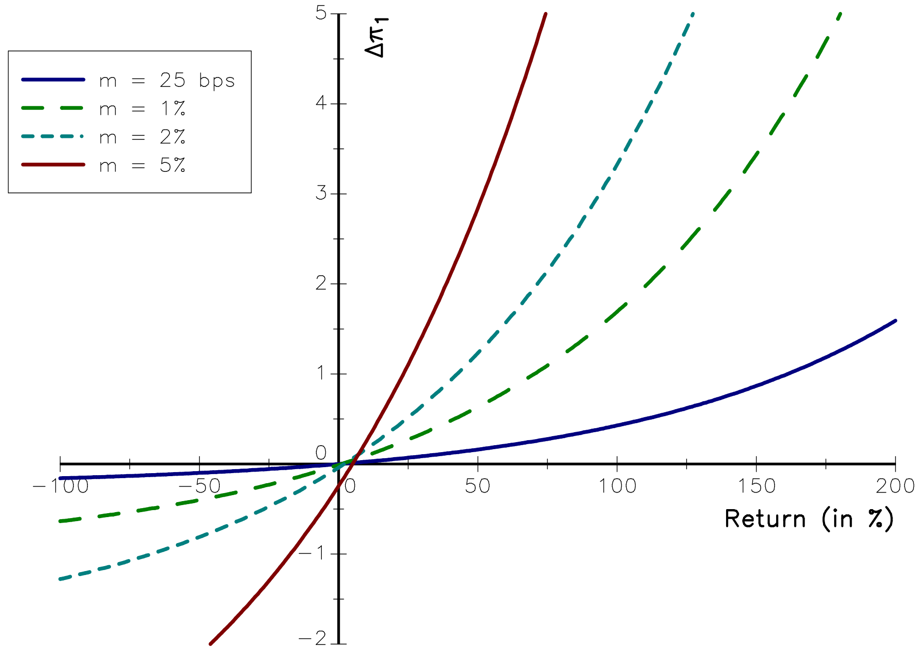
$$\pi_t = m A_0 e^{(R-m+\delta)t} - C_0 - L_0$$

At time $t = 0$, $\pi_0 = m A_0 - C_0 - L_0$. This implies that

$$\pi_t = \pi_0 + m A_0 \left( e^{(R-m+\delta)t} - 1 \right).$$

[27] It corresponds to the $-m_s\,\mathrm{d}s$ term in the integral.
[28] This means that $\delta_t$ may be a negative function of $m_t$.

Figure 4: Impact of the gross return $R$ on the asset manager' income




We deduce that

$$\begin{aligned}\Delta\pi_t &= \pi_t - \pi_0 \\ &= mA_0\left(e^{(R-m+\delta)t} - 1\right)\end{aligned}$$

In Figure 4, we report the relationship between $R$ and $\Delta\pi_t$ for different values of the management fee $m$ when $A_0 = 1$ and $\delta = 0$. We observe that the profitability of an asset manager is a leverage[29] on the return $R$. In particular, asset managers can gain high profits when performance is high, but they can also experience losses when the return is highly negative and costs are constant[30]. Moreover, this relationship is very sensitive to the management fee. We can distinguish between two types of asset managers:

1. Asset managers with low fees
   These asset managers have therefore more stable income and their business model is to increase the asset under management by capturing net inflows ($\delta > 0$).

2. Asset managers with high fees
   These asset managers have less stable income and may suffer a lot in bear markets. Their primary objective is then to protect the performance of their funds and to propose strategies that are less sensitive to the beta of the market.

[29]Contrary to common beliefs, listed stocks of asset managers are high beta stocks and not low beta (or defensive) stocks. For instance, if we consider our sample of twelve asset managers and banks, the average beta of asset managers is 1.50 versus 1.59 for banks during the period January 2000-April 2015.

[30]Because the income of the asset manager is very sensitive to the average return of AUM, this implies that an equity manager faces more risk than a bond manager. Another implication is that a balance mix of asset classes is preferable than a specialization in one asset class.

We retrieve the traditional breakdown of the asset management industry (BCG, 2014). Passive investment belongs to the first category, whereas the second category includes specialized asset managers in equities, commodities and alternative asset managers (infrastructure, private equity and hedge funds). We also notice that the leverage effect is amplified if we consider performance fees[31].

Regarding expenses, the income of an asset manager is sensitive to operational losses. According to Basel II, the asset management industry is considered a low-risk business line[32]. Operational losses generally occur because of explicit and implicit guarantees. For explicit guarantees, we find principally portfolio insurance, guarantees on NAV and borrower default indemnification in security lending[33]. Implicit guarantees exist because of the reputational risk. In some instances, an asset manager prefers to compensate investors or to absorb losses rather than facing a potential claim or legal action[34].

## 4.2 The case of mutual funds

The materiality threshold proposed by FSB-IOSCO (FSB-IOSCO, 2015) for investment funds is USD 100 BN in assets under management. Using the list of the largest mutual funds in Table 5, this implies that about 10 mutual funds are eligible for the assessment pool. Most of them are equity index funds. This result is problematic for three reasons:

- First, it implies that equity funds are in some way more systemic than other funds, in particular bond funds. This result is only explained by the size of the equity market compared to other asset classes. However, we know that the equity market is the only liquidity provider in periods of stress. A good example is the 2008 financial crisis.
- Second, this implies that long-only index funds are more systemic than active funds. This result is curious because the strategy of long-only index funds corresponds to the average behavior of the market. Moreover, while passive management is subject to linear feedbacks, active management may induce non-linear network effects. This is particular true for liquidity and leverage. An index fund has no leverage and present a liquidity risk comparable to the liquidity risk of the market. This may be not the case of active funds especially concerning liquidity, because portfolio weights are different from the market capitalizations. This means that the liquidity profile of active funds is generally more risky than the liquidity profile of index funds.
- An absolute materiality threshold is sensitive to the market performance. For instance, an equity index fund with a size of USD 150 BN will be below the materiality threshold if the stock market realizes a drop of 34%.

The relationship between size and systemic risk is particularly challenging. Relying primarily on size (regardless of asset classes) as a materiality criterion assumes that asset classes are homogeneous with respect to liquidity. In practice, liquidity depends on asset class and

[31] Indeed, if we assume that the performance fee is calculated between time 0 and time $t$, introducing a performance fee in the model is equivalent to using a higher value of the management fee if the net return is higher than a threshold $R^{\star}$.

[32] In the Standardized Approach (TSA), the capital charge for each business line is calculated by multiplying the gross income by a factor assigned to that business line. For the asset management line, this coefficient is equal to 12%. It is the lowest factor. By comparison, this factor is equal to 18% for corporate finance, trading & sales and payment & settlement.

[33] This problem has been identified by FSOC (2014) – see page 115 of the 2014 Annual Report.

[34] For instance, State Street (2010) reported a loss of USD 414 million due to security lending in a period where there were no explicit guarantee on the security lending programs concerning their money market funds.

Table 5: Largest mutual funds (in USD BN)

| Fund | AUM | Asset class | | |
|---|---|---|---|---|
| | | Equity | Bond | Diversified |
| Vanguard Total Stock Market Index Fund | 406.5 | ✓ | | |
| Vanguard Five Hundred Index Fund | 209.4 | ✓ | | |
| Vanguard Institutional Index Fund | 195.5 | ✓ | | |
| Vanguard Total Intl Stock Index Fund | 162.5 | ✓ | | |
| American Funds Growth Fund of America | 149.4 | ✓ | | |
| Vanguard Total Bond Market Index Fund | 144.6 | | ✓ | |
| American Funds Europacific Growth Fund | 133.5 | ✓ | | |
| PIMCO Total Return Fund | 117.3 | | ✓ | |
| TianHong Income Box Money Market Fund | 114.8 | | | |
| Fidelity® Contrafund® Fund | 110.6 | ✓ | | |
| American Funds Capital Income Builder | 100.7 | | | (80 / 20) |
| American Funds Income Fund of America | 99.7 | | | (80 / 20) |
| Vanguard Total Bond Market II Index Fund | 93.4 | | ✓ | |
| Franklin Income Fund | 92.4 | | | (50 / 50) |
| American Funds Capital World Growth & Income Fund | 91.0 | ✓ | | |
| Vanguard Wellington™ | 90.7 | | | (60 / 40) |
| Fidelity Spartan® 500 Index Fund | 90.0 | ✓ | | |
| American Funds American Balanced Fund | 83.0 | | | (60 / 40) |

*Source*: Morningstar's database, May 5, 2015.

portfolio construction. To understand this issue, we introduce the liquidation ratio $\mathcal{LR}(t)$, which measures the proportion of the fund that can be liquidated after $t$ trading days (without incurring limitless costs). This statistic depends on the size of the fund (or AUM) and the liquidation policy. A simple rule is to define a maximum number of shares that can be sold every day for each asset that compose the portfolio of the fund[35]. The market convention is to consider a proportion of the three-month average daily volume (ADV). This serves as a proxy to bound liquidation costs: the higher the proportion of the ADV, the larger the trading costs. Another interesting statistic is the liquidation time $\mathcal{LR}^{-1}(\alpha)$, which is the inverse function of the liquidity ratio[36]. It indicates the number of required trading days in order to liquidate a proportion $\alpha$ of the fund assets.

In Table 6, we report our computations of the liquidation ratio and the liquidation time for several index funds using a size of USD 10 BN and assuming we can sell 10% of the ADV every day[37]. The indexes are S&P 500 Index, EUROSTOXX 50 Index, DAX Index, NASDAQ 100 Index, MSCI EM Index, MSCI INDIA Index and MSCI EMU Small Cap Index. We read the results as follows: $\mathcal{LR}(1)$ is equal to 88.4% for the S&P 500 Index meaning that we liquidate 88.4% of the assets[38] of the fund on the first trading day; $\mathcal{LR}(5)$ is equal to 24.1% for the DAX Index meaning that we liquidate 24.1% of the assets after

[35]See Appendix A.2 on page 43 for more information about the mathematical computation of the liquidity ratio.

[36]We have the following relationships: $\alpha = \mathcal{LR}(t)$ and $t = \mathcal{LR}^{-1}(\alpha)$.

[37]For the composition of the portfolio and the ADV statistics, we use the data of April 30, 2015.

[38]This represents $88.4\% \times 10 = 8.84$ billion of USD.

five trading days; $\mathcal{LR}^{-1}(75\%)$ is equal to 43 for the MSCI EMU Small Cap Index meaning that we need 43 trading days to liquidate USD 7.5 BN for this index. We observe that the liquidation risk profile is different from one index fund to another.

Table 6: Statistics of the liquidation ratio (size = USD 10 BN, adv = 10%)

| Statistics | S&P 500 | ES 50 | DAX | NASDAQ | MSCI EM | MSCI INDIA | MSCI EMU SC |
|---|---|---|---|---|---|---|---|
| $t$ (in days) | Liquidation ratio $\mathcal{LR}(t)$ in % | | | | | | |
| 1 | 88.4 | 12.3 | 4.8 | 40.1 | 22.1 | 1.5 | 3.0 |
| 2 | 99.5 | 24.7 | 9.6 | 72.6 | 40.6 | 3.0 | 6.0 |
| 5 | 100.0 | 58.8 | 24.1 | 99.7 | 75.9 | 7.6 | 14.9 |
| 10 | 100.0 | 90.1 | 47.6 | 99.9 | 93.9 | 15.1 | 29.0 |
| $\alpha$ (in %) | Liquidation time $\mathcal{LR}^{-1}(\alpha)$ in days | | | | | | |
| 50 | 1 | 5 | 11 | 2 | 3 | 37 | 21 |
| 75 | 1 | 7 | 17 | 3 | 5 | 71 | 43 |
| 90 | 2 | 10 | 23 | 3 | 9 | 110 | 74 |
| 99 | 2 | 15 | 29 | 5 | 17 | 156 | 455 |

*Source*: Bloomberg & Authors' calculation (data as of April 30, 2015).

**Remark 3** *These figures depend on the liquidation policy and the liquidation size. For instance, if we use an average daily volume of 30%, we obtain the results given in Table 7. In this case, liquidity ratios are improved. Nevertheless, we continue to observe that all these indexes do not present the same liquidity profile. Moreover, one can show that the dispersion of these liquidity profiles increases with the liquidation size as illustrated in Tables 17 and 18 on page 45, which correspond to a liquidation size of USD 50 BN.*

Table 7: Statistics of the liquidation ratio (size = USD 10 BN, adv = 30%)

| Statistics | S&P 500 | ES 50 | DAX | NASDAQ | MSCI EM | MSCI INDIA | MSCI EMU SC |
|---|---|---|---|---|---|---|---|
| $t$ (in days) | Liquidation ratio $\mathcal{LR}(t)$ in % | | | | | | |
| 1 | 100.0 | 37.0 | 14.5 | 91.0 | 55.5 | 4.5 | 9.0 |
| 2 | 100.0 | 67.7 | 28.9 | 99.8 | 81.8 | 9.1 | 17.8 |
| 5 | 100.0 | 99.2 | 68.6 | 100.0 | 98.5 | 22.6 | 40.4 |
| 10 | 100.0 | 100.0 | 99.6 | 100.0 | 100.0 | 43.1 | 63.2 |
| $\alpha$ (in %) | Liquidation time $\mathcal{LR}^{-1}(\alpha)$ in days | | | | | | |
| 50 | 1 | 2 | 4 | 1 | 1 | 13 | 7 |
| 75 | 1 | 3 | 6 | 1 | 2 | 24 | 15 |
| 90 | 1 | 4 | 8 | 1 | 3 | 37 | 25 |
| 99 | 1 | 5 | 10 | 2 | 6 | 52 | 152 |

*Source*: Bloomberg & Authors' calculation (data as of April 30, 2015).

In Figure 5, we report the liquidation ratio for different indexes[39]. We notice that the liquidity profile is better for the S&P 500 Index for a size of USD 50 BN than for the EUROSTOXX 50 Index for a size of USD 10 BN. We also observe that liquidating USD 1 BN of MSCI INDIA Index is approximately equivalent to liquidating USD 10 BN of EUROSTOXX 50 Index. To understand these results, we report in Table 8 the free-float market capitalization of each index. For instance, the capitalization of the S&P 500 is equal to USD 18 trillion at the end of April 2015. This contrasts with the capitalization of the MSCI EMU Small Cap, which is equal to USD 448 billion. We also compute the ownership ratio (OR) when the AUM of the index fund are equal to respectively USD 10 BN, USD 50 BN, USD 100 BN and USD 200 BN. We read the results as follows: the ownership ratio is 1.10% for a USD 200 BN fund replicating the S&P 500 Index and a USD 50 BN fund replicating the MSCI EM Index. We also indicate the corresponding size of the fund if we target a given ownership ratio. For instance, if we limit the ownership ratio to be lower than 50 bps, the maximum fund size is respectively USD 91 BN for the S&P 500 Index, USD 13 BN for the EUROSTOXX 50 Index, USD 5 BN for the DAX Index, USD 24 BN for the NASDAQ 100 Index, USD 23 BN for the MSCI EM Index, USD 2 BN for the MSCI INDIA Index and USD 2 BN for the MSCI EMU Small Cap Index.

Table 8: Statistics of the ownership ratio

| Statistics | S&P 500 | ES 50 | DAX | NASDAQ | MSCI | | |
|---|---|---|---|---|---|---|---|
| | | | | | EM | INDIA | EMU SC |
| MC (in USD BN) | 18109 | 2512 | 1052 | 4887 | 4564 | 381 | 448 |
| AUM (in USD BN) | Ownership ratio in % | | | | | | |
| 10 | 0.06 | 0.40 | 0.95 | 0.20 | 0.22 | 2.62 | 2.23 |
| 50 | 0.28 | 1.99 | 4.75 | 1.02 | 1.10 | 13.12 | 11.16 |
| 100 | 0.55 | 3.98 | 9.51 | 2.05 | 2.19 | 26.25 | 22.32 |
| 200 | 1.10 | 7.96 | 19.01 | 4.09 | 4.38 | 52.49 | 44.64 |
| OR (in %) | Maximum fund size in USD BN | | | | | | |
| 0.1 | 18 | 3 | 1 | 5 | 5 | 0 | 0 |
| 0.5 | 91 | 13 | 5 | 24 | 23 | 2 | 2 |
| 1 | 181 | 25 | 11 | 49 | 46 | 4 | 4 |
| 2 | 362 | 50 | 21 | 98 | 91 | 8 | 9 |

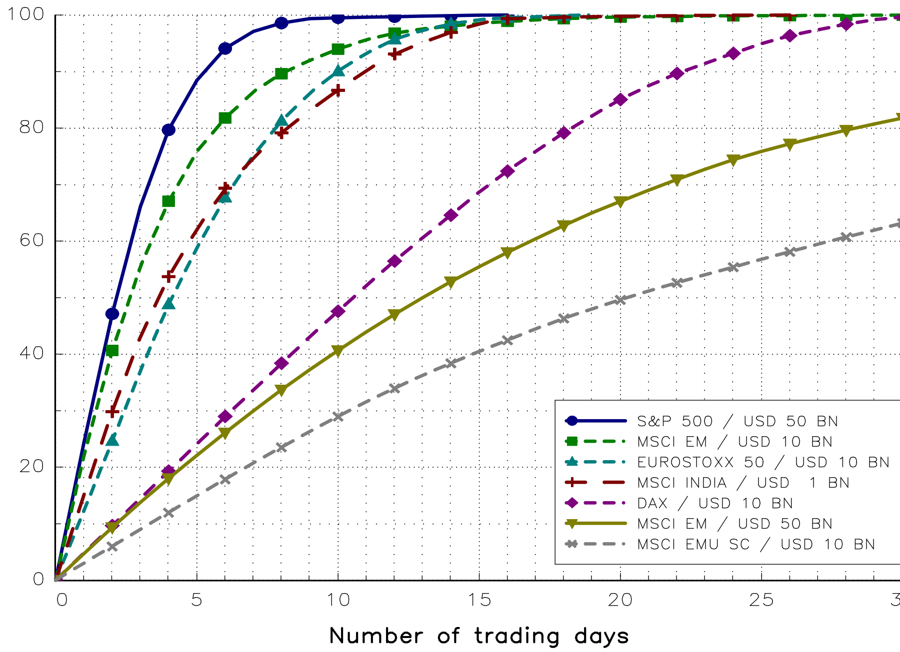
*Source*: Bloomberg & Authors' calculation (data as of April 30, 2015).

Besides the asset class, another important factor that affects liquidity is portfolio construction. Previously, the results were obtained by considering a cap-weighted (CW) portfolio. By definition, active management uses different weighting schemes for portfolios. In this case, liquidity is lower. Suppose a fund manager picking $n$ stocks in the universe of the S&P 500 index and building an equally-weighted (EW) portfolio of these $n$ active bets. The liquidity of the active fund will depend on the picked stocks, but also on the number $n$ of stocks. For instance, we compare the liquidation ratio[40] of the S&P 500 CW and EW portfolios in Figure 6. Notice how liquidity decreases. And this liquidity would have decreased even more with a more concentrated portfolio ($n < 500$).

[39] In Appendix C on pages 49 to 52, we report the liquidation ratio of the seven equity indexes when the ADV is 10% and 30% and the liquidation size is 1, 10 and 50 billion of USD.

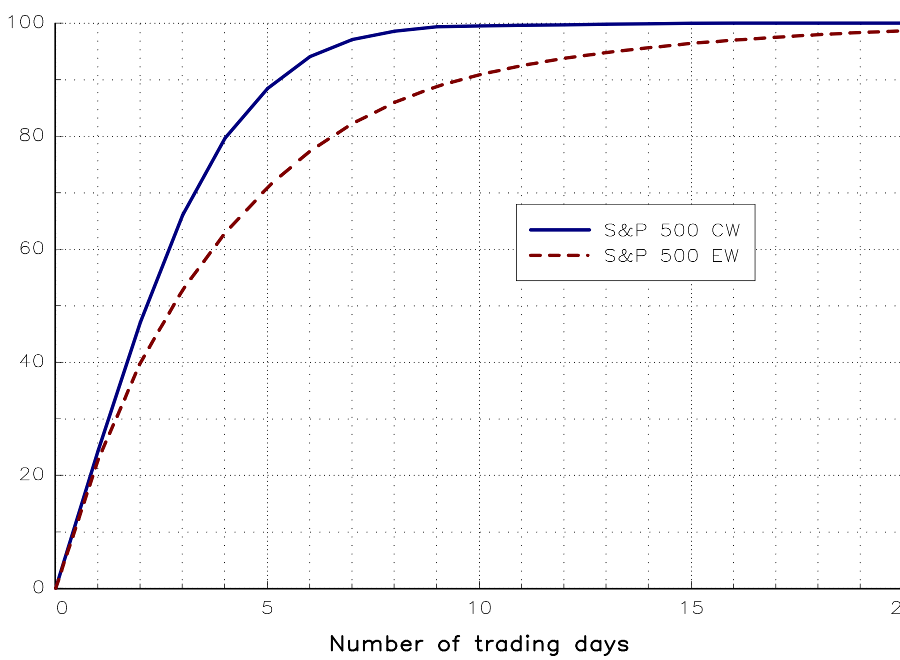
[40] We use 10% ADV for the liquidation policy.

Figure 5: Comparing the liquidation ratio (in %) between index funds




*Source*: Bloomberg & Authors' calculation.

Figure 6: Comparing the liquidation ratio (in %) between index and active funds




*Source*: Bloomberg & Authors' calculation.

All these numerical results illustrate that the liquidity risk of an investment can not be measured by its size. This questions the role of an absolute materiality threshold on size, because liquidity risk is certainly (one of) the most important components of systemic risk.

**Remark 4** *It would be valuable to study the liquidation ratio for bond markets. Unfortunately, there is no or poor data available to measure the average daily volume or the turnover of bonds. Nevertheless, we suspect that the bond market is less liquid than the stock market*[41]*. Even if we may find some contradictory figures*[42]*, there is no serious study with reliable data that can confirm that the liquidity of the bond market is similar to the liquidity of the stock market. Generally, people make a mistake by approximating the bond liquidity using the fixed-income futures market. One problem is that the cash bond market is generally a one-way market driven by buyers. Indeed, when buying a bond, most investors generally keep it until maturity. The secondary market is therefore very small compare to the primary market. Sometimes, one observes a market reversal meaning the bond market becomes a one-way market with only sellers. It is then difficult to compute realistic liquidation ratios because liquidity varies highly across time.*

## 4.3 Specialized investment funds

We consider three specialized investment fund categories which are often blamed for creating systemic risk. These funds, which are money market funds, exchange traded funds and hedge funds, are sometimes decried and their roles demonized in periods of crisis. Remember, for instance, when in 2008, some (in academia or mainstream media) explained how the subprime crisis was due to hedge funds. We now know that it was not the case.

### 4.3.1 The case of money market funds

According to the Investment Company Institute[43], total money market fund assets were USD 2.6 trillion in May 2015. In Table 9, we report the list of the largest money market funds in terms of AUM. Only three funds meet the FSB-IOSCO materiality threshold for investment funds. As we noted above, MMFs have been involved in a systemic shock during the 2007-2008 financial crisis due to investors' lack of confidence in the composition of prime MMFs. The root cause of the sudden lack of confidence of investors in MMFs can be found in the pro-cyclical provision of liquidity and maturity transformation activities of these funds. Interestingly, the risks associated with these activities are similar to the ones borne by banks which make MMFs part of the shadow banking sector. Separate studies and regulatory proposals have been made recently to regulate this sector of the financial credit markets (e.g., FSB, 2014; EBA, 2015).

An interesting question to ponder is whether it is adequate to include MMFs in the regulatory framework on SIFIs as these funds' systemic risk will be regulated for the entire MMF asset class by the current prudential proposals on shadow banking. Furthermore, large MMFs are often subsidiaries of financial institutions such as banks or asset managers, and it may be better to address any systemic risk created by these funds at the level of their parent institutions.

[41] See for instance Wang *et al.* (2008), Bao *et al.* (2011) and Dick-Nielsen *et al.* (2012).

[42] They are generally obtained with data from before the 2007-2008 financial crisis. But the liquidity observed in 2005 and 2006 was certainly abnormal.

[43] Statistics are available at the following web page: `http://www.ici.org/research/stats/mmf`.

Table 9: Largest money market funds (in USD BN)

| Fund | AUM |
|---|---|
| Vanguard Prime Money Market | 132.4 |
| JPMorgan Prime Money Market | 110.3 |
| Fidelity® Cash Reserves | 110.1 |
| Fidelity® Instl MM Fds Money Mkt | 65.0 |
| BlackRock Liquidity TempFund | 56.8 |
| JPMorgan US Government Money Market | 54.2 |
| Wells Fargo Advantage Heritage MMkt | 42.3 |
| Prudential Core Taxable MMkt | 41.0 |
| BlackRock Cash Funds Instl | 40.2 |
| Fidelity® Instl MM Fds Prime MMkt | 39.1 |
| Schwab Cash Reserves™ | 38.5 |
| Morgan Stanley Inst Liquidity Gov | 38.5 |
| Dreyfus Treasury Pr Cash Mgmt | 37.4 |
| Goldman Sachs Fincl Sqr Trs Instr | 37.2 |
| State Street Instl Liquid Reserves | 35.1 |
| Federated Prime Obligations | 34.1 |
| Goldman Sachs FS Government | 31.4 |
| Goldman Sachs FS Money Market | 30.5 |

*Source*: Morningstar's database, May 5, 2015.

### 4.3.2 The case of exchange traded funds

According to ETFGI (2015), the global ETF industry manages USD 2.8 trillion of assets at the end of April 2015. The dynamic evolution of the ETF market is very impressive with an annual growth of 25% since 2001. In Table 10, we report the largest ETFs. Most of them are equity funds, mainly because it is easier to provide intra-day liquidity on this asset class[44].

The rise of ETFs explains why this market has been under the scrutiny of supervisors and regulators these last years and has led to many debates[45] (synthetic versus physical replication, collateral risk, security lending, herding risk, volatility impact, etc.). Credit counterparty risk may be a problem, but the results of Hurlin *et al.* (2015) showed that it has been overestimated. Another important issue concerns the liquidity profile of ETFs. Past experiences show that there are some liquidity benefits to introducing ETFs (De Winne *et al.*, 2014). However, an ETF's liquidity cannot be higher than the liquidity of the underlying market. It is not an important issue for equity markets, but it may be a concern for some segments of the bond markets (credit, high yield, municipal bonds). The June 2013 episode is an example of a stressed period for those markets and we observed to some extent its repercussion on the ETF US market. For instance, some large High Yield ETFs traded with a discount to NAV of under 1%, while other municipal or emerging markets bonds ETFs temporarily stopped redemptions. However, this episode is more the direct result rather than the source of the bond market sell-off. This example also shows the blurred line

[44] ETFGI (2015) estimates that equities and bonds represent respectively 77.2% and 15.4% of ETFs/ETPs assets.

[45] See for instance FSB (2011), Ramaswamy (2011), Ben-David *et al.* (2014), Hurlin *et al.* (2015).

between risk factors and risk impacts[46]. It also demonstrates how liquidity is always the most likely transmission channel of systemic risk to which the asset management industry contributes.

Table 10: Largest exchange traded funds (in USD BN)

| Fund | AUM |
|---|---|
| SPDR S&P 500 ETF Trust | 173.9 |
| iShares Core S&P 500 ETF | 68.1 |
| iShares MSCI EAFE ETF | 60.2 |
| Vanguard Total Stock Market ETF | 55.9 |
| Vanguard FTSE Emerging Markets ETF | 50.1 |
| PowerShares QQQ Trust | 39.5 |
| iShares MSCI Emerging Markets ETF | 33.0 |
| Vanguard S&P 500 ETF | 31.4 |
| iShares Russell 1000 Growth ETF | 29.0 |
| Vanguard FTSE Developed Markets ETF | 27.5 |
| Vanguard Total Bond Market ETF | 27.2 |
| Vanguard REIT ETF | 26.7 |
| iShares Russell 2000 ETF | 26.7 |
| iShares Russell 1000 Value ETF | 25.8 |
| iShares Core S&P Mid-Cap ETF | 25.3 |
| iShares Core U.S. Aggregate Bond ETF | 24.3 |

*Source*: ETFGI, April 2015.

### 4.3.3 The case of hedge funds

The default of a hedge fund can certainly be a source of systemic risk as demonstrated by LTCM. Table 11 reports the largest hedge funds in terms of AUM. According to the data from the Morningstar database, the only hedge fund that could qualify as a SIFI under the proposed materiality threshold is the Bridgewater Pure Alpha Strategy 18% Vol with USD 32.5 billion in AUM. However, the strategy of that fund is certainly close to the strategy of the Bridgewater Pure Alpha Strategy 12% Vol which accounts for another USD 10 billion. This raises the question of whether family of funds with very similar investment strategies[47] and mandates would not be a better unit of assessment of potential systemic risk if AUM size is a major screening tool as it is currently[48]. Furthermore, in terms of AUM the hedge fund industry represents only a fraction of the assets managed by mutual funds or banks[49]. Hence, size does not seem to be an appropriate screening criterion if used on its own.

Of particular importance when considering the risk created by hedge funds is the issue of leverage, and some attempt has been made to include leverage in the materiality threshold

[46] Indeed, a market becoming illiquid will be revealed by the ETF market.

[47] The practice of using a similar strategy for different risk profiles is very frequent in the asset management industry. We can cite for instance Amundi with the VaR funds (VaR 2, VaR 4, VaR 8, VaR 20), which reached about USD 60 billion of assets at the end of 2006.

[48] This issue is particularly relevant with the multiplicity of investment formats (on-shore, AIFM, UCITS, mandates, etc.).

[49] According to Hedge Fund Research (`www.hedgefundresearch.com`), hedge fund assets approach USD 3 trillion at the first quarter of 2015.

Table 11: Largest hedge funds (in USD BN)

| Fund | AUM | |
|---|---|---|
| | F | AM |
| Bridgewater Pure Alpha Strategy 18% Vol | 32.5 | 169.3 |
| Brevan Howard Fund Limited Class A | 17.2 | 23.6 |
| Millennium International Ltd | 16.6 | 27.6 |
| Winton Futures Class B | 12.8 | 31.1 |
| Bridgewater Pure Alpha Strategy 12% Vol | 10.0 | 169.3 |
| AQR DELTA Fund | 9.7 | 131.5 |
| Bridgewater All Weather 12% Strategy | 8.0 | 169.3 |
| Millennium USA LP Fund | 7.2 | 27.6 |
| Babson Capital Global Loan A Acc | 6.3 | 217.4 |
| Renaissance Inst Diversified Alpha Fund | 5.2 | 27.1 |

*Source*: Morningstar's database, May 5, 2015.

criteria proposed by FSB-IOSCO in March 2015. It may be worth remembering first that leverage can evolve very quickly as the LTCM story epitomizes even for buy-and-hold strategies. Second, hedge funds' exposures to equity, liquidity, credit or volatility risk factors are typically very dynamic and adjusted down in periods of crisis (Roncalli and Weisang, 2009; Billio *et al.*, 2010; 2012). While an important factor, hedge fund leverage can consequently be difficult to monitor in a timely fashion for regulatory agencies. Furthermore, it may not be as representative of systemic risk nowadays as it was before the 2007-2008 crisis. In particular, new rules on derivative trading and margin requirements[50] make it harder for hedge funds to build leverage on most common assets (Dixon *et al.*, 2012).

More importantly, the combination of leverage with illiquid assets is potentially more prone to creating systemic risk than leverage alone (even considering high leverage ratios). In fact, the default of a mid-size hedge fund portfolio (in terms of AUM) invested, with leverage, in illiquid assets and being either strategically well interconnected with other large SIFI or being a strategic player in a particular market can create greater havoc through the exposures/counterparty channel (because of non-linear network effects) than a very large fund invested in highly liquid assets, such as a large US equity mutual fund. Such fund would not be considered among the candidates for the SIFI designation under the current proposal.

## 5 Discussion

In the following section, we discuss some specific points in the second version of the FSB-IOSCO proposal (FSB-IOSCO, 2015) with regards to defining SIFIs in the asset management industry. We start by discussing the appropriateness of some proposed indicators of the complexity and global activity dimensions of systemic risk for asset managers. Next, we discuss the current materiality thresholds proposed. Finally, we conclude with a proposal for a more robust scoring system to screen for SIFIs in the asset management industry.

[50]See the Dodd-Frank act in the U.S. for example.

## 5.1 Remarks on FSB-IOSCO indicators

In section 2, we showed, albeit in the case of banks, that while the systemic risk indicators across categories have high correlation coefficients, they capture different dimensions of systemic risk which is difficult to sum up to one number. Consequently, each category of indicators must be carefully examine and choices must be made based on the adequacy of the measures to the type of financial institutions. In the case of the asset managements and investment funds, the proposed FSB-IOSCO indicators for the "complexity" and the "cross-jurisdictional activities" categories are ill-defined and do not capture appropriately the systemic risk created by the activities of an asset manager. While it may be difficult to offer remedial options, the inadequacy of these measures must be discussed if only to ensure that in step 2 of the proposed assessment methodology, the qualitative assessment does not paint an inaccurate picture of the institutions under consideration.

In the "complexity" category, we find that for investment funds, the indicators 4-2 (ratio of collateral posted by counterparties that has been re-used by the fund) and 4-3 (proportion of an investment fund's portfolio using high-frequency trading (HFT) strategies) may not capture the intended risks or are too vaguely defined. Indeed, few funds re-use to some extent the collateral posted by counterparties. Similarly, high-frequency trading strategies are generally implemented by small or medium size funds. Hence, by construction, this complexity category is incompatible with the current materiality thresholds. Indeed, as seen in Table 5, the largest mutual funds use very simple strategies and are far from complex. These indicators are therefore inadequate. A more interesting indicator is certainly the average turnover of a fund. It is a simple statistic which indicates how actively a portfolio is managed. The complexity category also contains two liquidity metrics, which are the indicators 4.4 (liquidity profile) and 4.7 (amount of less liquid assets). Since we believe that liquidity is the backbone of systemic risk, we find it regrettable that only two indicators among 22 proposed are concerned with this particular dimension of risk.

In the "cross-jurisdictional activities" category, we find that the number of jurisdictions in which an asset manager has a presence[51] or the number of jurisdictions in which a fund is sold[52] is not necessarily representative of systemic risk. In fact, one may be trading global systemic risk for regional systemic risk. Indeed, a wide base of clients spanning different regions and having many different outlooks and needs could be a source of stability for an asset manager or a fund along the principle of diversification. Conversely, microcosmic network effects can come into play and destabilize a particular regional market. Investors from different large but geographically similarly located institutions cross paths regularly at social functions and informally exchange market sentiments and opinions. One could easily envision a scenario in which a large player in a national market decide to move on a particular asset manager (e.g., redeem) for purely idiosyncratic reasons but, because of its prominence on that national market place, subsequently leads the rest of the national players to redeem as well but this time for "systemic" reasons. Another aspect of this ill-defined measure is that most asset managers do not have custody of their clients' assets. Hence, the demise of an asset manager should not impact the clients' assets even across jurisdictions.

In order to resolve these issues, one may need to amend the definition of systemic risk to include mention of the impact of any systemic shock on the "real" economy as opposed to only "wealth" losses. Hence, losses due to market fluctuations may reflect a real change in the value of the real assets but does no harm to the functioning of the "real" economy.

[51] Indicator 5-1 for an asset manager.

[52] Indicator 5-2 for investment funds.

While this may be difficult to quantify, it is worth bearing in mind when assessing these measures. At worst, we may end up declaring SIFI institutions that are not and may provide by sheer size and extensiveness of their activities valuable services to the financial markets and their participants, while failing to capture others that are more systemically vital. The consequent cost for these institutions of this designation may well weaken the system as a whole and therefore be a source of fragility.

## 5.2 Remarks on the proposed materiality thresholds

We report in section 4 several tables summarizing by types (mutual funds, hedge funds, money market funds and exchange traded funds) the largest asset managers in each of these categories. Strikingly, when we apply the materiality thresholds described above, the list of potential SIFIs is limited to large equity long-only funds, and does not capture some of the players that were at the origins of past systemic shocks or more importantly the future likely sources of these shocks.

Second, the materiality threshold does not account for the nature of the instruments held in portfolio. The approach proposed is not therefore risk sensitive. It muddles together developed market and emerging market equities, government and corporate bonds and derivative instruments under the AUM banner. It is well known however that the nature of risk differs significantly among asset classes (not to mention the complexity of financial instruments). Hence, a fund managing USD 100 billion in equity is myopically seen as as risky as a fund managing USD 100 billion in bonds, or similarly USD 100 billion in developed market equity with USD 100 billion in emerging markets equity. Under this scenario, a USD 15 billion hedge fund with a leverage ratio of just under 10 running a strategy involving complex and exotic financial instruments is seen as less systemically risky than the SPDR S&P 500 ETF. Leverage can however change very quickly as the LTCM episode epitomizes well.

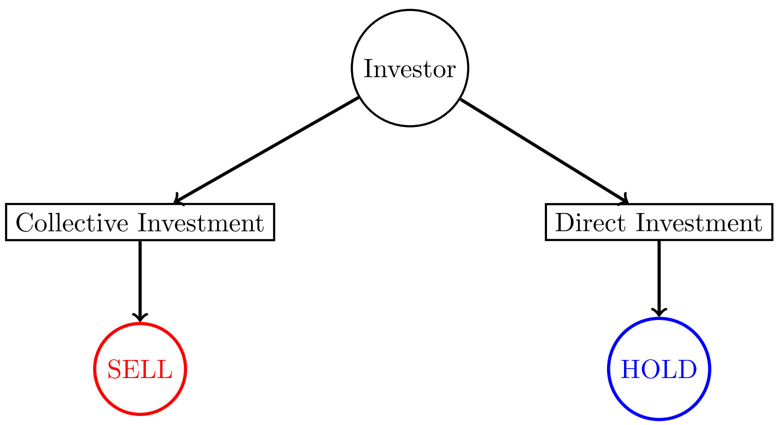
In fact, size as the main criterion for a materiality threshold to define a SIFI seems hardly appropriate, because net size is never but a measure of the “size” (or amplitude) of the linear effects of a shock. It is true that (net) size is often a by-product of successful institutions or portfolios that attract a large pool of investors (or a pool of large investors). Hence, size goes hand-in-hand with systemic risk, and can be seen as a gross proxy for the original amplitude of a systemic shock. However, size by itself is not a source of systemic risk and criticality-due-to-size is relative to the characteristics of markets and asset classes. Often at play are threshold effects.

In the end, liquidity in all its forms (and lack thereof) is crucial to the spread of risk. Even the problem caused by leverage is ultimately a problem of liquidity. Indeed, at least theoretically, one always knows where the line that cannot be crossed is. The problem is: can you unwind a position fast enough or with costs low enough so as to not cross that line? Differences in liquidity can multiply the size effect of asset liquidations depending on the market conditions for a particular asset. Furthermore, this is exactly when and where non-linear effects become primordial and net size looses its value as proxy for systemic risk. At this point, strategic position and interconnectedness of the troubled financial institution (substitutability and critical function channels) become more important than size to define and capture the systemic risk created. Any materiality threshold should attempt to capture how these non-linear effects can distort the map of systemic risk.

## 5.3 A proposal for a more robust scoring system

Our previous analysis highlights different issues concerning the current methodological proposal to identify NBNI SIFIs in the asset management category. To (partially) address them, we propose to take asset classes into consideration when deciding on a materiality threshold. The idea is that the current proposal is not risk (or liquidity) sensitive, meaning it does not take asset liquidity into account in defining materiality thresholds. As a result, the major "systemic" players are the long-only equity funds and not the actively managed funds with complex and highly leveraged strategies. Moreover, at the fund level, distortions are possible by breaking up large funds into families of smaller funds with similar strategies. Therefore, systemic risk should be assessed primarily at the asset manager level.

Figure 7: Rational decision in a period of liquidity stress




The central tenet of the relationship between systemic risk and asset management revolves around liquidity transformation and the liquidity promise. By definition, asset management creates systemic risk if an investment in a collective investment scheme adds risk when compared to direct investment and if this additional risk is sufficiently large to create a systemic shock. In a period of liquidity stress, the rational choice of an investor who participates in a collective investment fund is to redeem quickly his exposures (first-mover advantage). Conversely, when the investor is directly invested, the rational choice is to hold his exposures until normalization of the market. This difference explains why pension funds are excluded from the NBNI-SIFI framework.

We propose then the following scoring system for a materiality threshold. The asset manager's score $S$ is the arithmetic sum of the scores of the different funds that compose the asset manager's portfolio

$$S = \sum_i S_i$$

The score of the fund $i$ is defined as follows

$$S_i = \mathrm{AUM}_i \times \mathrm{LEV}_i \times \lambda_i$$

where $\mathrm{LEV}_i$ is the portfolio leverage and $\lambda_i$ is an asset liquidity factor that depends on the asset class of the portfolio. Ideally, this scoring should be linear with respect to asset

classes, meaning that a complex portfolio's score should be a weighted sum of the score of each sub-portfolio when dividing by asset classes. However it would be difficult to put in practice. We therefore propose to create a diversified category for portfolios which are exposed to several asset classes.

Calibrating the liquidity factors can be done statistically or by experts. The idea to estimate the liquidity factor is to find the equivalent size $x_j$ of a fund invested in the asset class $j$ which presents the same liquidity profile than a fund of size $x_i$ invested in the asset class $i$. In this case, we have

$$\frac{\lambda_j}{\lambda_i} = \frac{x_i}{x_j}$$

An example of the liquidity factors matrix could be the following:

| Asset Class | | $\lambda_i$ |
|---|---|---|
| Equities | Developed Markets | 1.00 |
| | Emerging Markets | 1.25 |
| | Small Caps | 1.50 |
| Bonds | Short Maturity | 1.50 |
| | Sovereign | 2.00 |
| | Investment Grade | 2.00 |
| | High Yield | 2.50 |
| | Emerging Markets | 2.50 |
| Foreign Exchanges | Developed Markets | 1.00 |
| | Emerging Markets | 1.25 |
| Alternative Investments | Commodities | 2.00 |
| | Real Estate | 3.00 |
| Specialized Funds | Diversified | 1.50 |
| | Closed-end Fund | 0.00 |
| | CW Index Funds on High Liquid DM Equity Indexes | 0? |

Obviously, closed-end funds must be excluded from the computation of the materiality threshold. Another issue concerns the cap-weighted index funds, which replicate highly liquid developed market equity indexes. It is difficult to see how such funds can add to systemic risk when compared to direct investment. For instance, what is the difference in terms of systemic risk between a direct investment (or a mandate) in the S&P 500 Index and participating in a very large collective fund that replicates the S&P 500 Index? We think the difference so small as to be negligible. There is perhaps systemic risk due to the market behavior, that is the behavior of the *asset owners*. But the *asset manager* does not create supplementary systemic risk in this case, because the fund portfolio is exactly the market portfolio.

# 6 Conclusion

The FSB-IOSCO framework published in March 2015 is a step further for the identification of NBNI SIFIs, in particular in the asset management industry. Compared with the first consultation paper which only focused on the fund level, this second consultation paper reintroduces the opportunity to define NBNI SIFIs at the asset manager level. We think this is the appropriate level to identify systemic risk. Indeed, systemic risk added by asset management, that is using collective investment vehicles, is principally related to four risks:

portfolio risk, reputational risk, leverage risk and liquidity risk. Ultimately, the issue behind each of these risks is to face a run in a market that cannot absorb large redemptions. Nevertheless, a run on a single fund is rare. Indeed, a strategy developed by a fund manager which encounters success is generally duplicated in other funds and mandates. Moreover, such stress situations for one fund generally affect as well the remaining business of the asset manager.

The additional layer of systemic risk induced by asset managers must be measured relative to the systemic risk already induced by the behavior of asset owners. It appears that this supplementary risk is essentially related to the liquidity promise (or liquidity transformation) of collective investment funds or the talent and the success of a fund manager. At the asset manager level, systemic risk coincides then with liquidity risk because of large redemptions. It is therefore important to take this factor into account when defining the future assessment pool of potential SIFIs in the asset management industry. We propose then a scoring system sensitive to the liquidity factor because we think it essential to complement the current proposal to determine the materiality threshold.

In this paper, we have shown that a criterion based exclusively on size perceives systemic risk in asset management as stemming mainly from the largest long-only equity index funds that replicate high-liquid cap-weighted equity indexes. This is paradoxical since most of past systemic risk events did not involve such funds. Moreover, by construction, these funds have no more, no less, the same behavior than their underlying markets. Consequently, we think the current materiality thresholds leave out key dimensions of systemic risk: leverage risk, liquidity risk and the risk of the investment strategy.

The FSB-IOSCO framework represents the first step of identification to address the question of systemic risk in the asset management industry. This first step will be complemented by a second step concerned with prudential policies. There are already large differences between the major players in terms of supervision and regulatory requirements. Before defining a regulatory framework addressing the management of systemic risk, it would be valuable to harmonize the current requirements concerning capital and risk management across jurisdictions and between asset managers. Moreover, whereas channels of systemic risk have been extensively studied in banking institutions, systemic risk implied by the asset management industry has so far been poorly documented. To explore this topic is a big challenge yet for academia that must be met in order to help supervisory bodies around the world to define a fair methodology.

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# A Mathematical results

## A.1 Systemic risk measures in the Gaussian case

### A.1.1 Marginal expected shortfall

Let us assume that the losses are normally distributed

$$(L_1, \ldots, x_n) \sim \mathcal{N}(\mu, \Sigma)$$

We can show that

$$\mathrm{ES}_\alpha(x) = x^\top \mu + \frac{\phi\left(\Phi^{-1}(\alpha)\right)}{1-\alpha}\sqrt{x^\top \Sigma x}$$

It follows that the marginal expected shortfall is

$$\mathrm{MES}_\alpha(i) = \mu_i + \frac{\phi\left(\Phi^{-1}(\alpha)\right)}{(1-\alpha)\sqrt{x^\top \Sigma x}}(\Sigma x)_i$$

Another expression of MES is

$$\mathrm{MES}_\alpha(i) = \mu_i + \beta_i(x) \cdot (\mathrm{ES}_\alpha(x) + \mathbb{E}(L))$$

where $\beta_i(x)$ is the beta of the bank loss with respect to the total loss

$$\beta_i(x) = \frac{\mathrm{cov}(L, L_i)}{\sigma^2(L)} = \frac{(\Sigma x)_i}{x^\top \Sigma x}$$

### A.1.2 Conditional value-at-risk

We also have

$$\begin{pmatrix} L_i \\ L(x) \end{pmatrix} \sim \mathcal{N}\left(\begin{pmatrix} \mu_i \\ x^\top \mu \end{pmatrix}, \begin{pmatrix} \sigma_i^2 & (\Sigma x)_i \\ (\Sigma x)_i & x^\top \Sigma x \end{pmatrix}\right)$$

We deduce that

$$L(x) \mid L_i = \ell \sim \mathcal{N}\left(\mu_i(\ell), \sigma_i^2(\ell)\right)$$

with

$$\mu_i(\ell) = x^\top \mu + \frac{(\ell - \mu_i)}{\sigma_i^2}(\Sigma x)_i$$

and:

$$\sigma_i^2(\ell) = x^\top \Sigma x - \frac{(\Sigma x)_i^2}{\sigma_i^2}$$

It follows that

$$\begin{aligned}
\mathrm{CoVaR}_\alpha(L_i = \ell) &= \mu_i(\ell) + \Phi^{-1}(\alpha)\,\sigma_i(\ell) \\
&= x^\top \mu + \frac{(\ell - \mu_i)}{\sigma_i^2}(\Sigma x)_i + \Phi^{-1}(\alpha)\sqrt{x^\top \Sigma x - \frac{(\Sigma x)_i^2}{\sigma_i^2}}
\end{aligned}$$

Because $\mathrm{VaR}_\alpha(L_i) = \mu_i + \Phi^{-1}(\alpha)\,\sigma_i$ and $m(L_i) = \mu_i$, we finally obtain

$$\Delta\,\mathrm{CoVaR}_\alpha(i) = \Phi^{-1}(\alpha)\sum_{j=1}^n x_j \rho_{i,j} \sigma_j$$

Another expression of $\Delta\,\mathrm{CoVaR}_\alpha(i)$ is

$$\Delta\,\mathrm{CoVaR}_\alpha(i) = \Phi^{-1}(\alpha)\,\beta_i(x)\,\frac{\sigma^2(L)}{\sigma_i}$$

### A.2 Computing the liquidation ratio

We consider a fund invested in $n$ assets. We denote $(N_1, \ldots, N_n)$ the number of shares hold by the fund. Let $P_i$ be the current price of asset $i$. The assets under management is equal to

$$\mathrm{AUM} = \sum_{i=1}^{n} N_i \cdot P_i$$

For each asset that composes the portfolio, we denote $N_i^+$ the maximum number of shares for asset $i$ that can be sold during a trading day. The number of shares $N_i(t)$ liquidated at time $t$ is defined as follows

$$N_i(t) = \min \left( \left( N_i - \sum_{k=0}^{t-1} N_i(k) \right)^+, N_i^+ \right)$$

with $N_i(0) = 0$. The liquidation ratio $\mathcal{LR}(t)$ is the proportion of the fund liquidated after $t$ trading days

$$\mathcal{LR}(t) = \frac{\sum_{k=0}^{t} N_i(k) \cdot P_i}{\sum_{i=1}^{n} N_i \cdot P_i}$$

## B Tables

Table 12: List of global systemically important banks (November 2014)

| | | |
|---|---|---|
| Agricultural Bank of China | Bank of America | Bank of China |
| Bank of New York Mellon | Barclays | BBVA |
| BNP Paribas | Citigroup | Credit Suisse |
| Deutsche Bank | Goldman Sachs | Group Crédit Agricole |
| Groupe BPCE | HSBC | ICBC Limited |
| ING Bank | JP Morgan Chase | Mitsubishi UFJ FG |
| Mizuho FG | Morgan Stanley | Nordea |
| Royal Bank of Scotland | Santander | Société Générale |
| Standard Chartered | State Street | Sumitomo Mitsui FG |
| UBS | Unicredit Group | Wells Fargo |

*Source*: FSB (2014), 2014 Update of List of Global Systemically Important Banks (G-SIBs).

Table 13: List of global systemically important insurers (November 2014)

| |
|---|
| Allianz SE |
| American International Group, Inc. |
| Assicurazioni Generali S.p.A. |
| Aviva plc |
| Axa S.A. |
| MetLife, Inc. |
| Ping An Insurance (Group) Company of China, Ltd. |
| Prudential Financial, Inc. |
| Prudential plc |

*Source*: FSB (2014), 2014 Update of List of Global Systemically Important Insurers (G-SIIs).

Table 14: Computation of the BNP Paribas systemic score (December 2013)

| Category | Indicator | Indicator value[(1)] | Sample total[(1)] | Indicator score[(2)] | Category score[(2)] |
|---|---|---|---|---|---|
| Size | Total exposures | 2,032 | 66,313 | 306 | 306 |
| Interconnectedness | Intra-financial system assets | 205 | 7,718 | 266 | 370 |
| | Intra-financial system liabilities | 435 | 7,831 | 556 | |
| | Securities outstanding | 314 | 10,836 | 290 | |
| Substitutability/financial insitution infrastructure | Payment activity | 49,557 | 1,850,755 | 268 | 369 |
| | Assets under custody | 4,181 | 100,012 | 418 | |
| | Underwritten transactions in debt and equity markets | 189 | 4,487 | 422 | |
| Complexity | Notional amount of OTC derivatives | 39,104 | 639,988 | 611 | 505 |
| | Trading and AFS securities | 185 | 3,311 | 559 | |
| | Level 3 assets | 21 | 595 | 346 | |
| Cross-jurisdictional activity | Cross-jurisdictional claims | 877 | 15,801 | 555 | 485 |
| | Cross-jurisdictional liabilities | 584 | 14,094 | 414 | |
| Final score | | | | | 407 |

[(1)]The figures are expressed in billion of EUR.

[(2)]The figures are expressed in bps.

*Source*: BCBS (2014), G-SIB Framework: Denominators & BNP Paribas (2014), Disclosure for G-SIBs indicators as of 31 December 2013.

Table 15: Statistics of the liquidation ratio (size = USD 1 BN, adv = 10%)

| Statistics | S&P 500 | ES 50 | DAX | NASDAQ | MSCI EM | MSCI INDIA | MSCI EMU SC |
|---|---|---|---|---|---|---|---|
| $t$ (in days) | Liquidation ratio $\mathcal{LR}(t)$ in % | | | | | | |
| 1 | 100.0 | 90.1 | 47.6 | 99.9 | 93.9 | 15.1 | 29.0 |
| 2 | 100.0 | 100.0 | 85.0 | 100.0 | 99.6 | 29.8 | 49.6 |
| 5 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 62.2 | 80.3 |
| 10 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 86.6 | 94.2 |
| $\alpha$ (in %) | Liquidation time $\mathcal{LR}^{-1}(\alpha)$ in days | | | | | | |
| 50 | 1 | 1 | 2 | 1 | 1 | 4 | 3 |
| 75 | 1 | 1 | 2 | 1 | 1 | 8 | 5 |
| 90 | 1 | 1 | 3 | 1 | 1 | 11 | 8 |
| 99 | 1 | 2 | 3 | 1 | 2 | 16 | 46 |

Table 16: Statistics of the liquidation ratio (size = USD 1 BN, adv = 30%)

| Statistics | S&P 500 | ES 50 | DAX | NASDAQ | MSCI EM | MSCI INDIA | MSCI EMU SC |
|---|---|---|---|---|---|---|---|
| $t$ (in days) | Liquidation ratio $\mathcal{LR}(t)$ in % | | | | | | |
| 1 | 100.0 | 100.0 | 99.6 | 100.0 | 100.0 | 43.1 | 63.2 |
| 2 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 69.4 | 85.3 |
| 5 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 98.5 | 96.8 |
| 10 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 98.2 |
| $\alpha$ (in %) | Liquidation time $\mathcal{LR}^{-1}(\alpha)$ in days | | | | | | |
| 50 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| 75 | 1 | 1 | 1 | 1 | 1 | 3 | 2 |
| 90 | 1 | 1 | 1 | 1 | 1 | 4 | 3 |
| 99 | 1 | 1 | 1 | 1 | 1 | 6 | 16 |

Table 17: Statistics of the liquidation ratio (size = USD 50 BN, adv = 10%)

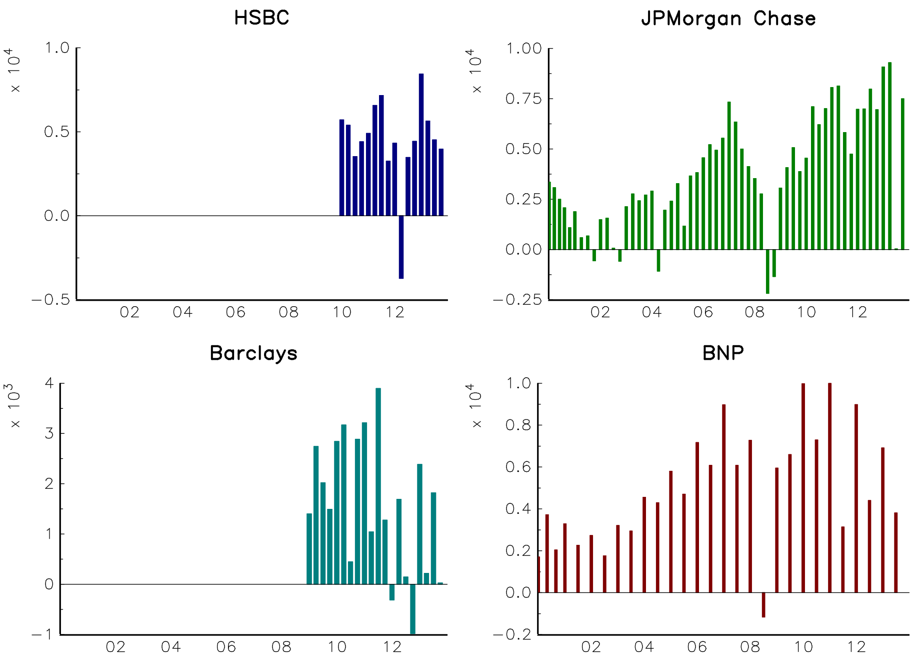
| Statistics | S&P 500 | ES 50 | DAX | NASDAQ | MSCI EM | MSCI INDIA | MSCI EMU SC |
|---|---|---|---|---|---|---|---|
| $t$ (in days) | Liquidation ratio $\mathcal{LR}(t)$ in % | | | | | | |
| 1 | 24.3 | 2.5 | 1.0 | 8.3 | 4.7 | 0.3 | 0.6 |
| 2 | 47.1 | 4.9 | 1.9 | 16.7 | 9.3 | 0.6 | 1.2 |
| 5 | 88.4 | 12.3 | 4.8 | 40.1 | 22.1 | 1.5 | 3.0 |
| 10 | 99.5 | 24.7 | 9.6 | 72.6 | 40.6 | 3.0 | 6.0 |
| $\alpha$ (in %) | Liquidation time $\mathcal{LR}^{-1}(\alpha)$ in days | | | | | | |
| 50 | 3 | 21 | 53 | 7 | 14 | 181 | 102 |
| 75 | 4 | 35 | 84 | 11 | 25 | 353 | 211 |
| 90 | 6 | 50 | 111 | 15 | 41 | 548 | 370 |
| 99 | 9 | 74 | 144 | 22 | 83 | 776 | 2273 |

Table 18: Statistics of the liquidation ratio (size = USD 50 BN, adv = 30%)

| Statistics | S&P 500 | ES 50 | DAX | NASDAQ | MSCI EM | MSCI INDIA | MSCI EMU SC |
|---|---|---|---|---|---|---|---|
| $t$ (in days) | Liquidation ratio $\mathcal{LR}(t)$ in % | | | | | | |
| 1 | 66.1 | 7.4 | 2.9 | 24.7 | 13.8 | 0.9 | 1.8 |
| 2 | 94.1 | 14.8 | 5.8 | 47.2 | 26.1 | 1.8 | 3.6 |
| 5 | 100.0 | 37.0 | 14.5 | 91.0 | 55.5 | 4.5 | 9.0 |
| 10 | 100.0 | 67.7 | 28.9 | 99.8 | 81.8 | 9.1 | 17.8 |
| $\alpha$ (in %) | Liquidation time $\mathcal{LR}^{-1}(\alpha)$ in days | | | | | | |
| 50 | 1 | 7 | 18 | 3 | 5 | 61 | 34 |
| 75 | 2 | 12 | 28 | 4 | 9 | 118 | 71 |
| 90 | 2 | 17 | 37 | 5 | 14 | 183 | 124 |
| 99 | 3 | 25 | 48 | 8 | 28 | 259 | 758 |

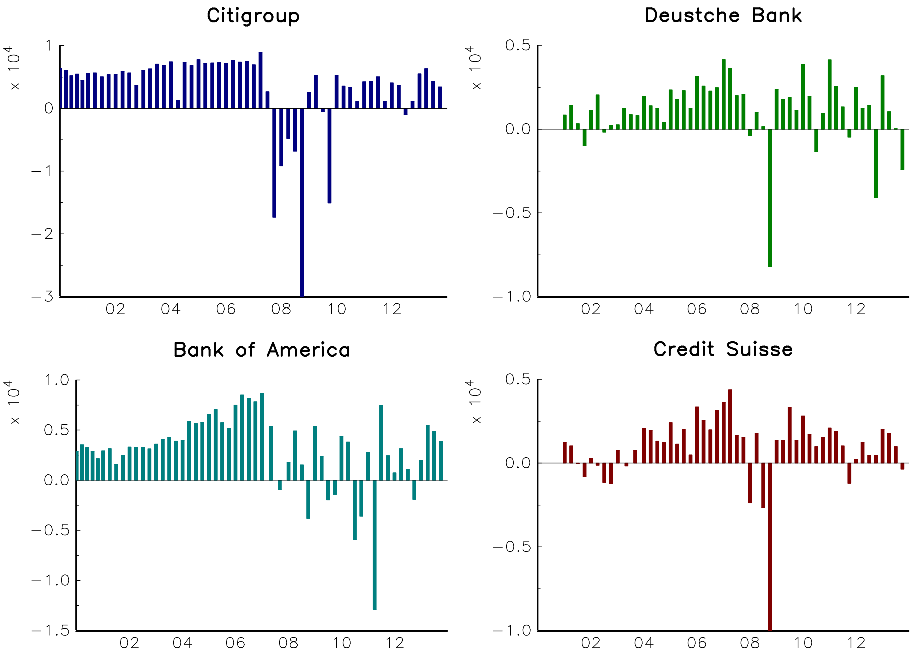
# C Figures

Figure 8: Pre-tax income of some banks (in USD MN)



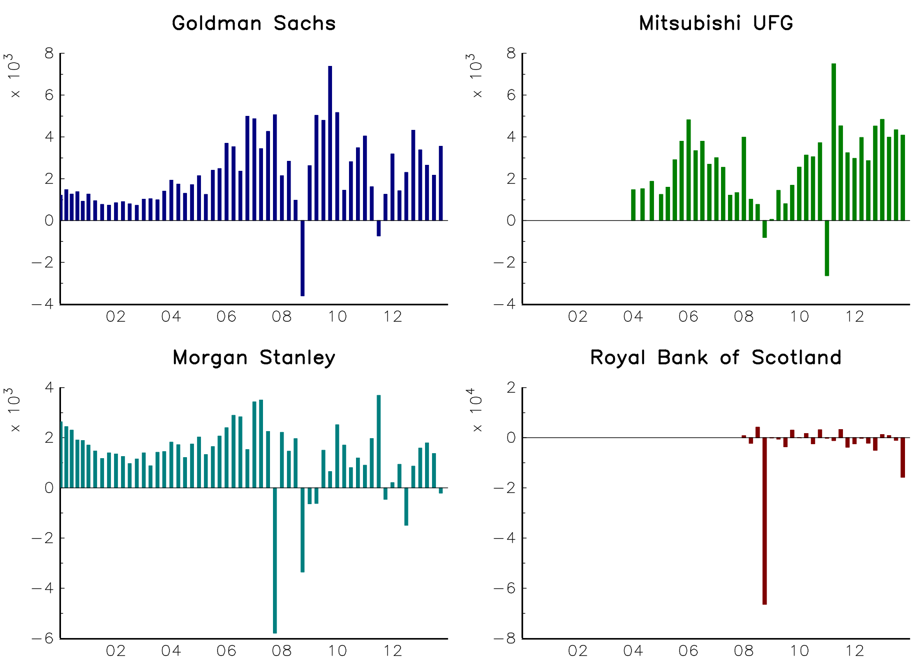

*Source*: Bloomberg.

Figure 9: Pre-tax income of some banks (in USD MN)



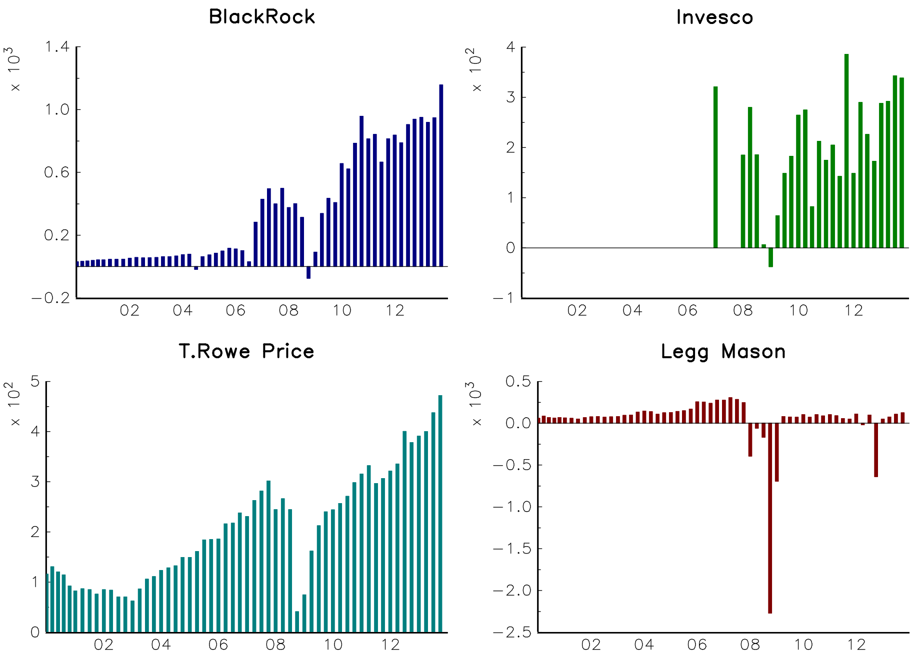

*Source*: Bloomberg.

Figure 10: Pre-tax income of some banks (in USD MN)



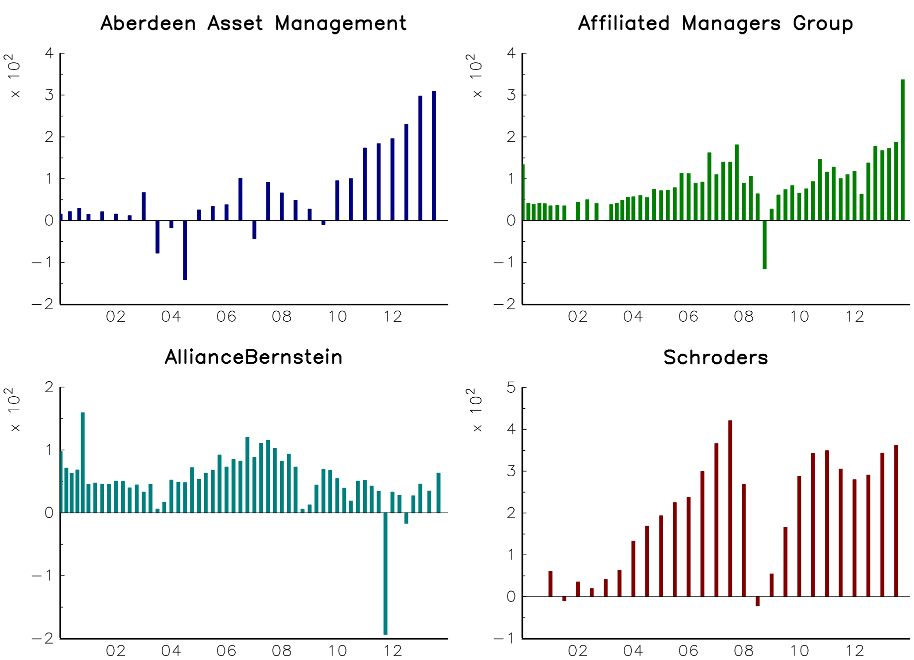

*Source*: Bloomberg.

Figure 11: Pre-tax income of some asset managers (in USD MN)



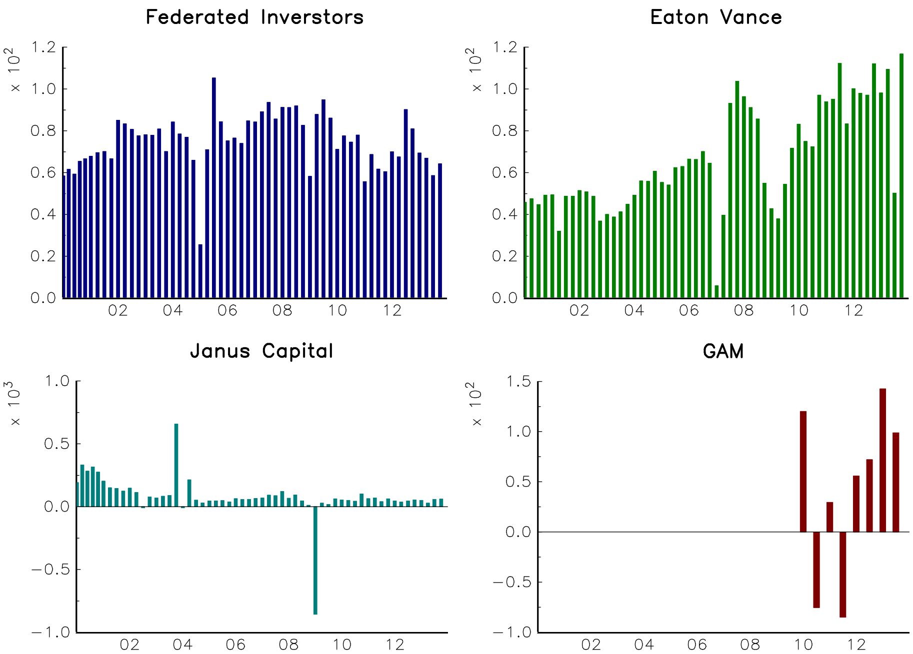

*Source*: Bloomberg.

Figure 12: Pre-tax income of some asset managers (in USD MN)



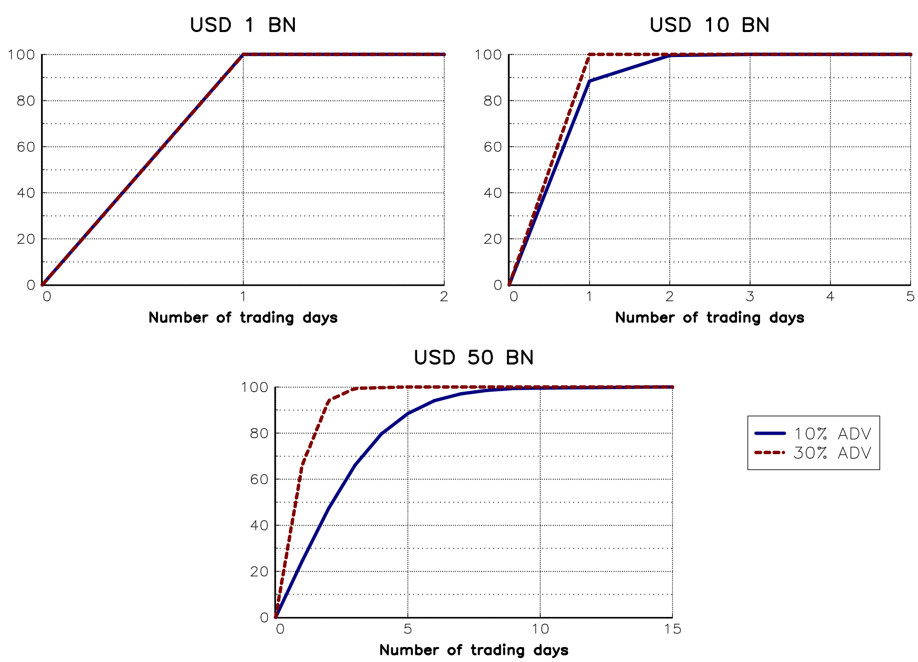

*Source*: Bloomberg.

Figure 13: Pre-tax income of some asset managers (in USD MN)



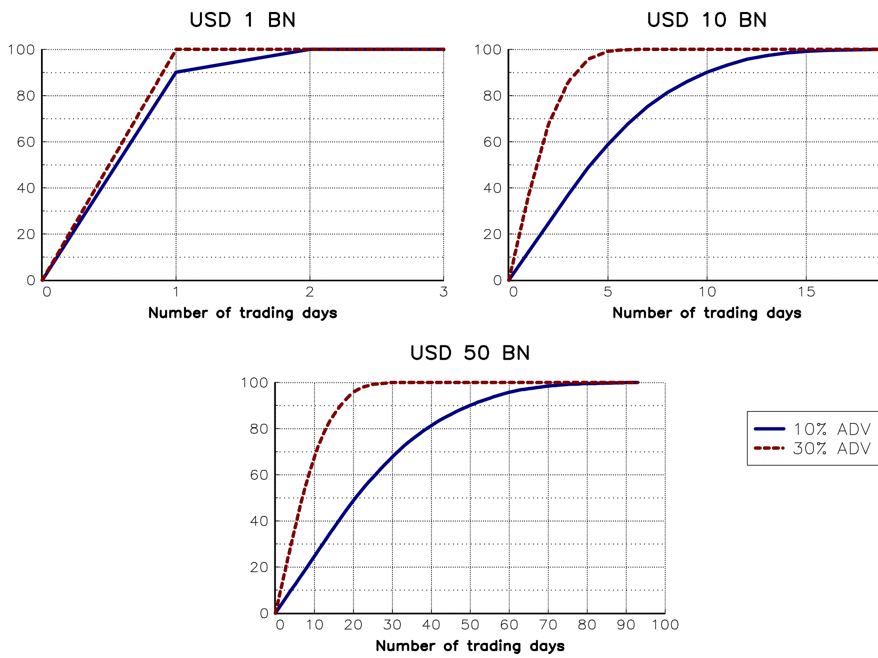

*Source*: Bloomberg.

Figure 14: Liquidation ratio (in %) for the S&P 500 index



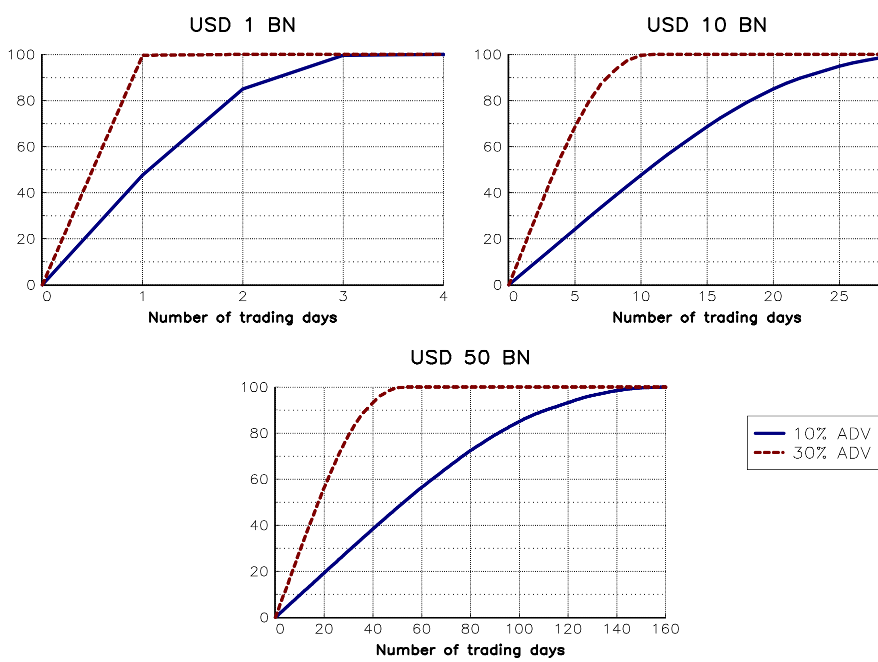

*Source*: Bloomberg & Authors' calculation.

Figure 15: Liquidation ratio (in %) for the EUROSTOX 50 index



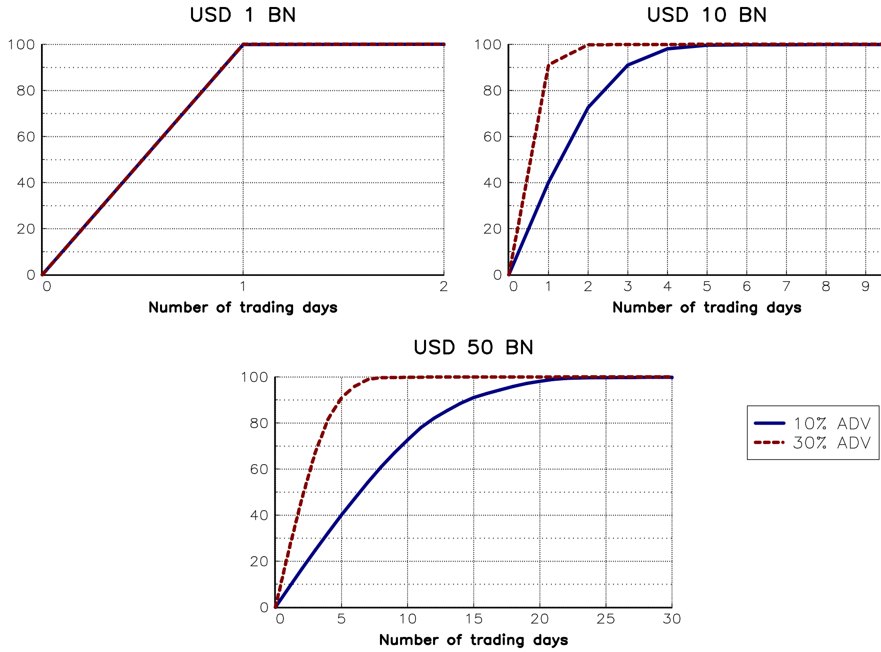

*Source*: Bloomberg & Authors' calculation.

Figure 16: Liquidation ratio (in %) for the DAX index



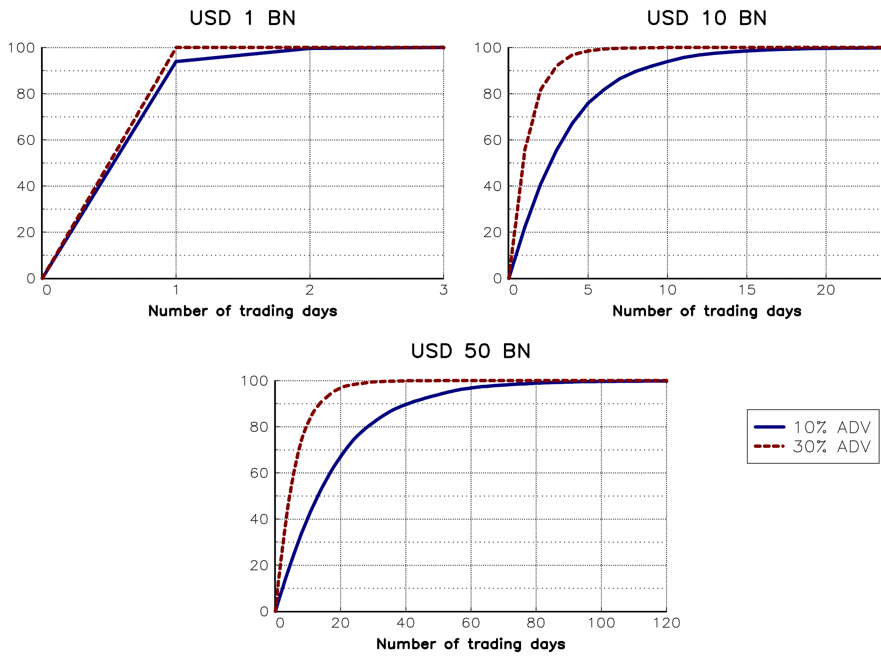

*Source*: Bloomberg & Authors' calculation.

Figure 17: Liquidation ratio (in %) for the NASDAQ 100 index



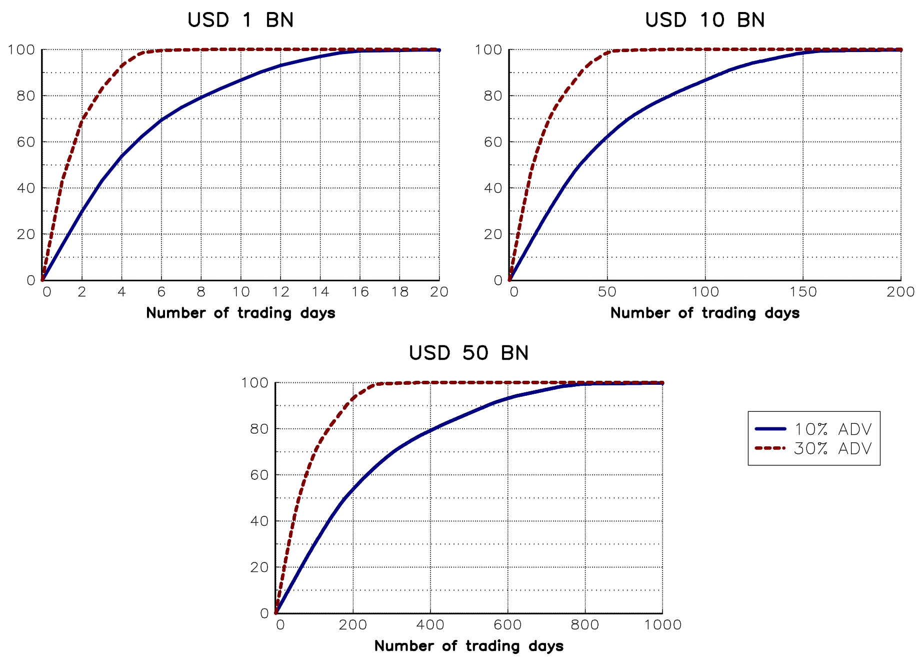

*Source*: Bloomberg & Authors' calculation.

Figure 18: Liquidation ratio (in %) for the MSCI EM index



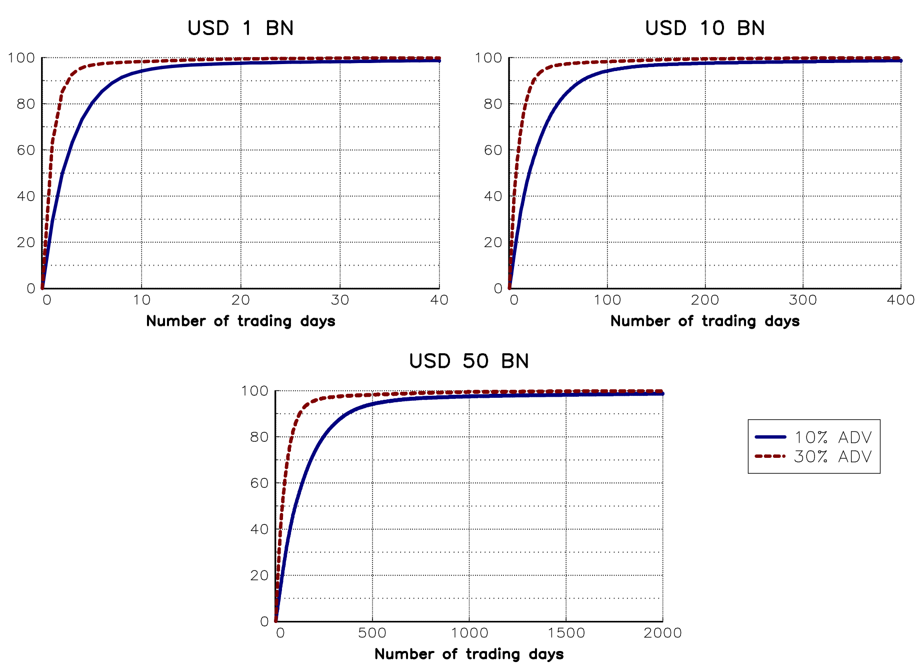

*Source*: Bloomberg & Authors' calculation.

Figure 19: Liquidation ratio (in %) for the MSCI INDIA index




*Source*: Bloomberg & Authors' calculation.

Figure 20: Liquidation ratio (in %) for the MSCI EMU SMALL CAP index




*Source*: Bloomberg & Authors' calculation.