



ELEMENTS FOR EFFECTIVE SYSTEMIC RISK ASSESSMENT UNDER THE DSA

REPORT

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EXECUTIVE SUMMARY

The European Union's 2022 Digital Services Act (DSA) updated the liability rules in the 2001 e-Commerce Directive and introduced two special categories, Very Large Online Platforms (VLOPs) and Very Large Online Search Engines (VLOSEs). The regulation obliges them to undertake systemic risk assessments and then to mitigate the risks identified. Scale was considered important because of the number of individual users that could be harmed, the role large services play as public spaces and in shaping information flows, and an assumption of risks to societal systems.

The DSA requires assessment of systemic risk in four broad areas of risk to society including:

- from illegal content;
- from negative effects on fundamental rights;
- on civic discourse and electoral processes, public security and health; and
- in relation to gender-based violence, minors, and individuals' physical and mental well-being.

Systemic risk has long been assessed in financial markets. Unlike for financial markets where the risk of concern is to the continued provision of the service and viability of the firms providing it, the DSA's provisions represent a novel and very different use of the concept of systemic risk. The DSA considers sources of risk to be both characteristics of the VLOPs/VLOSEs (such as design or functionality) and user behaviour.

Our investigation confirms the limits of simply borrowing the concept of systemic risk and its associated terminology from the financial sector where it arguably began. We, nonetheless, consciously test the boundaries of some concepts and demonstrate that there are several elements of the understanding of systemic risk in the financial sector that can usefully be applied to thinking about VLOPs/VLOSEs and used as part of a framework of risk assessment.

The conceptualisation of financial systems as being made up of various core and peripheral players who are interconnected through direct and indirect relationships of varying weights or significance is a useful model upon which to build for VLOPs/VLOSEs. Distinguishing among core players and peripheral players can indicate the potentiality and severity of risk and identify critical players, shared assets or vulnerabilities, and possible mitigation points.

VLOPs/VLOSEs are at the centre of complex ecosystems that they govern through technology, contracts, rules, conditions, standards, or other means. A variety of complementors – innovators, traders, or content producers – can have co-creative roles and therefore contribute to the level of risk.

Risk areas may be characterised by integrated platform ecosystems where the proprietary ecosystems of VLOPs/VLOSEs are interconnected through shared assets, common users and/or third parties, and other overlapping relationships. For example, VLOPs/VLOSEs may be drawing on common data resources or connected through functionalities that allow for shared value creation from content, or reliance on common resources for identifying and removing illegal content.



Examination of these shared assets may need to be conducted in a coordinated manner based on the evidence gathered from the risk assessments and audit reports. Interlinkages with smaller, often with less stringent terms and less developed content moderation systems, comes across clearly in the literature as a source of risk on VLOPs.

Concentration in the market and dominance in society are inextricably linked in the literature yet, as in the financial sector, the link to systemic risk is complicated. The extent to which it equates to higher risk, or fragility, may be conditioned by various factors and specific to individual areas of risk. Some of those designated under the DSA will also be designated under the Digital Markets Act as gatekeepers, which has implications for some risk areas. For example, any assessment of risks to media freedom and pluralism should take advertising market dynamics into consideration.

In the finance literature, sources of risk are identified as shocks, which can be from external sources (exogenous) or from inside the system (endogenous) and either idiosyncratic to single players or systemic, affecting multiple players or the entire system. Shocks are conceived of in finance literature as singular events, and therefore do not capture structural features of the system or characteristics of players, which are considered mediating factors. Though not appropriate for considering structural sources of risk from VLOPs/VLOSEs, we argue that the concept of shocks can be appropriate for considering negative effects stemming from user behaviour and exogenous sources of risk.

One core element of the concept of systemic risk in financial providers is that follow-on effects from a negative event for one player or system can have a domino-like negative and possibly catastrophic consequences for other financial providers who are otherwise healthy as well as for the wider economy. This “dominos falling one after another” sense of systemic risk does not seem to apply directly in digital markets, though it does seem that some VLOPs/VLOSEs are critical to the economic, social and digital ecosystem as a whole, and that a failure of one could have consequences for many others, including smaller service providers.

The distinctions between endogenous and exogenous shocks, each of which can be either idiosyncratic or systemic, we argue, should be utilised in a risk assessment framework. Thinking of sources of risk in this way can help to identify some locations for risk mitigation and assign responsibility for intervention or mitigation measures. This framework indicates that risk assessment and mitigation should not only focus on those sources of risk that are contained within an individual platform’s ecosystem and that coordination on identification and mitigation may also be required for some sources of risk.

There have been efforts to investigate cross-platform propagation of harmful content and contagion of harmful user behaviour, which can be conceived of as minor shocks. These have produced some evidence on the relationships between peripheral platforms and core ones designated under the DSA. On a platform characteristic level, the extent to which a platform can be used to mimic broadcast, to reach large audiences quickly seems to be a factor. Key structural issues for systemic risk are therefore the extent to which VLOPs and VLOSEs are connected to users of peripheral services and whether any features of their design or functionalities create interlinkages with such services.



A benchmark of what constitutes systemic failure or systemic crisis is necessary for determining what constitutes a negative effect and what mitigation is appropriate. While this exists in a clear and calculable fashion in the finance sector, there is not an EU consensus on the good or ideal condition in many of the risk areas in the DSA, and no clear understanding of what failure would look like that VLOP/VLOSE providers can use to shape risk assessment.

For each of the risk areas addressed by the DSA establishing the equilibrium and the point of failure should be developed through an iterative process and feedback loops that we argue must be widely inclusive. The broad convening power of the European Commission and the Digital Services Board established by the DSA, as well as the researcher access enabled by the DSA, can be used to ensure that the process of assessment, auditing and monitoring achieves this.

Three main types of measures are used for assessing systemic risk in the financial sector. The same are relevant for VLOPs/VLOSEs. The first would likely need to be the domain of the Commission and the Digital Service Board, which will have the most complete view of all assessment and auditing reports, while VLOP/VLOSE providers should consider the second two in their assessments.

- how much of the overall system will be affected by a shock in one player;
- how much any individual player contributes to the systemic risk embedded in the whole system; and,
- the ability of any given player to resist shocks and mitigate the associated risk.



1. INTRODUCTION

With the Digital Services Act (DSA), European Union policymakers set into law ground-breaking policy that holds digital services, namely online intermediary services, accountable for “ensuring a safe, predictable and trusted online environment” (DSA, 2022: recital 3). In addition to establishing basic requirements for how digital services deal with illegal content, the DSA introduces two special categories: Very Large Online Platforms (VLOPs) and Very Large Online Search Engines (VLOSEs). Both of which face additional obligations to undertake systemic risk assessments and then to mitigate any systemic risks these assessments identify. The notion of systemic risk in this context by the Commission was distinctly novel and evidently intentional. A different approach, simply high-risk, was later used in the proposal for a regulation on AI.¹ The concept of systemic risk seems to have been borrowed from the financial services sector, where it has long been used and for which there is a mature academic literature. The DSA requires assessment of systemic risk of societal harm. Whereas in financial markets it might be relatively straightforward to identify the actors involved and the sources of risk, the application of this concept where the system or systems are societal raises many questions, particularly around the scope and nature of the assessment, the potential for measurement of risk, and the criteria for determining the quality of risk assessments.

This report aims to contribute toward answering some of the questions most relevant to the implementation of the systemic risk provisions in Section 5 of the DSA, by drawing on the understanding of systemic risk and its application in financial services and banking. Not only is the literature about systemic risk most developed in relation to the financial sector, financial markets, and banking but these sectors are similarly characterised by network effects, relationships with businesses and individual consumers, and often both national and cross-border scale. We present findings from a multi-stage systematic review of the literature on systemic risk in financial markets and banking and of the literature on online platforms and digital services. The aim was not to be able to make claims about the literature per se, but to undertake a *scoping review* that would identify the conceptual boundaries, the core findings, and variables used (Xiao & Watson, 2019, p. 99).² The research questions we sought to answer were:

- How has the concept of systemic risk been defined and used in relation to financial services and with what normative underpinnings?
- In what ways do these understandings of systemic risk map onto understandings of how VLOPs and VLOSEs may pose a risk of harm?
 - How do they define ‘the system’ and what do they indicate in terms of scope?
 - What do they consider to be the features or characteristics that make a risk or a service systemic?

¹ The proposal from April 2021 for harmonised rules on Artificial Intelligence: <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021PC0206&from=ES>

² This robust approach was used to ensure validity and reproducibility. For the elaboration of the methodology in steps see Annex 1.



We found remarkably little evidence of attempts to directly define ‘the system’ in the financial literature on systemic risk, but there were several consistent assumptions about the nature of systems and the sources of risk. The systemic nature of risk implies the potential for harm to the wider economy and therefore society. There is an assumption that harm would not be contained to the actors involved in the specific financial system. Sources of systemic risk are considered shocks. Market structure, characteristics of the financial institutions, and other factors determine the potential for contagion or propagation of risk and therefore the strength of the shock and potential for it to result in systemic risk.

The DSA requires systemic risk assessments in four areas:

- a) “the dissemination of illegal content through their services;
- b) any actual or foreseeable negative effects for the exercise of fundamental rights in particular the fundamental rights to human dignity enshrined in Article 1 of the Charter, to respect for private and family life enshrined in Article 7 of the Charter, to the protection of personal data enshrined in Article 8 of the Charter, to freedom of expression and information, including the freedom and pluralism of the media, enshrined in Article 11 of the Charter, to non-discrimination enshrined in Article 21 of the Charter, to respect for the rights of the child enshrined in Article 24 of the Charter and to a high-level of consumer protection enshrined in Article 38 of the Charter;
- c) any actual or foreseeable negative effects on civic discourse and electoral processes, and public security;
- d) any actual or foreseeable negative effects in relation to gender-based violence, the protection of public health and minors and serious negative consequence to the person’s physical and mental well-being.” (DSA, 2022: art. 34)

These are broad and challenging areas, and the ecosystems of VLOPs/VLOSEs are arguably much more complicated than financial systems. Our investigation revealed the limitation of borrowing terminology across industries, but also demonstrates that some fundamental concepts and understandings can be usefully applied. We draw on these as the building blocks for the defining of a novel notion of systemic risk in digital services, with a focus on the operationalisation of the concept for the purposes of assessment and mitigation. To the best of our knowledge, this is the first attempt to provide a systematic approach and understanding of systemic risk in this field.

The report is intended for a variety of audiences. While it is structured to be read as a whole, there is signposting at the start of each section and there are takeaways at the end of each to enable the reader to skip parts and focus on those of most interest. The next section discusses the way the term systemic risk came into the DSA and the evidence of understandings of it in the policy documents leading up to the Act, so readers very familiar already with the DSA may wish to skip to section 2.5. The two sections that follow focus on the findings from the financial literature, discussing first definitions of the system, what defines risk as systemic, and approaches to measurement. Those less interested in the details on the financial sector could rely on the takeaways in subsections sections 3.5



and 4.5. Sections 5 and 6 then draws on the platform literature, applying the concepts drawn from the financial literature, with takeaways in sections 5.4 and 6.4. Section 7 presents the conclusion on the application of the concepts and suggests directions for the assessment of risk by VLOPs/VLOSEs.

The key conclusions we draw are:

- The concepts that structure the understanding of systemic in financial services are not a perfectly adaptable to the risk areas of the DSA which require careful balancing of fundamental rights and attention to the public interest in efforts to prevent harm, however there are several elements that can be useful for structuring risk assessment by VLOPs/VLOSEs.
- VLOPs/VLOSEs should assess risk with an understanding of their role within integrated platform ecosystems paying attention to relationships with other core/central players and peripheral players. Here whether a VLOP/VLOSE is also designated a gatekeeper under the DMA will be relevant though likely in differing ways across the four risk areas covered by the DSA.
- Coordination among VLOPs/VLOSEs will likely be necessary for identifying and mitigating sources of risk that are systemic, affecting multiple platform ecosystems. These can be common endogenous or exogenous sources of risk.
- There is a need to transparently establish what conditions and thresholds constitute systemic crisis or failure in each risk area. Benchmarks should be arrived at through inclusive, iterative processes.
- The accumulation of minor negative effects or harms should be considered in assessment, and they could be considered weak shocks, though the concept of shock has not yet been used to capture this type of accumulation.
- There is a possibility of free-riding behaviour by VLOPs/VLOSEs and ensuring this is not allowed to result in low standards of assessment and weak risk mitigation may require careful attention in audits and monitoring based on widely agreed thresholds for systemic failure and accompanying understandings of “negative effects” in each of the risk areas.



2. THE USE OF 'SYSTEMIC RISK' IN THE DSA

To set the scene, this section elaborates on the way the term systemic risk came to be used in the DSA. The findings presented here are based on examination of key documents beginning with the Commission communication '[Shaping Europe's Digital Future](#)' from February 2020 through the proposal for the DSA put forth by the Commission in December 2020. The sample was not exhaustive, due to the constraints and focus of this project, but did include the Council response to the communication, the inception and final impact assessments, the summary report on the consultation, and the explanatory note that accompanied the proposal.³ Within this sample, the term *systemic risk* itself does not appear until the documents released at the time of the proposal. Nevertheless, there are other uses of the term *systemic* in relation to online platforms and discussion of the nature of their roles and risks that appear to lead up to the use of this term in the DSA Article 34.

This section covers themes evident in the documents that indicate the rationale behind the use of the term systemic risk in the DSA. It finds that scale was considered important not only because of the number of individual users that could be harmed, but also because of the role large services play as public spaces and in shaping information flows. It also argues that an assumption of risks to societal systems was evident in the rationale of the policy makers, along with an understanding that risks could come from characteristics of the services or from user behaviour and that there would be differences in severity.

2.1 Scale and Systemic Role

Before the term systemic risk was used in these policy documents, there was ample evidence of an understanding that scale was a crucial element of the potential for harm. The February 2020 communication raised concerns about public debate and political campaigning moving online and threats to an 'information space.' This started an elaboration of a *systemic role* being played by very large online platforms related to both scale of reach and the function of the platforms. In its inception impact assessment, the Commission defined the problem it would seek to address with the Digital Services Package. The first part was related to **the scale at which well-established categories of illegal content circulated due to the extensive scale of online platforms**. The second was a "new set of issues" that it argued, stemmed from the nature of recommender systems and advertising businesses as well as from intentional abuse by users and had become a policy problem particularly where platforms structure information flows "at scale" so have become "*de facto* 'public spaces' in the online world" (emphasis in the original) (European Commission, 2020a).

The idea that due to their scale and intermediation of information flows, certain platforms had become public spaces featured prominently in the final impact assessment as well. Even as the assessment opted for user numbers as a proxy for the level of risk, **it noted the *systemic role* to citizens and businesses as "public spaces" and the "systemic role in amplifying and shaping**

³ The full list of documents appears in Annex 2. An obvious gap is the absence of the three own initiative reports from European Parliament Committees, which were not included, however these were summarised extensively in the final impact assessment.



information flows” (European Commission, 2020b, p. 13), which it linked to algorithmic decision making and design choices aimed to benefit advertising business models.⁴ The explanatory memorandum that accompanied the DSA proposal cites the particular impact of VLOPs on the economy and society and argues that they “due to their reach have acquired a central, systemic role in facilitating the public debate and economic transactions” (European Commission, 2020c, p. 6). Finally, the recitals of the DSA itself justify the additional obligations on VLOPs and VLOSEs as due to their role and reach, arguing they have a greater impact on society and that they pose systemic risk when they are being used by a significant share of the population.

2.2 Threats to Systems

The other element that seems part of the understanding of systemic risk in the DSA is that **the potential harm is not just to individual users, but to systems in society**. A risk is therefore systemic when it can lead to harm to individuals at a large scale or to systems essential to the governance and good functioning of society (see further discussion in earlier CERRE Report (Broughton Micova, 2021)). Of course, a vast number and variety of public or societal systems could be affected by VLOPs and VLOSEs functioning or use, but the policy documents indicate a focus on those related to democracy, public security, and public health.

One set of systems clearly considered in the DSA are those related to the execution of democracy, or democratic processes. In its February 2020 communication the Commission used the term ‘information space’ arguing that with public debate and political advertising having moved online **there was a need to defend democracy**. The potential for harm to ‘democratic systems’ is noted also in the inception impact assessment. Public debate or discourse and the dissemination of information and opinion are clearly core concerns related to the functioning of democratic systems that are noted in the final impact assessment, which refers to “authorities’ capacity to ensure open political processes” (European Commission, 2020b, para. 42), and the explanatory note accompanying the proposal. According to Recital 81 of the adopted DSA, the third category of risk explicitly concerns ‘democratic processes’ and ‘electoral processes’.

As evident in the adopted version of the Act, **other societal systems were also considered at risk**. The Impact Assessment that accompanied the proposal includes law enforcement, national authorities, and businesses dependent on platforms in its list of stakeholders for whom the status quo on digital services may be a problem. In addition to the potential for harm to individual well-being, the third and fourth risk areas covered by the DSA are also concerned with harm to public security and public health. Both public security and public health are also the subject of Article 36 of the DSA that deals with situations of crisis such as natural disasters, acts of terrorism, or pandemics.

⁴ A more in-depth discussion of the arguments and evidence is found in part 2 of the impact assessment.



2.3 Severity and Sources

In the policy documents leading up to the DSA and the Act itself, there is a clear acknowledgement that there are gradations of severity of negative effects or harms. **The principle of proportionality is fundamental to the DSA.** VLOPs and VLOSEs are expected to consider the severity and probability of systemic risks in their risk assessments (DSA, Rec. 79 & Art 34.1) and be proportionate in their mitigation measures (DSA Art.34). While systemic risk is associated with scale, as discussed above, the understanding is that the severity of negative impacts may vary.

The **sources of systemic risk identified in the policy documents are the functioning of the platforms and the behaviour of users.** The final impact assessment noted two sources: the amplification functions of platforms stemming from their business models' requirements for optimisation, and the vulnerability of platforms to manipulation by users. The advertising systems were particularly cited as having the potential to contribute to risk. This was later reflected in the DSA itself which states that the "advertising systems" of VLOPs and VLOSEs "can also be catalyser for the systemic risks" (DSA, Rec. 88). Overall VLOPs and VLOSEs must assess how "the design and functioning of their service, as well as the intentional and, oftentimes, coordinated manipulation and use of their services, or the systemic infringement of their terms of service" contribute to systemic risk (DSA, Rec. 84). The DSA's Article 34.2 states that the influence of specific design features and functionalities on systemic risk should be considered.

2.4 Unclear Role of Business or Service Failure

One issue **not addressed clearly in the policy documents** is the extent to which the DSA is concerned with **the risk posed by the business failure of any given VLOP or VLOSE provider, or cessation of service for other reasons.** The potential of individual firm failure, such as specific bank, insurer or shipping company collapsing, is an inherent part of the understanding of systemic risk in other sectors. The failure of a firm is different than the failure or closure of a specific service. While in banking the failure of a firm would be at stake, with VLOPs/VLOSEs there is potential for failure at the level of the provider, or entire firm, or just the service, a specific VLOP or VLOSE. Risks stemming from such failures are not discussed in the policy documents or explicated in the DSA itself. Potential closure or failure to maintain service is not mentioned among the factors listed in Article 34.2 that should be considered in assessments for their potential influence on systemic risk. Would the sudden failure of any given VLOP or VLOSE, or the company that provides them have a negative effect on public health or security or on an election processes?

Millions of small businesses depend on certain social media for communication with their customers and for marketing. Digital services, including VLOPs have been crucial for the campaigns of many political candidates and parties, especially local level ones and smaller parties for which national media are unattainable. There even is evidence of the role that certain platforms, including VLOPs have played a role in disaster management (Bhuvana & Arul Aram, 2019). The nearly 6-hour outage of Facebook and Meta's other services in October 2021 was more than just small annoyance for many



businesses and organisations (Isaac & Frenkel, 2021) and could be an indication of what the effects of a longer or permanent sudden failure might be.

2.5 Takeaways from Evidence on the Understanding of Systemic Risk in the DSA

The evidence examined in this section indicates that in the DSA the systemic nature of the risk VLOPs and VLOSEs are required to assess is about scale, for which **user numbers serve as a proxy for both the numbers of individuals who might be affected by any harm and the extent to which a service functions as a public space, and about impact on public systems**, ones necessary for the good functioning of society and the economy. The DSA is clear that the sources of risk can come from the design and functioning of a service or from the malicious behaviour of users, be they individuals or institutional actors. One source of risk that does not seem to have been considered is the risk of the failure (business or technical) of a VLOP or VLOSE resulting in systemic harm, which would be a core consideration in other sectors. The DSA recognises that there can be variation in the severity of the harm associated with different risks and that they will not all have the same potentiality.

The challenge set out by the DSA is to assess and mitigate the systemic risks. This requires measurement and prediction of the potential for harm. We now turn to the experience from the financial sector to help inform this by looking at the key features of systemic risk, factors, and measurement approaches.



3. DEFINING THE SYSTEM IN THE FINANCIAL SECTOR

The existing literature on systemic risk in financial markets does not tend to provide a definition of the ‘system’ that is being discussed, though some outline some elements that can be seen to describe it are evident (for instance, Sillmann et al., 2022). What is clear is that some level of interaction is assumed. **While all systems are made of certain components, which can include various players, the interactions among players and other systems are crucial.** Defining a system is a very complicated task, as it has multiple dimensions that can vary over time, making difficult to define boundaries. In this section, we will consider the features of each player (different types of banks and the Central Bank), the multiple ways through which they can be interlinked, and their impact on other systems’ players (consumers, for example).

We find that banks can be very different in their characteristics (such as size, ownership structure, business model) as well in the degree of interconnection they have (while most of the banking systems can be proxied through a core-periphery model, single players may show considerable variation in both the number and the size of their interconnections, which also evolve over time). As one of the main features of banks and financial markets is to allocated funds from those who have in excess (savers, for instance) to those that lack them (consumers, firms, or governments, for example), **failure and systemic risk in financial services is susceptible to affecting other systems and players. This is something that can also occur with VLOPs/VLOSEs**, from which there is also potential for harm to society and the economy.

3.1 Types of Players in the System

The players that compose financial systems can differ in numerous features. This is the case with the banking system, which is a very peculiar system. Firstly, what we collectively refer to as banks **vary in size from small and regional institutions to national and transnational banks**. This means within a system the players can vary in term of their relative market power, their capacity for internal governance, or their ability to diversify their assets.

Secondly, **they can have different ownership structures and business models**. There are state-owned and privately-owned banks. Ownership structure can affect banks’ performance and their risk-taking. Using a sample 181 large European banks, Iannotta et al. (2007) find that mutual banks and government-owned banks are more cost-effective, but also less profitable. The latter also exhibit lower asset quality, which is assessed through the generation of higher non-performing exposures (NPE), while the former show higher asset quality (also with respect to privately-owned banks). The authors also note that ownership concentration is positively correlated with lower NPE and bank’s insolvency risk. Bardoscia et al. (2017) find that market integration and diversification can lead to higher systemic risk, although this is also dependent on banking network’s structure.

In a national system there can be distinctions between foreign and domestic owners. **There are also a variety of business model in banking that can coexist in a banking system**. For example, there are commercial banks, whose business model is mostly based on lending activities through loans generation, and investment banks, which specialise in investment activities and advisory. There are



also less common models such as cooperative (or mutual) banks, which normally lend to small and medium enterprises (SMEs) in local regions and, while in general cooperative banks are small, they are also numerous and until a few years ago they represented overall a large share banks' assets in Europe (see Cihak & Hesse, 2007), and Islamic banks, which are distinct in that they apply Sharia law in lending, which prohibits from receiving an interest rate on their loans, so revenues are generating through profit/loss risk-sharing on the projects that they finance.

According to Beck et al. (2013) there is very little difference between conventional banks and Islamic banks in business orientation, but while the latter are less efficient, show higher intermediation ratio, asset quality, are more capitalised than the former. Čihák & Hesse (2010) found similar patterns, albeit they show that they are dependent on banks' size: among small banks, Islamic ones are better capitalised, while the opposite is found among large Islamic banks, which seem to have poorer credit risk capabilities. They are also characterised by complex governance structure and the uniqueness of their financial products, which require additional effective monitoring by those involved in governance (Trinh et al., 2020).

Demsetz & Strahan (1997) find that US larger banks are able to better diversify their assets, but this does not necessarily mean that their risk-taking is reduced. Stiroh (2004) noticed that while profits are less volatile, they show a large risk component. Using a sample of European banks, Baele et al. (2007) estimate that increased diversification in revenues shows an increase in systematic risk and, on average, a decrease in idiosyncratic risk (affecting only one player).

All these players are, at the same time, severely affected by another player, the Central Bank, which also performs a regulatory function in the system. The Central Bank plays multiple roles (Goodhart, 1995; Blinder, 2010) at the same time and, in this context, represents a special player for a number of reasons:

1. Every Central Bank is always the lender of last resort to the banks that conduct business under its jurisdiction. Various lending mechanisms, especially in period of distress or crises, are created to ensure that banks have enough liquidity to meet their obligations and there is enough confidence in the solvency of the system.
2. A Central Bank controls the variation of the monetary base through the purchase of securities, such as governmental bonds and mortgage-backed securities during various waves of quantitative easing, which along with the mechanisms in point 1 also affect the prices of the securities held in the asset's side of banks' balance sheets.
3. Every central bank is also invested with supervisory and regulatory duties. It performs a rules and norm setting function, including through monetary policy decisions related to policy interest rates. For example, ECB's Single Supervisory Mechanism (SSM) is responsible for the oversight of European Globally Systemically Important Banks (GSIB), while the other national banks fall under the supervision of national non-GSIB and regional banks).

The various roles played by central banks are not always in concert. Importantly, supervisory objectives are not always aligned with monetary policy objectives, in other words there is tension



among these goals, and this generates uncertainty that could, in turn, be a source of (potentially systemic) risk (see, for example, Criste & Lupu, 2014). To take a very recent example, in order to curb excessively high inflation rates, the US Federal Reserve raised interest rates, but did so too late and too quickly. In an attempt to achieve its price stability mandate (broadly defined as a positive but low inflation rate in the medium term), it missed its financial stability one (that is, making sure that financial markets, institutions, and structures are stable). The outcome was the failure of Signature Bank, Silicon Valley Bank, and First Republic Bank.

3.2 Interconnection among a Variety of Players

The various types of players in financial systems can have direct and/or indirect linkages. Probably the most well-known ones are the direct interbank linkages, that is, interbank credit and debt positions. For example, Bank A buys part of a debt security of another bank (Bank B) or deposits some funds in a bank account opened in Bank B. The latter is what happened during the attempts to avoid the default of the three previously mentioned by the largest US banks. Regardless of the way that this type of bank interconnection is created, this generates a credit position (lender bank) and debt one (borrower bank). The two positions are associated to different types of risk: credit risk and liquidity risk, respectively. If the borrower bank defaults, the lender bank would incur in a partial or total loss of its credit, which would affect its equity and decrease both its profit and profitability (return on equity) and capital ratios (less equity increases the leverage). On the contrary, if the lender bank withdraws its loan or deposit from the borrower bank, the latter would face a cash outflow, worsening its liquidity ratio, making it more difficult to absorb other potential shocks.

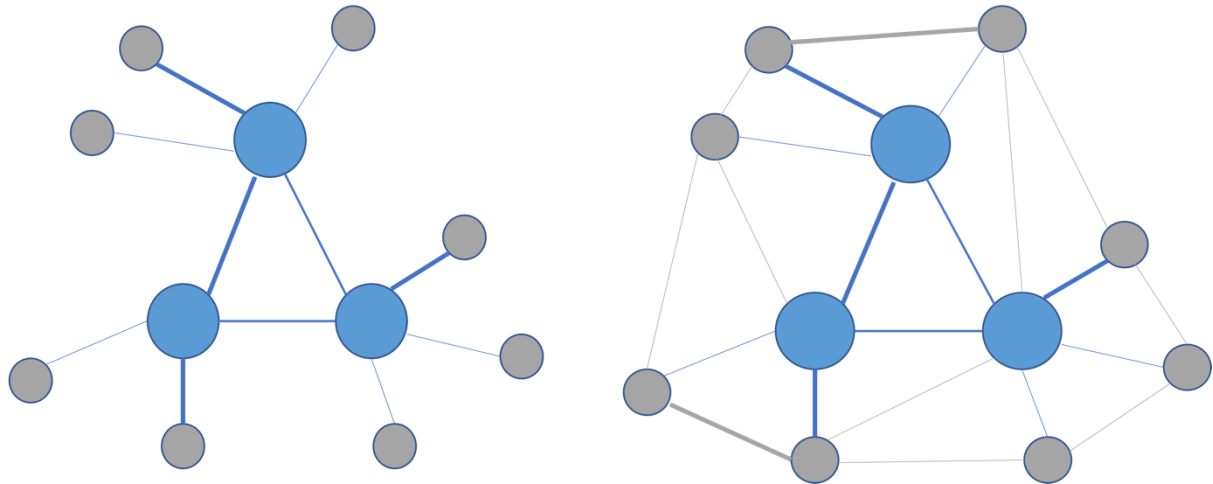
However, **banks' assets and liabilities (and thus, their capital too) can have correlated movements.** **Banks often own similar or positively correlated securities**, such as mortgages, or governmental bonds. This means that, even when they are not directly linked, **they could be indirectly through systematic shocks hitting the items present in their balance sheets.** Recalling the previous example, the increase in policy rates affected the debt securities held by US commercial banks. However, assets' correlation is not perfect. In fact, it also depends on the composition of banks' assets. One may think that the largest US bank, JP Morgan, should have suffered the increase in interest rates even more so than Silicon Valley banks, due to its significantly larger balance sheet. However, JP Morgan is also one of the largest mortgage providers, and mortgages benefited from the increase of rates. So, while JP Morgan incurred in losses in its 'available for sale' securities, it made profits in its mortgages and there was no confidence loss and successfully managed policy rates shocks. It is also key to mention that the size of JP Morgan may have helped it through the so called 'too big to fail' mechanism: investors know that if JP Morgan has financial difficulties and is not able to solve them by itself, regulators would intervene to avoid the default, as the default of a globally systemically important bank would probably lead to a systemic banking crises (JP Morgan is not only large, but also central in the banking network).

This leads to considering banking networks. Depending on whether the focus is more macro or micro, there are different layers. We can think about a regional banking network, a national or an international one. Banks can decide to:



- Neither lend to nor borrow from other bank(s): they are isolated from the banking network.
- Either lend to borrow from some or all the banks of the considered banking network.

Figure 1 Illustration of different core and periphery relationships within banking systems



This means that the banking network will have an ever-changing shape that spans from a completely disconnected banking network (no banks lend to each other) to a completely and perfectly connected banking network (all banks lend to each other). While the two extremes are theoretically possible, they actually never occur. More frequently, banking networks, especially in developed countries, have a tree-shape, also known as node constellations, including institutions of various sizes (Papadimitriou et al., 2013). They **can be represented with a core-periphery model showing few banks with many links to many banks which, in turn, have a few links**. For example, Fricke & Lux (2015) assess that this model represents well the overnight interbank transactions on the e-MID trading platform. Figure 1 illustrates two different variations of the core-periphery model that have different levels of interconnection among the peripheral players. In the left-hand version central players are interconnected and peripheral ones are connected to central ones. On the right-hand side there is also interconnection among the peripheral banks.

The number of bank interlinkages that each bank within a system has, is relevant, as suggested by the centrality of each bank (in network theory, the bank would be called node). Nonetheless, interbank linkages' size and the size of banks are features to be considered too. Two banks could lend each other a very small proportion of their assets or a larger one, for example. A lender bank may be much larger than the borrower bank, etc. As Figure 1 illustrates, the *weight* of the relationship between each bank can differ significantly with implications for how much that relationship matters to its exposure to risk.

As Papadimitriou et al. (2013) correctly point out, a bank's centrality (core bank) is not to be confused with its size (how large the bank is in terms of assets). **In fact, bank centrality relies on the number and size of interbank connections.** While it is quite often the case that large banks are core and is a correct assumption to be made ex ante, we will see that this positive correlation cannot be so easily transferred into the field of VLOPs/VLOSEs.



As mentioned above, within these networks of core and peripheral players there can be various business models and ownership structures. These differences can also explain the extent and nature of the interlinkages among banks. As Berger et al. (2008) demonstrate, foreign banks tend to have banking relationships with larger, older, and more transparent firms, while firms with foreign banking relationships are more likely to have multiple banking relationships with a diversity of ownership types and more relationships overall than other firms, especially those with state-owned banking relationships.

3.3 Multi-level Systems

When considering systemic risk in banking systems, we can consider sub-national, national, transnational and global boundaries. This not only affects number of banks considered, but also their relative size and the interconnections they may have. The assumption of the proper level of segmentation depends on the analysis to be carried out. Assuming a very narrow boundary may neglect relevant interlinkages and, possibly, contagion effects. On the contrary, broader boundaries are much better at capturing these relationships and, therefore assessing systemic risk, although this is achieved at the cost of much higher complexity and uncertainty in estimations and forecasts.

Even if the proper boundary is found, it is worth noticing that systems can change and evolve over time. Cerutti & Zhou (2017), using Bank of International Settlements (BIS) data on cross-border bank lending, find that the so called deglobalisation of the global banking system, which started after the 2007-08 global financial crisis, is actually a process of regionalisation of banking systems: in other words, interbank linkages are much stronger and more frequent within certain economic zones, instead of being more widely spread across continents. Other authors (Hale, 2012; Minoiu & Reyes, 2013) also find that the formation of new interbank exposures slowed down after the 2007-08 financial crisis.

Transnational banks are, on average, large and operate in multiple jurisdictions with their own branches. While each jurisdiction's supervisory authority is responsible for the oversight and regulation of the given jurisdiction's unit of a transnational bank, this can also generate conflicts between different countries' authorities, due to the different level of monitoring and requirements, and ineffective supervision. This may lead the transnational bank gaining a competitive advantage on the banks of a given jurisdiction, not necessarily because its unit is more efficient, but simply by the leveraging on a lighter supervision (which, in 'normal times', translates into higher profits) on the unit that operates in the 'lighter supervision' jurisdiction. Moreover, due to their presence in multiple national banking systems, transnational banks can affect the propagation of a systemic shock across national banking systems. Due to the large size of this type of banks, their default would be systemic probably for at least some of these national banking systems.

This is certainly the case with GSIB, which are also known to be 'too big to fail' (for a literature review on the topic, please see Mishkin, 2006; Strahan, 2013), which means that the cost of allowing the default would be too severe for banking system(s), financial markets and, ultimately, real economy. As we pointed out in section 2.4, the DSA does not consider societal risks from the business failure of



any given VLOP or VLOSE, however, given the reliance on some of these by vast numbers of organisations, SMEs and even public institutions, this kind of risk might be something for competition authorities and policy makers to consider.

3.4 Relationship of System to Wider Economy and Society

In the financial systems literature, **a relationship between the ‘system’ and the wider economy and society was clearly assumed and inherent in the understanding of risk**. It covers the extent to which systemic risk in the financial sector includes potential of harm to other kinds of businesses and/or industries. Healthy banking systems and financial markets are considered to be a necessary, albeit not sufficient, condition for a stable and sustained economic growth (see, for example, Arestis et al., 2001; Blejer, 2006; Cave et al., 2020).

Giglio et al. (2016) investigate how the accumulation of systemic risk in the financial sector increases risks faced by the real economy (corporations and households). They find that systemic risk indicators forecast monetary policy decisions, due to the fact that they contain useful information regarding the probability of future macroeconomic downturns. Monetary policy ultimately affects lending and credit growth can even become negative (a rare event).

One of the roles of banks is to monitor borrowers. Carletti (2004) developed a theoretical model where firms could choose to borrow from either a single bank or two banks. Two-bank lending suffers from duplication of effort and sharing of monitoring benefits, but it benefits from diseconomies of scale in monitoring. Thus, two-bank lending involves lower monitoring but not necessarily higher loan rates than single-bank lending. The optimal borrowing structure balances the benefit of monitoring for the firm in terms of higher success probability of the project against its drawbacks of lower expected private return and higher total monitoring costs. This model helps explain the empirical observation that multiple-bank lending does not unambiguously increase loan rates or firms' quality.

Detragiache et al. (2000) developed (and empirically tested) a theoretical model to explain why firms, irrespective of their dimensions, are used to having multiple banking relationships, that is, they borrow from multiple banks. Their model predicts that firms whose banks are better capitalised or whose creditors find it more difficult to enforce loan repayment should be more likely to resort to multiple banking. Conditional on adopting multiple banking, however, bank fragility should be associated with a larger number of relationships. At the same time, using European firms and banks' data, they show that the efficiency of the loan enforcement mechanism tends to be negatively correlated with the share of firms using a single banking relationship.

Central banks, supervisory authorities, and regulations impact on lending standards. For example, Basel IV, the main international regulation that impacts systemically-important banks in most of the developed countries, considers a different risk-adjusted capital absorption depending on the type of security that is financed by banks, determining a distortion on the asset allocation and lending, for example, different weights are given to loans to firms and to governmental bonds. While two banks may have similar accounting capital ratios (or book values), the risk-adjusted ones can be very



different, as their calculation also depend on the different weight that each security they hold is associated with.

While regulations impose some threshold, they also incentivise each bank to develop their own internal rating systems to give a weight within the intervals defined by Basel IV for each type of securities they hold. While not mandatory, banks are encouraged to develop the mentioned internal rating systems, as they will lead less capital absorption, subject to the national macroprudential authority's approval. In the light of banks' profit maximisation (proxied by maximisation of return on equity), risk-adjusted capital requirements affect lending choice and standards. Regulations affected banks' balance sheet so much that they are now pro cyclical, which means that when the economy goes well, lending standards decrease, credit increases, and more projects (entrepreneurs and households) are financed. On the contrary, when the economy slows down and/or there are idiosyncratic shocks (or, even worse, systematic shocks) to banks, due to capital and liquidity requirements, lending standards increase, less credit is provided to the real economy, which ultimately slows down even more.

3.5 Takeaways on Defining the System in Financial Sector

The review of the literature on the financial sector resulted in several observations about the understandings of these systems that we argue can be useful in considering systemic risk in VLOPs and VLOSEs. Each player's features are key to understanding a player's contribution to systemic risk. While the financial sector's literature provided examples of differentiation across banks, they share many common features and similar types of risks. When moving to VLOPs/VLOSEs, we will notice that each of them will show some stronger differentiation in their features. This will lead to VLOP-specific implementation of risk mitigation measures, which, as we will see below, will also depend on the DSA risk area under consideration.

The extent and nature of the interlinkages are crucial and there are clear ways of considering these. Firstly, **the distinction between core and periphery is a key element**. In defining the system relevant to assess, one would consider the extent to which core players (we assume VLOPs and VLOSEs to be core) are interlinked with each other and with peripheral players. It would also consider the extent of interconnection among peripheral players. **Contrary to what we have seen with banks, in the VLOPs/VLOSEs systems, 'core' players may not necessarily be the largest ones** (or the largest ones only), but those that have many interlinkages across different VLOPs/VLOSEs.

Secondly, **the weight of the interlinkages should be considered as these both identify the most critical players and the nature of the risk involved**. Important questions to answer are whether there is an exchange or sharing of exposure (such as debt), or sharing of responsibility (monitoring, for instance), and ones about the diversity of the relationships and the conditions governing them. Although banking systems are often assessed at the national level, interlinkages with the transnational are usually considered. With VLOPs and VLOSEs being by default transnational, as will be discussed further in Section 7 below, this feature from the financial sector seems less relevant, but they are obliged to deal with illegal content defined according to Member State and EU law. Finally, the role of



the central banks as both player and regulator shows interesting parallels to the roles that platforms play within their ecosystems, a point which we will return to in Section 7. There are, of course, extensive dissimilarities, not least in the fact that, unlike VLOPs/VLOSEs, central banks are national institutions⁵ with clearly defined public mandates. VLOPs/VLOSEs are also part of much more complex systems of distributed responsibility and often polycentric co-regulation (Broughton Micova & Kukliš, 2023; Finck, 2018) involving national regulatory authorities, self-regulatory instruments, the Commission among others as well as their own internal mechanisms.

⁵ The exception being the European Central Bank, which is owned by the central banks of the countries of the Eurozone and has a treaty-derived public mandate.



4. DEFINING THE RISK IN THE FINANCIAL SECTOR

Once that players and their interconnections have been defined and investigated, we can focus on the risks they generate and/or are affected by. In this section we continue examining the financial sector literature and define systemic events and shocks, their features, propagation, and contagion. Definitions of failures are also provided, albeit we will see in subsection 7.3 that they cannot be easily readjusted to VLOPs/VLOSEs system. We find that shocks can be categorised as endogenous/exogenous and idiosyncratic/systematic and this classification will be useful for VLOPs/VLOSEs' risk assessment. We notice that accumulation of weak shocks is overlooked in the financial literature, while it could be potentially relevant for VLOPs/VLOSEs system. We also find that contagion and contribution to systemic risk can be measured in different ways, and they are affected by both individual player's features and network's shape, but financial risk assessment tools would require some adjustment to be relevant for VLOPs/VLOSEs systems.

4.1 Systemic Events and Shocks

De Brandt & Hartmann (2000)'s seminal paper provides a systematic understanding of 'systemic risk', before applying it to the banking system. They define the concept of 'systemic event', which is instrumental for defining the former. A systemic event can be i) defined in a narrow sense or in a broad one, ii) be either weak or strong.

A systemic event (in the narrow sense) is defined as the release of a negative news related to one of the actors of the system (a shock that is uniquely related to that actor is also defined as idiosyncratic shock) negatively impacting at least another actor of the same system or, if there is, one of its components/institutions (for instance, financial markets for banks). If only a single actor/component is hit by the systemic event and there is not failure or crash, the systemic event takes a weak form. On the contrary, if multiple actors/institutions are affected by it (so, if there is contagion), leading to a failure of one of them, although the latter was ex ante (pre-shock) solvent, this systemic event (defined in a narrow sense) is strong.

A systemic event always depends on one or more shocks. Depending on the considered feature, **we can distinguish between shocks in two different ways:**

- Endogenous vs exogenous shocks
- Idiosyncratic vs systematic shocks

Endogenous shocks are those shocks that are generated within the system (such as a shock to a single bank, or a monetary policy shock – please recall that we defined the central bank as a player within the banking system), while **exogenous shocks are all those shocks that hit the system, but not being generated by any of the players**, come from other systems that are interlinked with the banking system (for instance, geopolitical shocks, elections, US Federal Budget debt ceiling, natural disasters – Fukushima, hurricanes, and so on –, Covid-19, US-China Trade war.)

Idiosyncratic shocks are those shocks that initially hit a single individual bank (for instance, earning announcements, quarterly reports, a new CEO appointment) and they are generally endogenous



shocks, although there exist some exogenous ones (supervisory authorities' announcements on stress test outcomes, or approval/refusal of capital distributions, for example).

Systematic shocks are shocks that simultaneously hit many banks (such as fiscal policy shocks, inflation rate surprise – the difference between market participants' forecasted inflation rates and actual inflation rates –, regulatory changes) and they are generally exogenous, even if a limited number of endogenous systematic shocks exist (monetary policy announcements, for instance).

These various types of shocks hit banks in their balance sheets (or T-accounts), which are composed by assets, liabilities, and equity with the assets always being equal to the sum of liabilities and equity. This is an accounting equality and, by definition, always holds. It is worth providing more details on this issue, as shocks affect banks' balance sheets in very different manners, making them more fragile or solid to future shocks and systemic events.

Equity is defined as the difference between assets and liabilities. This implies that it is affected by any change in the mentioned difference. To clarify the concept, we will present two examples. Assume that there are some deposits' outflows (or the repayment of one of the waves of TLTROs – targeted long term refinancing operations – one of the facilities introduced by the European Central Bank) and that there is an identical change in the assets (reduction of cash and cash equivalents, for example), so there is no impact on a bank's capital, although this shock to the balance sheet of this bank can affect its leverage ratio (broadly defined as the ratio between equity and assets), risk-adjusted capital ratio and liquidity coverage ratio – the latter is defined as the ratio between high quality liquid asset amount and total net cash flow amount for 30 days.

On the contrary, any shocks that affect that difference (for instance, some securities held among the assets are repriced, but liabilities are unchanged or not affected in the identical manner) will affect net profits, which are one of the components of capital. Note that they do not necessarily affect liquidity ratios (such as depreciation of real estate properties) – although they could (the sale of some of the 'held to maturity' securities at a price different from their book value, for example), but they certainly affect leverage ratio and risk-adjusted capital ratio. If the bank is listed on a stock market exchange, shocks can affect the prices of equity and debt securities issued by the bank.

A rapid fall/rise in these securities' prices could be a proxy for the confidence that market participants have on the bank(s): they could generate the so called 'confidence shocks'. Confidence is key for every firm, but especially for commercial banks, as their balance sheets show a structural 'maturity mismatch': most of their assets are long-term (such as mortgages), while the contrary can be stated for their liabilities (for instance, deposits, various types of short-term debt, interbank debt, and so on). Consequently, banks are affected by the so called 'rollover risk', that is, the risk of not being able to refinance their liabilities.

If the bank is not completely disconnected from the other banks, that is, the bank either lends some funds to at least another bank or borrows some funds from at least another bank, some direct interconnections through this bank's balance sheet and another bank (other banks)' balance sheet(s)



are established: interbank credit and/or debt. They both are susceptible to generating risks to the banks, albeit in a different manner, depending on whether the interconnection is through an interbank credit or debt. The former can generate a credit risk to the lender bank if the borrower bank details, while the latter generates a liquidity shock to the borrower bank if the lender bank suddenly withdraws the funds.

Many research papers, such as Calef (2020), show that most banking crises are due to liquidity shocks rather than credit risk. It is worth noticing that if a knock-on (domino) effect starts and some banks default, the two types of risks may amplify one another. **‘Confidence’ is a quite underscored element in banking systems. Similar shocks can be mitigated or propagated very differently, depending on the level of confidence that market participants have on peripheral/core banks/banking systems.** ‘Confidence’ shocks can hit a single bank but can become systemic. We have just outlined three relevant sources of risk: credit, liquidity, and confidence.

What we found missing in the literature was recognition of the effects of accumulation of similar or identical weak shocks. There is a clear focus on the one-off event-type shock, though perhaps of varying lengths. Weak shocks are likely to be frequent and can accumulate to significant negative effects, especially ones stemming from risky assets or behaviour, such as the practice of issuing sub-prime mortgages before the 2007-08 global financial crisis. Though these are likely to occur, our search indicates that the banking and finance literature overlooks their relevance and seems uniquely focussed on events/shocks that ultimately turn out to be systemic (see more in section 5.4). In a recent example, Signature Bank, Silicon Valley Bank, and First Republic Bank did not experience deposit outflows only when they were forced to release the news, but they had been undergoing smaller, but continuous deposit withdrawals in the days preceding and leading to the news. In other words, this accumulation of small idiosyncratic shocks led to a large idiosyncratic shock (news), which, in turn, decreased confidence not only in the shocked banks themselves, but also on some of others of similar size, determining additional sizeable deposit outflows, and on financial markets. A systemic shock occurred and has been mitigated only by the prompt intervention of policy makers (US Federal Reserve – Fed – and Federal Deposit Insurance Corporation – FDIC).

4.2 Contagion and Propagation

A systemic event (in broad sense) occurs when multiple actors/institutions are affected by an idiosyncratic shock experienced by one of the actors (deposits outflows from SVB, for instance) or a systematic shock, which, by definition, is a shock that simultaneously hits most of/all the actors, (a Central bank’s policy rate increases, for example). **Depending on whether there is propagation, we can distinguish strong systemic shocks in a broad sense (there is contagion) from the weak ones (no contagion).** It is worth noting that it turns out that often systems are affected by systemic events that lie somewhere between the narrow sense definition and the broad one.

Consequently, we can define ‘systemic risk’ (in a broad or narrow sense) as the risk of strong systemic events (in a broad or narrow sense, respectively). In other words, the common element of systemic risk is the fact that there is contagion that leads to the failure of one or more



actors/institutions. In the extreme case, the consequence could be that the system is impaired, that is, the systemic event(s) led to a systemic crisis. It is key to notice that the transmission of systemic events could be either propagated or mitigated by certain actors (or nodes), depending on whether they are sufficiently solvent to absorb it, the level of interconnectedness, competition, and other features, preventing a substantial and fatal transmission to other actors (for discussion see Allen & Gale, 2000, 2004; Sáez & Shi, 2004; Allen & Carletti, 2006; Allen & Babus, 2009). In the case of a systemic risk, mitigation is essentially ruled out.

Both theoretical and empirical papers have long disputed whether high banking concentration is a stabilising factor or a destabilising one. High levels of concentrations may enhance banks' market power in the form of higher real interest rates applied to loans/mortgages. This produces a duplex effect: higher rates attract borrowers (that is, entrepreneurs) with riskier projects, as those have the potential to repay the debt, but also more likely to fail. This is the so-called risk-shifting effect ((Boyd & De Nicolo, 2005)). At the same time, higher interest rates mean larger revenues: this is the so called 'margin effect', as noticed by Martinez-Miera & Repullo (2010). So, the overall impact is ambiguous and, depending on the paper, authors focus in just one of them. Martinez-Miera & Repullo (2010), on the contrary, in their theoretical paper consider both of them and found that there is a non-linear U-shaped relationship between concentration and bank failure. In other words, there is an optimal level of concentration that minimises the likelihood of default and it is an intermediate level of concentration. However, Jiménez et al. (2013) were not able to fully confirm their findings. In effect, all these authors fail to consider another factor: network. Acemoglu et al. (2015) theoretically find that interbank linkages have a non-linear impact on banking stability and a highly interconnected banking system is less prone to crisis if the shock is not too large. Calef (2020) provides an empirical support to the concentration-stability view by considering interbank linkages together with the two previously mentioned effects.

Finally, a vertical or horizontal view on the concept of systemic risk can be taken. The former applies, where the focus is on the impact of the systemic risk of a given system on other systems, while if the focus is only on the effects within the system itself, systemic risk is analysed through horizontal lens. Quite often both researchers and policy makers (almost) exclusively focus on the latter, while the former is rather relevant. In the context of the economy, banks and, more in general, financial institutions, mimic the role of the heart in for human beings: one of their roles is to support the (possibly efficient) allocation of funds from those who are in excess of them (savers, who are also consumers) to those that are shortage (such as entrepreneurs, or governments), providing liquidity, but also monitoring projects, assessing risk and, ultimately, sustaining economic growth.

4.3 Failure

There have been a few ways to define what constitutes a systemic banking crisis, however, the literature arrives at an accepted calculation of solvency as a key determinant.



Demirgüç-Kunt & Detragiache (2002) define systemic banking crises as occurring when emergency measures were taken to assist the banking system (such as bank holidays, deposit freezes, blanket guarantees to depositors or other bank creditors), or if large-scale nationalizations took place.

Kaminsky & Reinhart (1999) define the beginning of a banking crisis as follows: (1) bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions (as in Venezuela in 1993); and (2) if there are no runs, the closure, merging, takeover, or large-scale government assistance of an important financial institution (or group of institutions) that marks the start of a string of similar outcomes for other financial institution.

Boyd et al. (2009a) criticised the crisis dating literature, as it relies too much on governments' interventions, which always take place after a systemic crisis has occurred, making the crisis dating discussed above unreliable to forecast future crises. For this reason, they elaborate some systemic bank shocks (SBS) indicators, depurating the previously created crisis dating dummies by governments' intervention components. However, their proposed measure may easily bias the estimation of the likelihood of a systemic crisis, crises' observations are likely to be underestimated.

Both definitions suffer from the risk of dating a banking crisis too early or too late, so other measures have been developed, such as z-score. This was first developed by Roy (1952) and has been applied to the banking industry by several authors (A. Berger et al., 2009; Boyd et al., 2009b) as a proxy of bank resilience. The commonly accepted definition is the following:

$$z - score = \frac{ROA + Leverage Ratio}{\sigma_{ROA}}$$

where ROA is the return on assets, leverage ratio is the ratio between equity and assets, σ_{ROA} is the standard deviation of the return of assets. This measure can be computed both at bank level and national level. The index provides the number of standard deviations of profitability necessary to deplete all the equity. Higher profitability and leverage ratios increase the indicator. In other words, an increase (or a decrease) in a banking system (bank) z-score indicates an improvement (or a worsening) of banking system (bank) solvency.

While a systemic banking crisis implies low (even negative) levels of z-scores, the vice versa is not guaranteed. Nonetheless the latter can predict the former. A higher z-score makes a systemic crisis more unlikely. It does not necessarily mean that there is lower systemic risk, but if there is a systemic shock that would hit capital, it 'should' be better absorbed. Systemic risk does not necessarily lead to failure. If not mitigated or absorbed, however, it can then lead to systemic crisis or system failure.

4.4 Fundamentals of Risk Measurement in the Financial Sector

Two commonly used proxies for measuring the level of risk of a firm (including in banking and finance literature) are provided by expected shortfall (ES) and value-at-risk (VaR). The latter is defined as the maximum loss that a corporation can experience with confidence $1 - \alpha$ (or, equivalently, the probability of losing more than that monetary value is α). ES is defined as the expected loss, conditional to the losses being larger than the VaR in absolute value.



The financial literature provides some statistics to measure risk. Acharya et al. (2017) apply the VaR concept to financial institutions by considering the contribution to gain/losses of each of security i of a bank (the two elements are security's return and portfolio weight) and computing the sensitivity of ES to the exposure to each security i , that is, defining security i 's marginal expected shortfall ($MES_{i,\alpha}$). This measure allows for a simple estimation of the impact of both idiosyncratic and systematic shocks that can affect bank's balance sheet. It effectively detects minor shocks before they become systemic, and most often they will not reach that level.

Together with this concept, these scholars also introduce the concept of bank's systemic expected shortfall (SES_i), which indicates if a bank's level of equity falls below the 'required'⁶ one (required by regulation) as a consequence of a systemic crisis (proxied by the fall of the aggregate banking system's equity below the same required threshold). It is possible to prove that there is a positive linear relationship between $MES_{i,\alpha}$ and SES_i , making it possible to use them for macroprudential stress-testing purposes.

Other authors, such as Huang et al. (2009), Billio et al. (2012), Segoviano et al. (2020), used credit default swaps (CDS) or other market data in order to measure systemic risk. Ballester et al. (2016), using banks' CDS spreads data and a PCA-GVAR combined approach (PCA stands for principal component analysis, while GVAR stands for generalized vector autoregressive model), managed to distinguish idiosyncratic contagion from the systematic one. Finally, another branch of this literature focused on the so called CoVaR, introduced by Tobias & Brunnermeier (2016), whose measure is a proxy of financial sector's VaR given the VaR loss incurred by a financial institution. Although this measure is easy to be interpreted, it is not exempt from some drawbacks, as pointed out by V. Acharya et al. (2012).

Poledna & Thurner (2016) developed a measure to assess the proportion of systemic risk generated by each bank's liability to the overall systemic risk. The individual impact is seen as a negative externality. As such, they propose transaction tax ('Systemic Risk Tax') on all those transactions that increase systemic risk. According to their model, this tax would affect the structure of the network leading to a decrease of systemic risk, while raising at the same time funds that can be used by public authorities to bear costs of potential failures of banks.

4.5 Takeaways on the Nature of Risk in Financial Sector

Sources of risk are identified as shocks, which can be exogenous or endogenous to the system and either idiosyncratic to single players or systemic, affecting multiple players or the entire system. The contagion or propagation of these shocks is what makes the difference between weak and strong shocks and the dynamics (speed, spread) of contagion and propagation are determined by the ability of individual institutions to absorb the shocks and where the shocks occur. It is key to see whether shocks occur in the periphery and travel to core players or spread among peripheral ones, or if they

⁶ Macroprudential authorities, such as Basel committee and central banks are those that assess capital requirements to be maintained by each systemically relevant bank. Similar regulations exist for insurances too.



occur in core players and spread among core players and/or to the periphery. The nature of the relationships among core and peripheral players conditions this.

Shocks in the finance sector are singular events, which could have secondary or tertiary outcomes, however they are not structural or feature related. Structural characteristics or features can affect the likelihood of a shock being mitigated or propagated. The financial sector literature does not consider the possibility of an accumulation of minor shocks. As we will discuss further in section 7, this means that the way **the concept of shock is used in finance is too restrictive for direct application to VLOPs/VLOSEs. It can serve as a starting point, particularly in relation to user behaviour sources of risk**, however the notion that sources of risk can be both exogenous and endogenous and either idiosyncratic to a single service or systemic to multiple ones has potential to be operationally useful.

Contrary of the clear definitions of failure in the financial literature, what constitutes a failure in VLOPs/VLOSEs system must be specific to the risk areas. This, we argue, requires multi-stakeholder agreement. Once that risk areas are defined, the mitigation of shocks or accumulation of shocks will require monitoring efforts and different ‘reacting’ times, depending on the risk area, as we will see below in the report.

There are a variety of nuances but as can be seen in the literature reviewed **three main types of measures are used for assessing systemic risk in the financial sector.** The first type measures how much of the overall financial system will be affected by a shock in one player. The second type measures how much any individual player contributes to the systemic risk embedded in the whole system, and the third measures the ability of any given player to resist shocks. **We argue that these three types of measures may also be useful in the assessment of risk by VLOPs/ VLOSEs and in the oversight by the Commission.** They are likely more relevant to some risk areas than others and mainly for user or service behaviour related sources of risk rather than those stemming from VLOP/VLOSE characteristics.



5. DEFINING THE SYSTEM FOR PLATFORMS AND SEARCH ENGINES

As discussed in section 2 above, the DSA and the policy documents leading up to it offer some indications as to what is systemic about the risk that VLOPs and VLOSEs are expected to assess. Services are systemic at a certain scale, which is due to their reach and their function in society due to that reach. Risks are systemic when there is potential for harm to societal systems. Service providers are required to conduct risk assessments that are specific to their services, but the DSA does not identify services as systems themselves. We know that **assessment of systemic risk in the financial sector is not a solely internal exercise**. While mitigation measures may be internal to any given service, as they are for any given bank or insurer, the understanding and assessment of risk is not. It is highly dependent on the characteristics of a system, which is made up of a variety of interconnected institutions and providers. In this section we consider the nature of the system, or systems, of VLOPs and VLOSEs looks like.

Firstly, we discuss the characteristics of these services – which have been described as ecosystems –, the different types of services that have been designated so far, and categories of non-designated services or other actors that could be considered to be in a system with VLOPs and VLOSEs. Secondly, we examine the different kinds of interconnection, including the role of assets and functionality. In the third part of this section, we consider the role of concentration in the market and find that like in the financial sector the effects on risk are unclear, but there is evidence that forms of dominance and gatekeeping are particularly important for some of the risk areas.

5.1 The Nature of VLOPs and VLOSEs

VLOPs and VLOSEs are both intermediary services defined in the DSA as online platforms and online search engines⁷ that have average monthly active recipients of 45 million or more. They are also multisided services operating platform ecosystems transnationally. Here we will take each of these aspects in turn.

The **Commission recognized the multisided nature of these services in its approach to the calculation of active recipients**. The answers it provided to service providers ahead of their first publication of user numbers stated that where the service is multisided, users on all sides should be counted including individual end users, business users, traders, and advertisers (European Commission, 2023b). It is also inclusive in terms of the varied functionalities for which recipients might use the service, listing viewing, listening, and buying

As of April 2023

Very Large Online Platforms:

Alibaba AliExpress
Amazon Store
Apple AppStore
Booking.com
Facebook
Google Play
Google Maps
Google Shopping
Instagram
LinkedIn
Pinterest
Snapchat
TikTok
Twitter
Wikipedia
YouTube
Zalando

Very Large Online Search Engines:

Bing
Google

⁷ These are defined in Article 3 (l & j), though only online platforms are defined as hosting services while search engines are defined as intermediary services without specifying to which of the three categories they belong.



as well as providing content, selling, and advertising. In the list of those designated on 24 April 2023 there is variety in the types of services and functions they offer their users (European Commission, 2023a). There is also variety in the business models with some that are more or less dependent on advertising alongside other revenue sources. Just as in the finance sector there is the rare public model, as the list of VLOPs includes Wikipedia, a non-profit service.

Commercial VLOPs and VLOSEs are at least two sided and most are multisided in terms of the users they serve and markets in which they operate. While search engines are arguably more limited in their function than online platforms, they are nevertheless serving both end users and advertisers, and potentially others. There is a well-developed body of literature in economics and business that has examined this and its implications. Indirect network effects between or among the sides were identified early on (Rochet & Tirole, 2003, 2006) with often zero or no cost to one of the sides. Some remain limited to direct network effects, while those with more complex business models make use of both direct and indirect network effects (Flew, 2021; Nooren et al., 2018). Especially those dealing in advertising were described as multisided because they traded with users, advertisers, content providers, app developers, and others (Evans, 2003; Evans & Schmalensee, 2016; Flew, 2021). Competition scholars have been particularly concerned about the way the welfare of the various consumers is intertwined and subject to feedback effects (Coyle, 2018; Wismer & Rasek, 2017). VLOPs and VLOSEs are multisided and there are network effects and welfare relationships among those on the various sides.

The concept of a platform ecosystem came to be used to describe these relationships, especially the power dynamics and roles in value creation and extraction. At its most basic level a platform ecosystem is a system in which a platform, its complementors (such as app developers, plug-in creators, or traders), and consumer/users interact to create value⁸. However, as Tiwana (2014) identified already several years ago, the platform owners orchestrate an asymmetrical relationship with both consumers and complementors. Kapoor et al. (2021) conducted a systematic review of the platform ecosystem literature focused on the nature of the services and found consistent identification of a central role for the platform, or platform owner as rule definer and coordinator, linked to a technology and/or a value proposition, and involved in multisided markets (see also Kenney et al., 2019; Schrieck et al., 2016). This is a powerful regulatory role that is closely connected to gatekeeping and the centrality of a platform as an intermediary (Busch et al., 2021). It involves not only technical mechanisms such as contractual rules and standards, but also norm setting and influence over behaviour, in a manner that appears similar to the role of central banks discussed above.

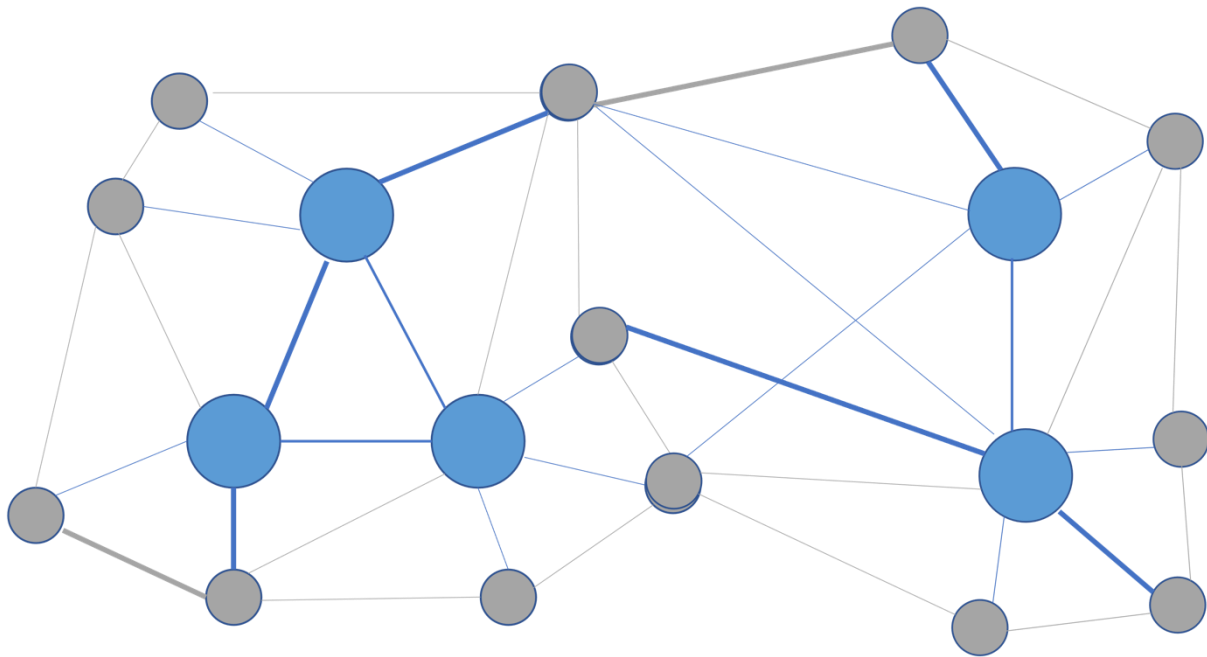
Platform owners often operate more than one service within an ecosystem or with integrated ecosystems (van Dijck et al., 2019). Complex ecosystems have evolved around **hybrid platforms**

⁸ The literature on platforms in general does not make a distinction between online platforms and search in its discussion of ecosystems and among the examples used one can find app stores, search engines, social media, e-commerce trading platforms and others. The impression given is that the concept, as elaborated, is applicable to all.



offering both innovation and transaction or exchange of goods or information. The most successful platforms, including most VLOPs and VLOSEs, are now hybrid ones as a result of acquisitions or expansion by innovation platforms wishing to manage more aspects of the consumer experience or of successful transaction platforms opening APIs to third party creators of complementary apps or services (Cusumano et al., 2020). As Busch and colleagues (2021) point out, **these can take the form of consistent embedded relationships that take an infrastructural form with other commercial or even public services.** They give the examples of maps platforms' API-based relationships with ride or accommodation apps as well as state emergency or disaster response services. Figure 2 uses the same core-periphery model used to illustrate integrated platform ecosystems. It includes one ecosystem of three VLOPs/VLOSEs connected to each other, perhaps owned by the same company, at the centre of an ecosystem that is integrated with another in which there are two VLOPs/VLOSEs that are central and also connected, perhaps also by ownership or by functional interlinkages, or even by highly overlapping user-base. In the middle are three smaller players that would also be considered core due to the extent of the interconnections. Around them are peripheral players that can be complementors,

Figure 2 Illustration of core and peripheral players in integrated platform ecosystems



content providers, major traders, third party partners, trusted flaggers or others.

It has also been pointed out that individual users often are both end users and complementors complicating network effects and expectations of responsibility (Kapoor et al., 2021). For example, to mitigate content related harms on video-sharing platforms many of the measures expected entail user engagement and sharing of responsibility, especially by 'user-creators' (Broughton Micova & Kukliš, 2023; Kukliš, 2021). **Platforms are therefore at the centre of complex ecosystems that they govern through technology, contracts, rules, conditions, standards, or other means. Nevertheless, a variety of complementors in the form of innovators, traders, or content producers also have co-creative**



roles, and therefore can all contribute to the level of risk. The variations in the weight of the relationships in Figure 2 show differences in the importance of that relationship to risk, and can represent shared responsibility, strength of dependence, volume of interaction, or other factors. They can also represent a combination of these.

Unlike financial institutions, which as discussed in section 4.3 are often nationally based, VLOPs and VLOSEs are by definition and by nature transnational. By definition, of course, they are designated based on an EU-wide user base. By nature, they grew initially as networks not bounded by national borders. Though many originated in the United States or China, they were never designed to serve only national populations. In Europe they spread freely enjoying the rules against national interference and limited liability afforded by the e-Commerce Directive (De Streel & Husovec, 2020). The problem this posed in terms of jurisdiction have been solved by the DSA's Article 2, which sets out the scope of the Act.

From a systemic risk perspective, another challenge arises in terms of accounting for the transnational nature of the other actors in any given platform ecosystem. There are cultural and political difference to be considered inherent in several of the risk areas identified in the DSA, which means **that the multinational nature of the user base and the institutions that may be negatively affected has to be accounted for**. The multinational array of complementors, many of whom are even based outside of the EU, are a considerable source of risk. This risk can stem from unintended consequences of behaviour, but often is intentional misuse, such as for trolling, bullying, or grooming.

There is already a considerable amount of evidence of malicious use of VLOPs, state sponsored as well as by non-state actors (Giglietto et al., 2020; Lukito, 2020; Schlesinger, 2020). Even the non-profit Wikipedia can easily be the site of information wars (Buchatskiy, 2022), while at the same time being used by other VLOPs as a source of fact to counter disinformation (Ford, 2022). There is no real parallel in the financial sector where even misuse by users, for example for money laundering or tax evasion, does not contribute to systemic risk for the banks. The financial sector is also bound by 'know your customer' rules that have no parallel in VLOPs/VLOSEs which allow for varying levels of anonymity. The systemic risk areas in the original proposal for the DSA included "intentional manipulation" (European Commission, 2020c, art. 26(1)). Although this did not end up in the adopted text, **the potential for intended manipulation by individuals, organisations or institutions in multiple jurisdictions remains crucial to consideration of systemic risk**.

5.2 Interconnection among VLOPs and VLOSEs with other Services and Institutions

As discussed in section 4.1 above, in the financial sector interconnection is fundamental to the understanding of systemic risk in the sector. The extent of ties among institutions and the nature of those ties contributes to the assessment of risk. In addition, there are central players that also play a regulatory role in the system, setting rules, norms and influencing behaviour in various ways. There are also **distinctions between the core and the periphery and considerations of the extent to which concentration, especially among the core players is a contributing or mitigating factor in risk**. Among



the core players an issue is the level of concentration of interlinkages and shared dependence on common assets. Another issue is the extent to which core players (with high potential to disrupt if they fail) are exposed to risk via connection to smaller, perhaps more reckless ones in the periphery. Treating VLOPs and VLOSEs as core, for the reasons outlined in section 2, here we first examine more closely the interconnections among them in terms of functionality and assets, and then the ways they are connected to other services in the periphery that may contribute to risk.

Several of those designated as VLOPs or VLOSEs are part of the same global conglomerates (Bourreau & De Streel, 2019). They therefore share capital and human resources and are connected via a variety of internal systems. Those that are involved in the trade in advertising may have proprietary systems on the supply side, or have intermediaries within their conglomerates, but still be connected to other VLOPs or VLOSEs through use of the same third party or demand side services involved in that complex ecosystem (see Broughton Micova & Jacques, 2019, 2020a). One element of interconnection among financial services for the purposes of systemic risk assessment is the extent of reliance on a common asset. For services within the same conglomerate there are obvious shared assets of various types. For advertising dependent VLOPs and VLOSEs an important asset is user data (Bourreau et al., 2017; Broughton Micova & Jacques, 2020b), also a contributor to the power of these services both in the market and society (Busch et al., 2021; Furman et al., 2019; Lynskey, 2019). **Those within the same conglomerate rely on shared data, and VLOPs and VLOSEs that are owned by different companies may still be drawing on common data resources if they are connected to the same intermediaries or advertisers.**⁹ Trading platforms will have data assets related to product information, product images, reviews, transactions, and others.

Another asset for many VLOPs and VLOSEs is content, and **they can also be connected through functionalities that allow for shared value creation from that content and through common content.** For example, YouTube's model is partly reliant on people sharing videos and provides functionality to share directly to a variety of other VLOPs and smaller platforms, while VLOPs such as Twitter and Facebook derive value from the circulation of YouTube links shared through this functionality. Encouraged by marketers and brands, the hashtag has become a recognised and well used form across a variety of platforms, and one that search engines can pick up on through cross-platforms (Chang & Zhang, 2016). Used also in social movements (#MeToo, for instance) and extensively in political communication, hashtags are used simultaneously on multiple platforms and can be useful ways of identifying and organising content, as well as a means for generating engagement for platform providers.

Many of the risk areas set out in the DSA relate to harmful or dangerous content, and the mitigation measures expected according to Article 35 involve content moderation and means for ensuring effectiveness of notice and takedown. Reliance on hashtags for the purpose of content moderation has been found to be problematic due to inconsistency of use and deliberate avoidance (Gerrard,

⁹ Large advertisers or their agencies often have their own customer data or data from other sources that they bring into the systems operated by VLOPs or VLOSEs or advertising intermediaries (see previous CERRE report (Krämer et al., 2020)).



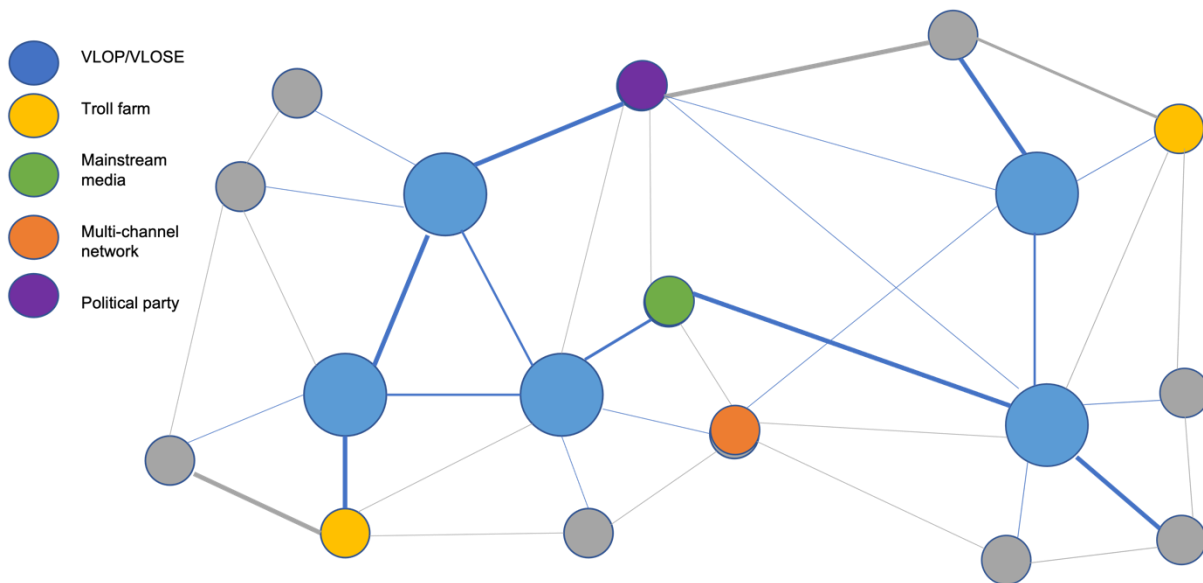
2018). **Many providers of VLOPs and VLOSEs already contribute to and rely on common content resources for identifying and removing illegal content.** Microsoft's PhotoID and 'hash' databases are used to identify child sexual exploitation content, terrorist content and other illegal content (for explanation see Broughton Micova & Kostovska, 2021b, sec. 2.3.4). **The extent to which VLOPs and VLOSEs are interconnected by reliance on the same assets and services for their governance measures and prevention of harm could be a factor in the level of systemic risk.** Examination of these shared assets used in the mitigation of negative effects such as common databases and detection tools, and assets shared that may present a common vulnerability to negative effects such as user data pools or verification tools, may need to be conducted in a coordinated manner based on the evidence gathered from the risk assessments and audit reports.

Interlinkages with smaller, often with less stringent terms and less developed content moderation systems, comes across clearly in the literature as a source of risk on VLOPs that are primarily for the sharing of user-generated content. This is mainly in the literature that looks at diffusion or contagion of harmful content, which will be covered in more depth in section 8.3. Periphery services can nurture communities whose users are also active on VLOPs leading to a transfer of harmful content and behaviour that has been popularised or normalised within those communities. Some peripheral services, such as Parler and 4Chan, have been found to be hotbeds of content and behaviour that would contribute to negative effects in the risk areas identified in the DSA (Israeli & Tsur, 2022). Users multi-homing and engaging with both core and periphery services should be assumed.

Interlinkages with multi-channel networks (MCNs) are common among VLOPs that are for sharing user-generated content and have contractual commercial relationships with influential users (Lobato, 2016). Such VLOPs often have functionalities or special arrangements with certain MCNs (Broughton Micova & Kostovska, 2021a), as well as direct relationships with major advertisers (Broughton Micova & Jacques, 2019). VLOPs and VLOSEs may also have special contractual relationships with certain publishers in some Member States, or with app developers. Several have also been found to have close ties with political parties, including embedding teams in campaigns and providing training (Kreiss & McGregor, 2018). **Many of these other actors can be central in terms of interconnection even if they are a not very large in relation to the whole system.** Figure 3 shows a very simplified illustration of what interlinkages could look like in relation to risk of negative effects on civic discourse.



Figure 3 Simplified illustration of ecosystem mapping for risk of negative effects to civic discourse



In this illustration, the mainstream media company, multi-channel network, and political party are all core players with connections to multiple VLOPs/VLOSEs. Figure 3 also shows two peripheral bad actors in what could be state-sponsored troll farms or similar that are connected to VLOPs and to smaller platforms, or other actors. Some of the peripheral actors here could also be trusted flaggers or fact checking organisations, smaller media, third party data processors, or others. The Figure 3's mapping is highly simplified and included here just to illustrate the kinds of interconnections among players that might be relevant. We were not yet able to identify a body of literature that examined the nature of interconnection between large trading platforms and smaller firms such as those that use these platforms for online store fronts, but it is likely that such interlinkages with peripheral firms within those ecosystems should also be considered.

5.3 Relationship with the Wider Society and Economy

In section 2 we identified impact on the wider society and economy as integral to the understanding of systemic risk that seemed to be behind its use in the DSA. Section 4 demonstrated that this is also fundamental to the concept of systemic risk in the financial sector. It is not about whether a single bank fails affecting its customers, but whether that failure will affect others who have nothing to do with that bank including through consequences for the overall functioning of the economy. Two issues emerged: spill over into other systems and the level of concentration. The potential for spill over is connected to the number of consumers affected and connections to other services, whether enough consumers are affected to affect spending in the economy, major employers are affected impacting employment conditions, or complementary systems such as pension funds or insurers are affected. This is essentially the extent to which the wider society is exposed to risk emanating from a given banking system or, as we are discussing here, the ecosystems of VLOPs and VLOSEs. In the financial services literature reviewed there was **unresolved debate as to whether concentration increased the risk**, made systems more fragile, or increased stability and lowered the risk of wider societal effects.



In any national market the level of concentration can be a factor, among others, in assessing the extent to which society is exposed to risk due to dependency on a few large players.

Concerns about concentration in online platform and search markets have been discussed in academic and policy literature extensively, usually focused on contestability and the fairness of competition. There has also been a growing body of literature on platform *dominance* concerned with their role in society as information intermediaries (see contributions in Moore & Tambini, 2018, 2021, for instance). It is outside the scope of this project to review all this literature, but we raise here some points relevant to the potentiality of risks to society in the areas set out in the DSA. **Concentration in the market and dominance in society are inextricably linked in the literature yet, as in the financial sector, the link to systemic risk is complicated.**

A great deal of attention has been paid to the state of competition in digital markets and whether there is *unhealthy* concentration that deters market entry or innovation (Crémer et al., 2019; Furman et al., 2019; Krämer et al., 2020; Nuccio & Guerzoni, 2019). Though debates about market definition and multihoming consumers continue, it is clear that a few services have significant shares of advertising spend, revenues generated, active users, and complementors engaged, as well as access to data. Market contestability and market power are issues covered by the Digital Markets Act, but there are competition related features also relevant to consideration of systemic risk. As discussed in section 2 part of the logic of the user-base calculation for designation was that the share of the user base was linked to the extent of exposure within the society to potential negative effects. **The extent to which this equates to higher risk, or fragility, may be conditioned by various factors and specific to individual areas of risk.**

One factor is the extent to which the level of concentration among VLOPs and VLOSEs or their individual market power is linked to innovation and cooperation in the mitigation of negative effects. In relation to some areas of systemic risk, there may be benefits to the scale and market power that these services have achieved and the concentration of players. It may be, as Nuccio and Guerzoni (2019) have argued, that the market has developed such that large research and development resources derived from expansive market power are required for innovation in some areas. However, they also found that of the vast income extracted from the market by large platform providers, very little was distributed as it was directed toward innovation or acquisition, so possibly a rather limited amount income was flowing back into the economy to support innovation by others. This phenomenon is explained by Prufer and Schottmüller (2021), and Calef and Prufer (2023) who find that in data-driven markets (this is certainly the case of VLOPs/VLOSEs) dominant firms are able to take advance for their market dominance to a *connected market*, approaching to a monopoly with diminished incentives to innovate. The latter can be significantly alleviated by mandatory (past) data sharing with smaller competitors (Klein et al., 2023).

One risk area where concentration of market power and capacity to innovate seems to play a role is in the dissemination of illegal content. A 2020 study of video-sharing platforms (VSPs), a subset of online platforms to which several of the designated VLOPs belong, found significant differences in the



capacity of VSPs to deal with illegal content, namely child sexual exploitation material, terrorist content, and incitement (Broughton Micova & Kostovska, 2021b). Larger platforms had invested significantly in technological solutions for automated detection and removal and cooperated on hash databases other resources, in some case following public and advertiser pressure.

For example, following the terrorist attack in Christchurch, providers of the large online platforms were immediately called upon by governments to act and were founding members of the Christchurch Call to Eliminate Violent and Terrorist Content Online¹⁰. Collective resources were developed, standards and commitments were made. The smaller platforms, including those where manifestos, statements, and plans were shared ahead of that and other similar attacks (Kupper et al., 2022), were not around the table. Some smaller VSPs seemed to be relying on these and/or on one or two third party services, while others remained outside collaborative systems. Broughton Micova and Kosovska (2021b) also found similar differences in relation to tools for the protection of minors from harmful content, which is relevant to risk of negative effects on the rights of the child. Recalling the discussion in the previous section about the regulatory role played by some VLOP and VLOSE providers, **assessing the impact on wider society may need to consider what is being taken up by smaller services, what options are being cut off or missed out due to the domination of larger service providers in this type of innovation and collaboration.**

Spill over into other systems in society goes well beyond consequences for innovation. The literature identifies consequences in a variety of areas not directly related to the relationship between platforms and their users, from hiring practices (Davison et al., 2016; Koch et al., 2018; Wade et al., 2020), and the exercise of labour rights (Caves & Singer, 2018), to the success or failure of small business, police and social services' efforts against human trafficking, and climate change, among others (Cunliff, 2020; Karlie & Ana, 2019; OSCE, 2020; Pohl & Finkbeiner, 2017). While many of these have fundamental rights implications, there is a clear emphasis in the DSA on communication-related rights and systems, namely the right to freedom of expression and information, the freedom and pluralism of the media, as well as civic discourse (DSA Art. 34(1)).

The literature contains two main areas of concern, both of which were also evident in the development of the DSA as discussed in Section 2. **The first is the relationship to the media industry, in particular the media companies producing news and informative content.** For some VLOPs/VLOSEs their relationship to the media industry is characterised by gatekeeping and market power (Parcu, 2020), which are dealt with under the DMA. The consequences for media, especially local media and news publishers, from the competition for advertising and gatekeeping role of digital services has been well evidenced (Australian Competition and Consumer Commission, 2019; Broughton Micova & Jacques, 2019; Cairncross, 2019; Competition & Markets Authority (CMA), 2020; Flew, 2021). There are also links between financial sustainability and the ability of media companies to withstand political pressure or capture (Milosavljević & Poler, 2018; Schiffrin, 2021). **Though it is**

¹⁰ See <https://www.christchurchcall.com/>



not the role of the DSA to address competition concerns in advertising markets, any assessment of risk to media freedom and pluralism should take these market dynamics into consideration.

The relationship between VLOPs/VLOSEs and media companies is not only one of competition for advertising. The business models and functionalities of platforms, such as the forms they establish for presentation and dissemination of content, the recommender systems and engagement functionalities, and other features have been found to result in changes in practices and strategies both in content production and revenue generation (Nielsen & Ganter, 2022; Poell et al., 2022). As Nielsen and Ganter point out news producers and media companies do not lack agency in this relationship. They are making decisions in the context of continual engagement with platforms, ones that create path dependencies that may “solidify into cultural organisational, and material structures, with norms, routines, and technical standards shared across organisations that can be hard to break with or change radically” (2022, p. 170). **In the context of the risk areas dealing with communications rights and media the most important complementors or users for VLOPs/VLOSEs will likely be media companies and news producers and the nature of those relationship will need to be assessed.**

The other area of concern relates to the role of platforms as public spaces and their opinion power. Helberger has defined “systemic opinion power” as “the power to create dependences and influence other players in a democracy” (2020, p. 846). It has since been argued that this power acts at levels of the individual citizen, the institutional newsroom, and the media ecosystem requiring a significant revision of ideas about media concentration and pluralism (Seipp et al., 2022). These arguments build on evidence about personalisation and exposure diversity (European Commission et al., 2022; Helberger et al., 2015; Joris et al., 2019), about agenda setting on other media (Schlosberg, 2018); and gradual shaping of the norms of public debate (Moore, 2018). The conclusion we draw from the wealth and breadth of literature in this area is that **there is ample evidence that what happens within the public spaces of VLOPs/VLOSEs is not contained there or even among their users but has consequences for media diversity and wider public debate.**

As we live in a platform society in which platforms are inextricably linked to fundamental societal structures (van Dijck et al., 2018), we have only scratched the surface when it comes to the ways that VLOPs/VLOSEs relate to wider society. We have focused on those related to innovation in the area of harm protection and to communication rights, namely freedom and pluralism of the media and civic discourse, because those are clearly indicated in the DSA risk areas. It is evident **that at stake in risk assessment is not just users within the ecosystems of the individual platform services, but complementors and businesses with direct and indirect relationships to the services and non-users who are affected as part of wider society.**

5.4 Takeaways on the System for Platforms and Search Engines

VLOPs and VLOSEs are situated in heterogenous ecosystems in which they have a central or core role. Other players include complementors, third party services and partners, and users of various types. Some of the other players in these ecosystems have malicious intent and may engage in intentional manipulation. Even when that is not the case however, these relationships can be locations



of risk. Direct and indirect network effects are features of these ecosystems. Some VLOPs/VLOSEs also have close ties in the form of shared resources and technology as part of the same conglomerates. Others are linked through shared assets or through common third-party partners. **Some are gatekeepers likely to be designated under the DMA, which has implications for some of the risk areas covered by the DSA.**

The relationships VLOPs/VLOSEs have with other players are varied, but they often play a regulatory role within their ecosystems through rule and standards setting, norm creation, and shaping conditions. Many relationships are governed by contracts of some kind set by VLOPs/VLOSEs while others are less directly controlled or are co-created. Other core but non-designated players within the ecosystems may also have standard or rule setting power, especially with peripheral players. VLOPs/VLOSEs have relationships with wider society, including those who have never been users, through direct and indirect connections or effects on other businesses and through influence on societal structures.



6. THE NATURE OF RISK IN PLATFORMS AND SEARCH ENGINES

One of the biggest challenges in assessing risk in VLOPs/VLOSEs is likely to be determining the sources of risk. In Section 4 above, we showed that the literature on systemic risk in the financial sector identifies the sources of risk as shocks, which can, but do not necessarily lead to systemic events. Shocks can be endogenous to the system or exogenous and can be idiosyncratic in that they affect a single player or systematic in that multiple or all players in a system are affected. Whether or not a shock results in a systemic event depends on a variety of factors including the length and strength of the shock and the propensity for propagation or contagion. For the latter the number, level, and nature of interconnections among the players is crucial. Also important are whether the shock occurs in a relationship with a peripheral player and which direction it propagates within the system, as well as the ability of individual players to absorb the shock.

In this section we attempt to apply these concepts of shocks and propagation or contagion to platforms and search engines. Of course, the sources of risk are different for digital services. As explained in section 2.3, the DSA was designed with risks stemming from both the functioning of platforms and the behaviour of users in mind. The notion of shock as used in financial markets is an imperfect one for capturing all the sources of risk stemming from VLOPs/VLOSEs, especially those that are innate in the design and business models of VLOPs/VLOSEs. The word itself implies a sudden and unexpected event, and in relation to finance it does not refer to structural issues or features, which are not considered sources of risk but mitigating factors. Also, as pointed out above, we did not find evidence of any recognition of the accumulation of minor shocks leading to systemic risk being considered in relation to financial systems, which we identify as a gap in that literature as well.

Therefore, **in using the term shock in this section we are consciously testing the boundaries of this concept. We argue that it is a useful way to think about sources of risk that derive from user behaviour and external events.** In particular, assessing the potentiality of shocks, or sources of risk, using the exogenous/endogenous and idiosyncratic/systemic distinctions would be a useful step in assessing systemic risk as envisioned by the DSA.

Our review of platform literature revealed a body of work, particularly in information systems research that investigates and models dissemination and propagation of content, most often focused on harmful content, and some on the contagion of certain negative behaviours on platforms. However, as we also show in this section, there is little research on the propagation of other negative effects and less clear visions of what constitutes failure in response to shocks.

6.1 Types of Shocks

Applying the concept of shocks to risks stemming from VLOPs/VLOSEs enables us to think systematically about a myriad of different things that could result in ‘negative effects’ or harm, in the risk areas identified in the DSA. Of the three main sources of shock in financial systems, only consumer confidence is one that could be also relevant to the ability of VLOPs/VLOSEs to prevent harm, as there is no clear parallel to credit and liquidity. However, **the distinctions between endogenous and**



exogenous shocks, each of which can be either idiosyncratic or systemic, we argue, can be utilised in a risk assessment framework. Thinking of sources of risk in these distinctions can help to identify some locations for risk mitigation and assign responsibility for intervention or mitigation measures.

Endogenous shocks in VLOPs/VLOSEs would be ones that happen within integrated platform ecosystems. These are among the users, complementors, and partners of platforms who form the networks involved in value creation for VLOPs/ VLOSEs. To some extent, responsibility is distributed within these ecosystems and cooperation is necessary (Broughton Micova & Kukliš, 2023; Helberger et al., 2018). However, where the endogenous shock is idiosyncratic, which would mean occurring only within the system in which a single VLOP/VLOSE shapes the rules and conditions the responsibility and capacity for mitigation would likely lie with that VLOP/VLOSE or its provider, perhaps in cooperation with its users and complementors. A systematic endogenous shock may require cooperation among VLOPs/VLOSEs and other core players.

For example, a sudden change in the management and content moderation capacity or approach of a single VLOP would be an endogenous idiosyncratic shock. Another example would be a terrorist attack live streamed on a single VLOP by one of its users. In both cases there is potential for contagion of the negative effects of the shock. Endogenous idiosyncratic shocks do not have to be large or instantaneous. There can be an accumulation of minor shocks over time. A design feature or practice that is unique to a given VLOP/VLOSE could also have the effect of a shock. An example of this could be the negative effects to fundamental rights to privacy from a feature of a single VLOP/VLOSE's business model, functionality or policy.

Endogenous systemic shocks would be sources of risk coming from among the user communities, the complementors, or partners of VLOPs/VLOSEs but affect multiple VLOPs/VLOSEs' individual ecosystems at once. A shock from the behaviour or terms of a shared third-party data intermediary would be an example of this. These shocks could also come from users common to multiple platforms. For example, a trader who is operating on multiple marketplaces that is selling fake Covid-19 testing kits or face masks falsely sold as medical grade could be considered a source of endogenous systemic shock. Likewise, a major influencer active on multiple VLOPs, such as Andrew Tate or a popular promoter of conspiracy theories or self-harm behaviour, could have a systematic negative effect in the ecosystems governed by multiple VLOP/VLOSE providers. These examples may represent smaller shocks from which negative effects build up over time, but endogenous systemic shocks can also be sudden or short term and can vary in size. A coordinated attempt by users or a single user to interfere in an election through content designed for voter suppression across multiple platforms could be considered such a shock. **Due to the systemic nature of such shocks, coordination among VLOP/VLOSE providers may be necessary for effective risk mitigation.**

The situation of **malicious users could present a grey area between exogenous and endogenous.** Users are within platform ecosystems, however, sometimes these can be automated uses, or bots, and sometime use of a platform is not organic but instrumentalised by an external actor for a specific purpose. An example of this would be state-sponsored troll farms that pose as users and utilise bots



in order to create a specific kind of disruption in civic discourse or have a short-term impact on an electoral process.

Exogenous shocks would come from outside the platform ecosystems. Arguably, these are more likely to be systemic, affecting multiple VLOPs/VLOSEs at once. Examples of such systemic exogenous shocks are political events, such as elections or changes in government, which are relatively predictable, or a change in legal obligations imposed by a state, which also comes with some advance warning. Others may be less predictable like a global pandemic or natural disaster. Smaller shocks could also come from changes in ancillary markets such as the closer of local media companies. **As with systemic endogenous shocks coordination among providers and probably with relevant public authorities and other institutions would assist with the identification and mitigation of negative effects from such shocks.**

Idiosyncratic exogenous shocks would affect only a single platform ecosystem. These might come from an event or change in circumstances in the country where the VLOP/VLOSE's provider is based. It could come from regulatory action related to some other aspect of the provider's business such as a competition authority decision. Targeted cyber-attacks such as those leading to data breaches or other malicious action affecting individual providers are also possibilities that could affect ability to mitigate negative effects in the risk areas covered by the DSA.

The risk areas in the DSA are broad enough that the number of potential shocks that could result in negative effects is likely to be impossible to entirely predict. Using the concept of shocks and these four categories, we argue, could be used to help identify types of sources of potential negative effects that should be considered in risk assessment and mitigation. In particular, **this framework indicates that risk assessment and mitigation should not only focus on those sources of risk that are contained within an individual platform's ecosystem and that, for some types, coordination may also be required.**

As in financial systems, it is possible that the vast majority of shocks are weak and mitigated in a routine and regular manner. However, just as the proliferation of sub-prime mortgage lending eventually built up to a systemic crisis in banking in the US, so can a multitude of minor shocks lead to significant harm in the DSA's risk areas precisely because of the size and roles played by VLOPs/VLOSEs (Broughton Micova, 2021). In the financial sector, contagion or the propagation of risk has been a crucial factor in determining when major shocks or a multitude of minor shocks lead to a systemic crisis, so the next section presents findings from the platform literature in relation to these concepts.

6.2 Contagion and Propagation

In the last several years there has been a great deal of research on the propagation or dissemination of harmful content on social media platforms. Several of the designated VLOPs fall into this category. Computer science and information systems researchers dominate this academic area, though often in multi-disciplinary teams involving political scientists, communication specialists, public health scholars, and others. Such research seems overwhelmingly focused on disinformation with some specific interest in the spread of conspiracy theories. A limitation of this research is an over-reliance



on Twitter for empirical studies.¹¹ Studies on the diffusion patterns of disinformation content on Twitter have resulted in epidemiological models using the metaphor of viral infection (see Chen et al., 2022; Monsted et al., 2017) and ones using forest fire models (see Kumar et al., 2021). These highlight the speed at which such content spreads as well as the roles of active spreaders and non-spreader users.

Despite the significant challenges to cross-platform measurement of content diffusion (Heft & Buehling, 2022), there have been **efforts to investigate cross-platform propagation. These have produced some evidence on the relationships between peripheral platforms and designated VLOPs.** For example, through extensive investigation into posting behaviour, including temporal analysis, Zannettou et al. (2017) found there to be a clear link between both ‘alternative’ (sources of disinformation or extremism) and ‘mainstream’ news circulation in communities on the smaller platforms Reddit and 4Chan and the news’ circulation on Twitter. More specifically, one subreddit *The Donald* and one 4Chan called */pol/* (for political incorrectness) accounted for 6% of mainstream news and 4.5% of alternative news shared on Twitter in that time, which is a notable amount considering the volume of news shared on Twitter. Similar evidence was found of common narratives being shared across Parlor and Twitter and interactions with YouTube URLs in relation to the 6 January Capitol hill riots using social network analysis (Ng et al., 2022).

Another area of interest in recent research has been contagion of harmful user behaviour, such as aggressive behaviour or incivility, or even the sharing of disinformation. Cross-platform transmission is less well evidenced in this area, but platform functionality and the link between harmful behaviour and harmful content have been investigated. For example, there is evidence of contagion of offensive and aggressive behaviour among commenters, even when commenters knew some of the uncivil comments were synthetic (by bots) and, counter to common assumptions, whether the platform allowed anonymity did not make a difference in commenters slide toward incivility (Umar et al., 2022). There is evidence of various motivations for sharing conspiracy theories, such as on 5G and Covid-19, from the activists who use platforms to essentially broadcast to those who unwittingly contribute to the dissemination through the humour effect (Ahmed et al., 2020).

The extent to which a platform can be used to mimic broadcast, to reach large audiences quickly seems to be a factor in the contagion of harmful user behaviour and harmful content, which can result directly from the behaviour. Livestreaming is a functionality that raises particular concern from a risk perspective. It has been used to essentially broadcast hate crimes and terrorism and creates illegal, harmful content that continues to circulate on peripheral platforms after it is removed by VLOPs. Though certainly much has been learned by platform providers and public authorities since the horrific livestreaming of the attack on a Mosque in Christchurch New Zealand, livestreaming still poses specific

¹¹ This has been due to the public nature of Twitter and until recently its easily accessible API, rather than the size of the platform or its user base.



challenges related to immediacy and identification (Zornetta & Pohland, 2022) as well as the potential for lasting spill over to smaller platforms.

Contagion and propagation of content, or arguably goods, and of user behaviour can be investigated, modelled and probably predicted to some extent. This will be useful in assessing the potential risk and effectiveness of mitigation measures. It can indicate the strength of shocks. **Key issues for systemic risk are therefore the extent to which VLOPs and VLOSEs are connected to users of peripheral services and whether any features of their design or functionalities create interlinkages with such services.** More work will need to be done on cross platform contagion, especially between peripheral services and the core VLOPs/VLOSEs in order to gauge the risk comprehensively and identify the governance tools or other mechanisms that can be used in those relationships to mitigate. However, determining exactly what content and behaviour is of concern is not so clear in three out of the four risk areas. At the same time, contagion and propagation concepts seem less applicable to risk of negative effects on societal institutions. While shocks might be identifiable, it is harder to see how contagion dynamics could be assessed in relation to freedom and pluralism of the media and electoral processes.

6.3 Failure

As was explained above, failure in financial systems is relatively easy to calculate. The point at which financial institutions fail is clear and there are measures that indicate at what point a shock becomes a systemic crisis, or failure of the whole system. When a government decides to bail out banks, it is always the case that there has been a systemic crisis and evident failure to resist shocks. This is much more difficult to determine in the risk areas for which assessments are required by the DSA. **Nevertheless, a benchmark of what constitutes failure is necessary for determining what constitutes a negative effect and what mitigation is appropriate.** Where fundamental rights are at stake there are balances to be achieved and proportionality is crucial, a point emphasised repeatedly in the Act itself.

Any circulation of CSAM could be considered a failure due to the harm involved in its creation. That any of it is occurring is arguably already a systemic crisis stemming from an inability to mitigate the systemic endogenous shocks in this risk area. One can also assume some consensus on terrorist content and incitement to terrorism, given the EU regulation on this (European Union, 2021) and levels of international cooperation. However, **given the scope of ‘illegal content’ that should be covered in risk assessments, there remains considerable ambiguity even in this risk area** (see Ledger & Broughton Micova, 2022).

In some risk areas there are measures that exist or generally accepted norms that could help determine what constitutes failure. Measures have been developed for the integrity of electoral processes (Garnett et al., 2023) and criteria have been established by the OSCE/ODIHR and the UN. Such measures and the expertise of those monitoring and managing elections, as well as other stakeholders could be likely be relied upon to arrive at benchmarks for failure. Measures of media plurality exist (CMPF, 2018) as do indexes of media freedom (RSF, 2023). However, these are still not



fixed or unproblematic concepts. Scholarship is continuing to debate and refine ideas about what they mean and what achieving them requires in terms of policy goals, especially in the context of the spread of digital services (European Commission et al., 2022; Karppinen, 2012; Parcu, 2020; Tambini, 2021). Despite the existence of measures, wider discussions will likely be necessary to arrive at an understanding, which itself will likely evolve over time.

There may be much more debate about what constitutes a systemic crisis, or failure, in relation to civic discourse, or negative effects on human dignity, non-discrimination or consumer protection.

For example, in relation to civic discourse our review of the literature revealed evident concern about the spread of disinformation, radicalisation pathways, and aggressive and uncivil communication. A particularly rigorous meta-analysis looking for causal relationships between democracy and various tendencies, features, and behaviours on digital services included polarization and populism among others stating clear assumptions that these are bad for democracy (Lorenz-Spreen et al., 2023). However, these assumptions are contested. Populism can be seen as a style or even strategy of political communication that can be part of effective civic discourse (Aalberg, 2017). As Kries and McGregor (2023) argue, polarization per se is not necessarily a problem for democracy, but is often the outcome of struggles for justice. Abolitionists and suffragettes were at one time considered extremists by the mainstream. There is no consensus on the ideal civic discourse.

For financial systems the policy goal will always be to prevent a systemic crisis, or failure of the system. This makes it easier to determine thresholds for shocks and when any given shock gets close to undermining the system's ability to return to an equilibrium, where the equilibrium is clear. **For each of the risk areas addressed by the DSA, establishing the equilibrium and the point of failure is likely going to have to be developed through an iterative process and feedback loops that we argue must be widely inclusive.**

6.4 Takeaways on the Nature of Risk in Platforms and Search Engines

The concept of shocks could be very useful for systematically considering risk by VLOPs/VLOSEs, but it is an imperfect tool because it does not adequately capture the structural and platform characteristic sources of risk. The distinctions between exogenous and endogenous and between idiosyncratic and systemic shocks can be applied effectively to identify sources of risk. This classification would allow for cost-effective and risk area-based monitoring (that is, depending on the assessed risk area, a certain type of shock or accumulation of shocks is more likely to occur, so more relevant to be monitored). Given the gap in the financial sector literature that we identified in addressing the accumulation of repeated minor harms, despite such phenomena existing, there may be an opportunity to expand the understanding of shocks for both financial services and VLOPs/VLOSEs. Alternatively, there may be a need to utilize a different concept to talk about the pollution-like negative effects of accumulated minor harms.

Contagion and propagation can be important elements to measures for some risk areas, however they are less suitable for those that address negative effects on societal institutions, particularly those



where volume and dissemination of content or repetition of specific behaviour are less central or not relevant. The most glaring mismatch between understandings of systemic risk in financial systems and in VLOPs/VLOSEs comes from the lack of clear indicators or thresholds for failure or systemic crisis.



7. CONCLUSIONS: ASSESSING AND MEASURING RISK IN VLOPs/VLOSEs

In the DSA, the systemic nature of risk is not only about the number of users affected by any harm but also derives from the way very large services function as public spaces and from the potential for effects on public systems due to the scale and role of the services designated as VLOPs and VLOSEs. **Of concern in the DSA is not the failure of the VLOPs/VLOSEs or the firms providing them, but risks to society from the use and functioning of these services.** Systemic risks, which can vary in severity and potentiality, can come from user behaviour or from characteristics of the VLOPs/VLOSEs. In this report we have tried to learn from the concepts and understandings related to systemic risk in financial services in order to inform the conduct of risk assessments and the implementation of the DSA.

This has not been a comparison of these two very different industries, but an investigation into the transferability and utility of core concepts. **Our investigation confirms the limits of simply borrowing the concept of systemic risk and its associated terminology** from the sector where it arguably began. Nonetheless, we also consciously test the boundaries of some concepts and demonstrate that **there are several elements of the understanding of systemic risk in the financial sector that can usefully be applied to thinking about VLOPs/VLOSEs and used as part of a framework of risk assessment.** In this final section we first set out some conclusions on the applicability of core concepts and understandings and then we present suggestions for the provisions on VLOPs/VLOSEs in the DSA indicated by findings. We close with some final thoughts for policy makers and stakeholders.

7.1 Applying Systemic Risk Concepts

In considering risk in highly networked sectors such as finance and digital services, the nature and strength of interconnections are crucial. The conceptualisation of financial systems as being made up of various core and peripheral players who are interconnected through direct and indirect relationships of varying weights or significance is a useful model upon which to build for VLOPs/VLOSEs. **Distinguishing among core players and peripheral players can indicate the potentiality and severity of risk and help identify critical players and possible mitigation points.** Platforms sit within their own ecosystems in which they have varying degrees of control depending on the extent and nature of private ordering they undertake. Nevertheless, they also are part of integrated platform ecosystems, connected through common users, complementors, shared assets, third party services, and other actors. **VLOP/VLOSE providers will be core players within integrated ecosystems but there may be other actors, even smaller ones, that are also core due to the number and strength of their interlinkages.**

In the literature on financial services sources of risk are identified as shocks, which can be **exogenous or endogenous** to the system and either **idiosyncratic** to single players or **systemic**, affecting multiple players or the entire system. There are limits to the extent to which the understanding of shocks as the sources of risk from financial systems can be applied to platforms and search engines. Firstly, in financial systems they are conceived of as discrete events that could have secondary or tertiary outcomes but are not structural or feature related, and therefore would seem inappropriate for



capturing the sources of risk stemming from the design and characteristics of platforms noted in the DSA. Another limitation is that the notion of shocks as sources of risk may not adequately account for the accumulation of minor harms, which although present in the financial sector as well does not seem to be addressed by the literature. Nevertheless, **we do argue that the concept of shocks can be appropriate for considering negative effects stemming from user behaviour and exogenous sources of risk.** The identification of shocks as exogenous or endogenous and idiosyncratic or systemic, even if they are minor ones that accumulate to systemic negative effects such as repeated aggressive behaviour by users or the circulation of harmful disinformation from state sponsored bots, would help VLOP/VLOSE providers and the Commission identify where mitigation measures are needed, especially where cooperation among services would be merited, in a cost-effective manner. We argue that **there will be a need to coordinate in tackling potentially systematic shocks affecting or originating from core players that are not designated services**, ones that are centrally and strongly interconnected among VLOPs/VLOSEs, in order to prevent negative effects in the DSA's risk areas.

The propensity for contagion or propagation of risk is crucial to the understanding and assessment of risk in financial services. There is also a wealth of literature on the propagation of harmful content and behaviour on digital services. Though less suitable for risk areas that address negative effects on societal institutions, **techniques for measuring the speed, scope, and nature of contagion will likely be relevant to the assessment of risk and the effectiveness of mitigations for areas where the risk of negative effects stem from content, goods, or behaviour.** Research on these dynamics has already produced evidence of **the importance of interlinkages between VLOPs/VLOSEs and smaller platforms** to diffusion dynamics.

For the financial sector there exist clear definitions, formulae even, for systemic failure or crisis. These serve as important lines that should not be crossed and provide benchmarks for measurement. The measurement of systemic risk in the financial sector is calculated using a three-part framework that essentially assesses:

- how the whole system is affected by one player;
- the contribution of an individual player to systemic negative effects or shocks;
- and the ability of individual players to withstand shocks, mitigating negative effects.

This clarity in the financial sector raises significant questions about the benchmarks for assessing risk and defining the negative effects that must be prevented for VLOPs/VLOSEs. While for some risk areas, or parts of them, there are EU or International laws, international standards, or widely accepted norms, there is not consensus on what constitutes good and failure in others. For example, fundamental rights often have to be balanced against each other and what counts as a negative effect on civic discourse is hotly debated. **We argue that it will be important to establish risk area-specific understandings of what systemic failure or crisis looks like and what effects contribute to those.**

In summary we have found multiple elements of the understanding of systemic risk from the financial sector that can be used as building blocks for how we understand systemic risk from VLOPs/VLOSEs.



Figure 4 sets out these main elements that we drew from the financial services literature that can have useful applications in the assessment of risk as called for in the DSA.

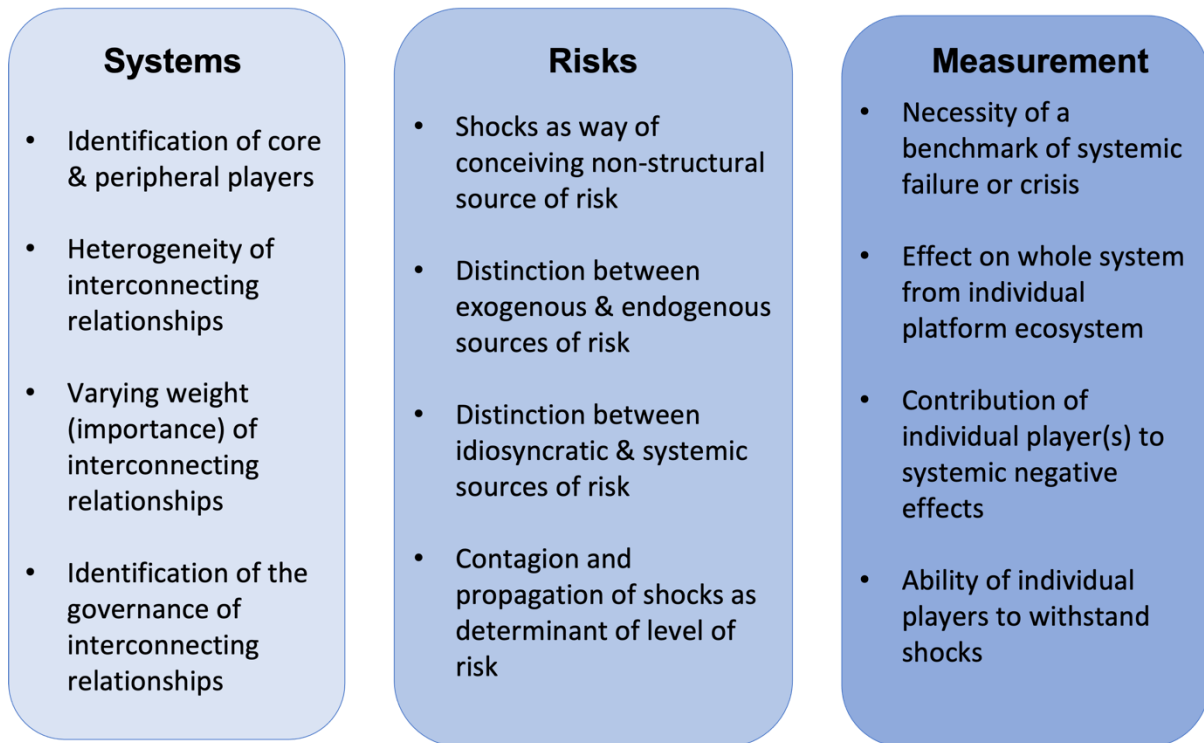


Figure 4 Main elements of systemic risk derived from literature on financial services adapted to VLOPs/VLOSEs

There are aspects of systemic risk in VLOPs/VLOSEs that we found were distinctive and for which the concepts from financial services were not adequate. Firstly, the definition of the ecosystem of players as being the location of failure has no parallel. For VLOPs/VLOSEs the systemic nature of the risk is related to the consequences for wider society from user behaviour and characteristics of the services, rather than the survival or failure of platform ecosystems. Secondly, while the financial literature does cover structural issues from players' features and market structure, it considers them intervening factors that affect the propagation of shocks, and the ability of players and systems to withstand them. They are not written about as sources of risk themselves. This means that the transposition of the concept to VLOPs/VLOSEs is not automatic and simple. Thirdly, the tendency for systemic negative effects to be the result of an accumulation of multiple, even millions, of minor incidents of harm propagated across VLOP/VLOSE networks is not captured by the notion shocks as it has been understood in the financial sector. This, we contend, requires a revision of the conceptualisation of shocks, that would also benefit the financial sector.

7.2 Informing the Conduct of Risk Assessment

One of the main aims of this investigation was to contribute to the effective implementation of the DSA and eventual prevention of negative effects from VLOPs/VLOSEs on the wider society. We therefore make some suggestions for the conduct of risk assessments based on the application of the relevant elements set out in Table 1.



The first risk assessments are due by the end of August 2023, which leaves little room for a priori establishment of understandings of systemic failure, attainable equilibrium, and what constitutes negative effects through inclusive multi-stakeholder processes. Nevertheless, the submission of assessments, auditing and oversight process foreseen in the DSA creates a vehicle for feedback loops and learning. It must be acknowledged that few stakeholders will have the capacity to engage individually with all the designated services and auditors in an effective manner so mechanisms will need to be developed for building that capacity or facilitating their involvement. The DSA's recital 137 refers to building "Union expertise and capabilities" in a very inclusive manner, and the Digital Services Board and the Commission will have significant convening power. The statements of Director General Roberto Viola at the first stakeholders workshop organised by the Commission on 27 June 2023 contained clear commitments to stakeholder involvement. There appears to be both the vehicles and will to have inclusive processes.

Following the first attempt by VLOP/VLOSE providers to conduct risk assessments would be the opportune moment for a wider process aimed at establishing the benchmarks for at least the more contentious and critical risk areas. Not all, even not most shocks, lead to a systemic crisis. Some characteristics or design features in VLOPs/VLOSEs may serve to mitigate risks in some areas while being a source of risk in others. What constitutes the levels and types that can be tolerated needs to be set through inclusive processes as there are delicate balances of fundamental rights to be made as well as interpretations of the public interest. This does not have to be started from scratch. Risk-area-specific public policy, stakeholder engagement, and court interpretations of fundamental rights, and other inputs should be part of an iterative and ongoing process. A lot of inclusively developed indexes and other tools such as the Human Rights Due Diligence Across the Technology Ecosystem, the Media Pluralism Monitor, and the Perception of Electoral Integrity Index, among many others.¹² Figure 5 below illustrated elements we argue should be brought together for this purpose.

¹² The Human Rights Due Diligence Across the Technology Ecosystem is an assessment tool developed by Business for Social Responsibility and the Global Network Initiative, and can be found at https://eco.globalnetworkinitiative.org/wp-content/uploads/2022/11/Human-Rights-Due-Diligence-Across-the-Technology-Ecosystem_Ecosystem-Mapping_Oct2022.pdf; the Media Pluralism Monitor is monitoring tool developed by the Centre for Media Pluralism and Media Freedom at the European University Institute and funded by the European Commission, which can be found at <https://cmpf.eui.eu/mpm2022-results/>; The Perception of Electoral Integrity Index is a tool developed by the Electoral Integrity Project and can be found at: <https://www.electoralintegrityproject.com/>

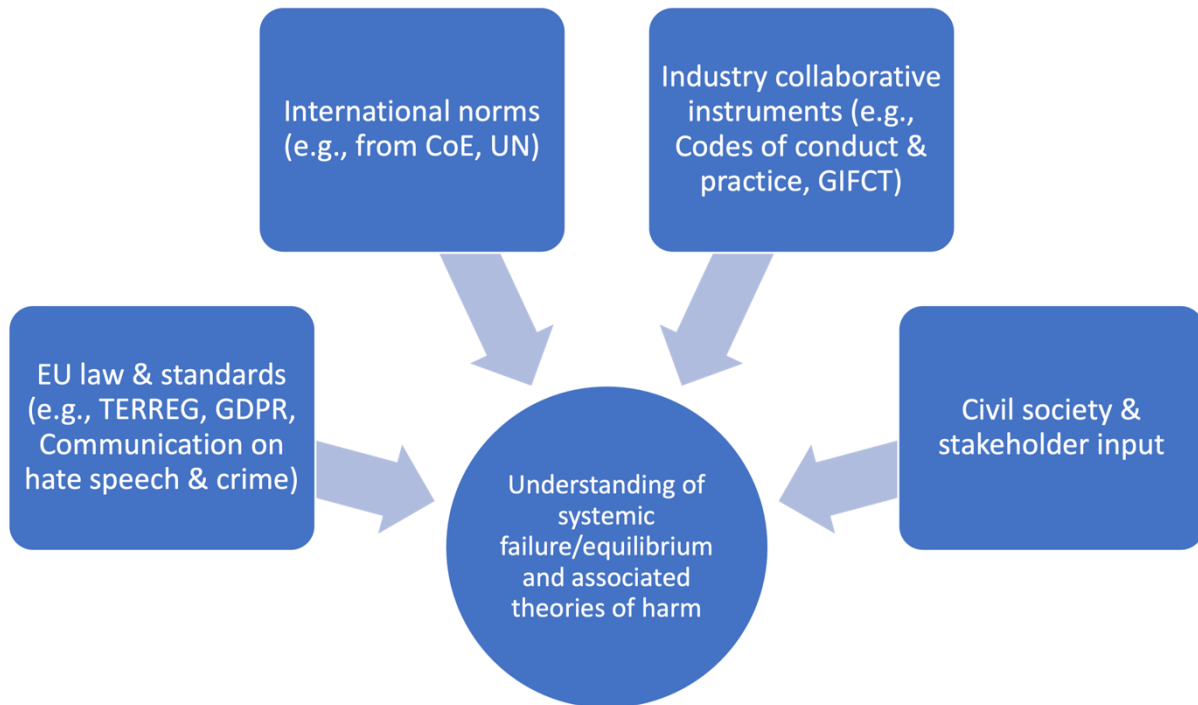


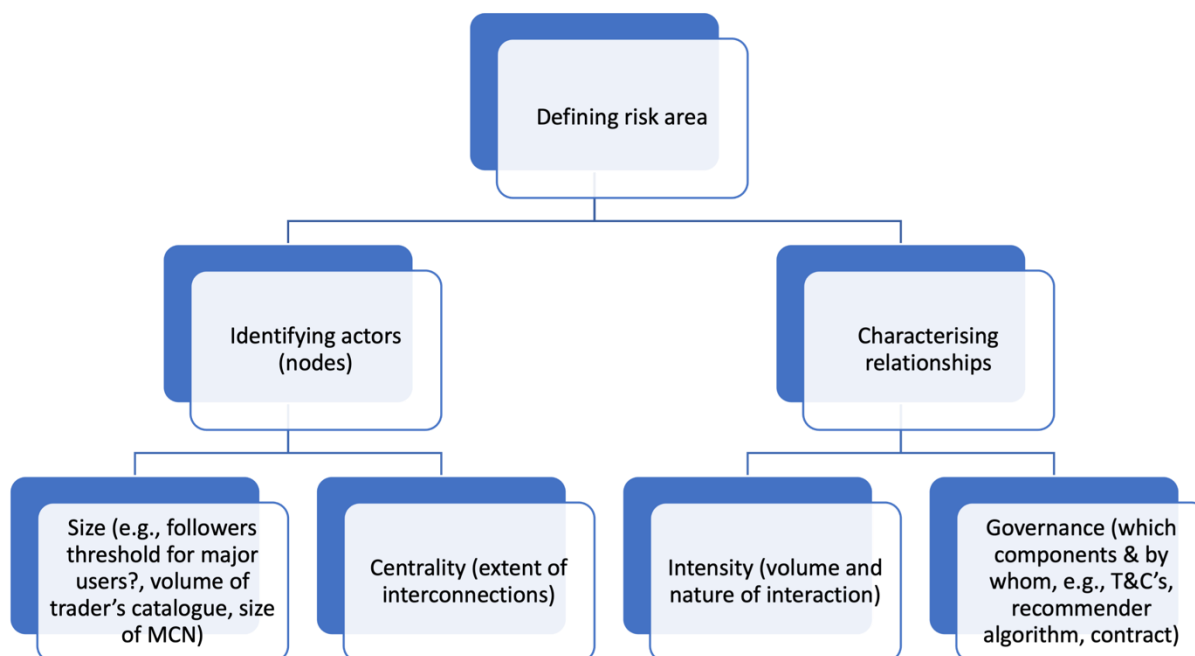
Figure 5 Illustration of the elements that could contribute to understandings of systemic failure and other necessary benchmarks

These benchmarks would necessarily have to be revisited periodically but should be established widely for use by all VLOP/VLOSE providers and auditors. The level of societal consensus will differ across risk areas, but it should not be left solely up to VLOP/VLOSE providers to make the difficult calculations. What should be avoided is for each VLOP/VLOSE provider and/or their auditing company to determine what constitutes the good, the failure, and the negative effects for things like civic discourse and electoral process or the balancing of the rights of the child with protection of their health and well-being.

The conduct of risk assessment for individual services should begin with a mapping of the relevant platform ecosystems in which the VLOP/VLOSE is a core player. The roles of market concentration and gatekeeping are complex, seem likely to differ across the four risk areas and are susceptible to changes over time, due to the potential evolution of the market structure. Nevertheless, the literature suggests that whether or not a service is also designated under the DMA and what the implications of that are for specific risk areas should also be taken into account. As part of the mapping, network analysis will likely be necessary and can help identify those core players that may be among the userbase and corpus of complementors. Figure 6 illustrates the mapping process as we envision it could be conducted for each risk area at least, but likely for the more granular sub-areas within each of the four contained in the DSA.



Figure 6 Mapping process for risk area ecosystems



Such mapping and thorough network analysis should not only enable the identification of sources of risk but also contributors to the mitigation of risks. The mapping should also aid in the identification of structural sources of risk.

For the assessment of risks VLOP/VLOSE providers will not likely be able to unilaterally measure the effect on whole societal systems from their platform ecosystems. This kind of overview would require the insight that the Commission and Board gain from the monitoring of all the designated services. Providers should be able to measure their contribution to negative effects in the risk areas and their ability to withstand the various kinds of non-structural sources of risk discussed above. For the later we suggest that the points noted in Table 1 below are useful considerations.

TABLE 1: DETERMINING SEVERITY, POTENTIALITY, AND LOCUS OF MITIGATION	
TIME	Urgency and immediacy vs gradual accumulation of harm.
EXOGENEITY/ENDOGENEITY	Is the source of harm within the integrated platform ecosystem or from an external source?
IDIOSYNCRATIC/SYSTEMIC	Is the source of harm within a VLOP/VLOSE's own ecosystem (from its components or users), or is it something affecting the ecosystems of multiple VLOPs/VLOSEs simultaneously?



PLATFORM COMPONENT/USER BEHAVIOUR	Is the harm stemming from the design, terms, practices or systems of the VLOP/VLOSE or from the behaviour of users (all types)?
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7.3 Further Considerations for DSA Implementation

One of the reasons there should be feedback loops and evolving expectations of risk assessment is that time matters, especially in certain risk areas. Time matters because while some shocks are events that create urgent negative effects, the effects of shocks are not always immediate. Small shocks can accumulate and be repeated in a way that is different from what happens in financial systems because there is not necessarily – or even not a likelihood of – a return to some kind of equilibrium. Instead, **there will be a continual establishment of the ‘new normal,’ and the ecosystems will be evolving over time. There is no guarantee that systemic risk will decrease shortly.**

One of the potential issues that makes iterative benchmarking essential is that different platforms provide different levels of effort to tackle negative effects. All but one of the VLOPs/VLOSEs designated so far are owned by profit maximising firms. They may attempt to decrease cost by decreasing the effort they put into risk assessment and mitigation, or they may invest more in order to distinguish themselves from competitors. Nevertheless, there is a good chance of differing levels of effort. This issue is most compelling if the lower effort in assessment and mitigation relates to systemic exogenous or endogenous shocks, where, as we have argued, some coordination will be needed, or idiosyncratic ones with high propensity to propagate beyond the originating ecosystem.

Free-riding behaviours are not only possible, but likely to occur. If this situation persists for a sufficient period of time, it **may lead to a coordinated effect of lowering the standards across the different VLOPs** (that is, the lower standards VLOPs drive the standards of previously higher standards VLOPs down). This occurs because the free-riding behaviour (the lower standards VLOP ‘enjoys’ the higher effort put by the higher standards VLOP) derives from a negative externality that is not internalised by any of the players.

This can be balanced in part by creating the right incentives through the auditing and enforcement mechanisms, to internalise the externality for VLOPs. As we have argued previously (Broughton Micova & Calef, 2023), the level of concentration in the audit market raises concerns about the incentive structure and potential for collusion. The DSA’s implementation must take account of the competition problems in auditing market but its audit requirements could allow for specialist auditing based on expertise in specific risk areas and/or provide clear direction, perhaps even support, for the multi-stakeholder involvement in auditing that is envisioned.

Finally, as we have pointed out, the DSA does not account for systemic risk in the risk areas from the failure or closure of any given VLOP/VLOSE or their provider. There are issues of dependencies and the extent to which the level of competition provides alternatives to users that can contribute to the potential for negative effects in certain risk areas. The DSA was enacted in a package with the Digital



Markets Act. It will be crucial that these remain in concert as the VLOP/VLOSE provisions of the DSA are implemented. Communication channels among regulators and competition authorities and across the various parts of the Commission can be used to monitor this and research should be encouraged into the links between competition concerns and the systemic risk to society that the DSA aims to mitigate.



8. ANNEX 1: METHODOLOGY

The approach taken for this report is a **multi-stage systematic literature review**. A systematic literature review is one that uses an explicit process and is reproducible. These are often used in medical or physical sciences to identify patterns in empirical results across all available data on a certain malady or phenomenon, most often quantitatively. Although a literature review is usually the starting point of any research, in social science they are rarely systematic.

Where systematic literature reviews or meta-analysis are conducted, it is often to be able to answer a question about the literature as the object of study. However, they can also have other purposes. Here we have employed this method to achieve the following:

- expand our individual fields of existing familiarity and discipline;
- ensure comprehensive coverage of current knowledge;
- engage with conceptual understanding and empirical application;
- ensure robustness of the research through transparency and repeatability.

We conducted a qualitative systematic review, which as Meier (2019) argues can uncover the theories, concepts and methods used in the literature in a structured manner. The aim was not to be able to make claims about the literature per se, but **to undertake a scoping review that would allow us to “identify the conceptual boundaries of a field” and the core findings and variables used** (Xiao & Watson, 2019, p. 99). This was critical to enable us to make claims about the understandings and assumptions underpinning the systemic risk research, as well as the methods used for measuring it. The following steps were taken:

1. Based on existing knowledge and initial reading, a set of search terms were combined with ‘financial markets’ and ‘banking’ together with ‘systemic risk’ and was piloted across the main databases. A review of the top returns across the databases was used to refine the search terms and approach to the databases. The extent of duplication showed that only ‘financial markets’ was sufficient. In line with what others have found (Gusenbauer & Haddaway, 2020) we determined that while Google Scholar is useful for many things, it does not have the repeatability and consistency for systematic review, so we eliminated it from our search strategy and also determined some constraints that needed to be introduced in others. Inclusion and exclusion criteria were developed.
2. The full search was conducted with the refined search terms and ‘financial markets’ across Web of Science, Scopus, SSRN (the latter within the last 3 years only), Westlaw, and the IMF working paper series. This returned 2259 articles, of which 455 were deemed relevant based on a check of the abstract and details against the inclusion and exclusion criteria.
3. After beginning to gain insight from stage 2 and while it was still underway, a search was conducted for ‘online platforms’ and ‘digital services’ with ‘systemic risk’, and then without ‘systemic risk’ but with each of the search terms used in phase 2. Additional inclusion and exclusion criteria were added unique to this area. The search was again done in Web of Science, Scopus, SSRN (the latter within the last 3 years only), and returned 900 items, of



which 38 were deemed relevant based on the criteria. It was evident from this stage that the concepts associated with systemic risk in the literature on financial markets have not frequently been used in relation online platforms and digital services in a manner relevant to the DSA.¹³

4. To address the fact that the terms used in relation to the financial sector did not yield many results in relation to platforms, we began to look at similar concepts such as ‘dissemination’ and began to address the specific systemic risk areas listed in the DSA. Informed by the understanding of systemic risk we chose to focus on two areas to use as critical cases to guide the search: the Covid-19 crisis; civic discourse and electoral processes. This phase also began with the databases listed above but was necessarily also more organic as the search terms were less clear. Two-directional snowballing was also used, in which articles cited heavily in already identified pieces were also included and Google Scholar was used to identify publications that had cited particularly relevant already identified pieces.

This was **exploratory research that used a systematic and iterative process to identify literature and draw definitional work, themes, and debates from it**. The understandings gained in the review of the financial sector literature informed the review of the platform literature. These are now presented separately in line with that process, with the intersections and distinctions made evident. Conclusions and recommendations draw on the synthesis of these reviews.

¹³ Certain terms yielded many results related to cybersecurity and infrastructure.



9. ANNEX 2: LIST OF POLICY DOCUMENTS EXAMINED FOR SECTION 2

European Commission (19 February 2020) Communication Shaping Europe's Digital Future
https://commission.europa.eu/system/files/2020-02/communication-shaping-europes-digital-future-feb2020_en_4.pdf

European Commission (2 June 2020) Inception Impact Assessment

European Commission (06 November 2020) SEC(2020) 432 REGULATORY SCRUTINY BOARD OPINION Proposal for a Regulation of the European Parliament and of the Council on a Single Market For Digital Services (Digital Services Act) and amending Directive 2000/31/EC {COM(2020) 825} {SWD(2020) 348} {SWD(2020) 349}

European Commission (15 December 2020) Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on contestable and fair markets in the digital sector (Digital Markets Act) COM/2020/842 final

European Commission (15 December 2020) COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT Accompanying the document PROPOSAL FOR A REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on a Single Market For Digital Services (Digital Services Act) and amending Directive

European Commission (15 December 2020) COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT REPORT ANNEXES Accompanying the document PROPOSAL FOR A REGULATION OF THE EUROPEAN PARLIAMENT AND THE COUNCIL on a Single Market For Digital Services (Digital Services Act) and amending Directive 2000/31/EC {COM(2020) 825 final} - {SEC(2020) 432 final} - {SWD(2020) 349 final}

European Commission (15 December 2020) COMMISSION STAFF WORKING DOCUMENT EXECUTIVE SUMMARY OF THE IMPACT ASSESSMENT REPORT Accompanying the document PROPOSAL FOR A REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on a Single Market For Digital Services (Digital Services Act) and amending Directive 2000/31/EC {COM(2020) 825 final} - {SEC(2020) 432 final} - {SWD(2020) 348 final}

European Commission (15 December 2020) Summary Report on the open public consultation on the Digital Services Act Package

European Council (9 June 2020) Council Conclusions on Shaping Europe's Digital Future, 8711/20



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