

DANMARKS NATIONALBANK

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A small number of participants dominate the interbank market

The Danish interbank market has 88 direct participants, and the volume of liquidity exchanged between the participants within a year is equal to more than eight times Denmark's GDP. The institutions are highly interconnected, meaning that problems in one institution may spread to other institutions in the network.



A small number of participants spread liquidity

The Danish interbank market is a complex network. A few core institutions are important in terms of spreading liquidity. At the same time, only a small number of institutions connect isolated institutions with the rest of the network.

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Robust institutions are important

The interbank market is highly concentrated and a well-functioning market is therefore dependent on the central participants being robust.

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The interbank market is an important cog-wheel in the financial system

In the interbank market, financial institutions make large, time-critical payments in kroner to each other via Danmarks Nationalbank's payment system, Kronos. These payments help to distribute liquidity in the financial system, thereby supporting the short-term funding requirements of the institutions. The payments relate to e.g. uncollateralised money market loans or the krone leg of currency swaps. In 2017, the financial institutions exchanged liquidity worth 8.5 times Denmark's GDP in the interbank market.

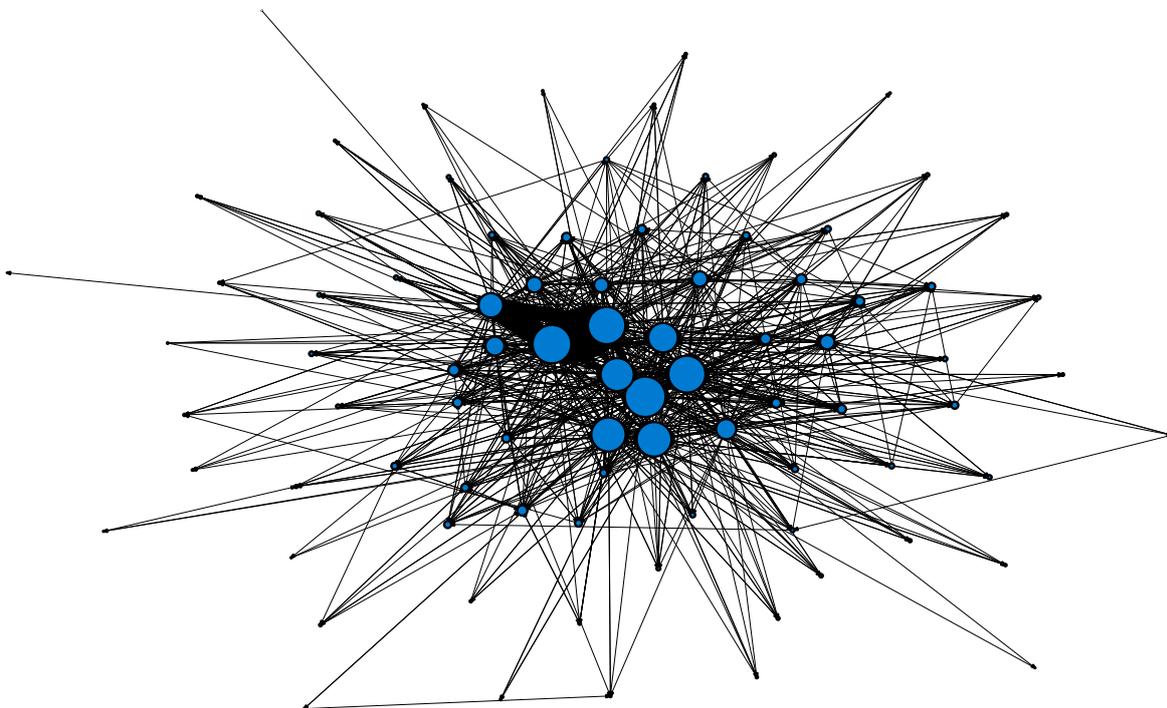
88 financial institutions are direct participants in Kronos. The direct participants are virtually all Dan-

ish banks and mortgage credit institutions as well as branches of foreign banks. In addition, some 1,800 banks from 117 different countries participate indirectly in Kronos, submitting payments via direct participants.¹

This analysis looks at the complex interbank network created when the direct participants perform many thousands of transactions on behalf of themselves or indirect banking connections. Specific network measures make it possible to identify the institutions at the centre of the interbank market, i.e. institutions with a systemic role in the network

The complex interbank network created by transactions between direct Kronos participants, 2017

Chart 1



Note: The thickness of the links shows the volume of payments between institutions (incoming and outgoing). The node size reflects the number of links. The nodes with the thickest links to each other are placed close together in a core, while nodes with thinner links are pushed further out.

Source: Danmarks Nationalbank.

¹ See S. T. Nielsen, Banks from more than 100 countries send payments via Kronos, *Danmarks Nationalbank Analysis*, No. 19, November 2017.

in terms of spreading liquidity, or with critical links.

Chart 1 shows the Danish interbank network in 2017. The blue nodes represent the individual institutions. The node size reflects the number of links of each institution. The links between nodes illustrate payment flows between institutions. The higher the turnover between two institutions, the thicker the link between the nodes representing those institutions. The nodes with the thickest links to each other are placed close together, while nodes with thinner links are pushed further out in the network.

A small number of core participants dominate the interbank market

At the core of the network are three institutions known as liquidity super-spreaders. A super-spreader helps to pass on large volumes of liquidity to and from most of the participants in the market and can therefore be said to be key to the interbank market.

The super-spreaders are identified by the liquidity spreading index (LSI), which calculates the institu-

tions importance as both remitters and recipients for many counterparties in the network, cf. Box 1. This allows mapping of the institutions playing an active role in terms of receiving surplus liquidity or distributing it to institutions with a need for liquidity. Hence, the institutions can be grouped according to whether they are at the core or the periphery of the network.

Chart 2 shows the LSI scores of the 10 institutions contributing most to spreading liquidity in the interbank market compared with the market share of each institution. Based on their LSI scores, the institutions can be divided into two groups: the core and the periphery of the network. The core consists of the three super-spreaders – FI 24, FI 77 and FI 74 – which jointly account for 99 per cent of liquidity spreading in the market, while only 1 per cent is attributable to the remaining 85 institutions. Consequently, the network may be vulnerable to change of behaviour or shocks to the super-spreaders.

The three super-spreaders have the highest market shares in the interbank market, jointly accounting for 86 per cent of the total transaction volume. This means that the core institutions – especially the largest two – play a larger role as liquidity spreaders than their relative market shares would indicate. On the other hand, it also means that the transaction patterns of some of the peripheral institutions do

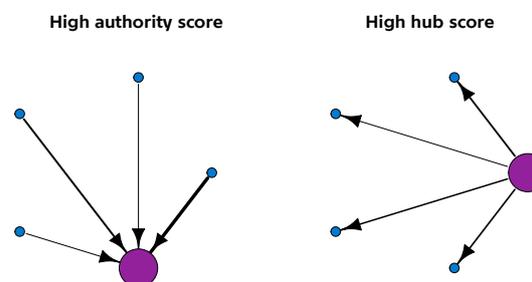
Identification of super-spreaders

Box 1

The liquidity spreading index (LSI) calculates how active a role an institution plays in the network by taking into account the institution's ability to both distribute and receive liquidity using *hub* and *authority* scores, as illustrated in the chart below. Institutions that at the same time serve as both remitters and recipients for many counterparties in the network achieve high LSI scores.

An institution's ability to distribute liquidity is determined by its hub score. The hub score is high if an institution remits liquidity via many links to different institutions, or if the institution remits very large payments to a few counterparties. Conversely, the authority score is used to determine the ability to receive liquidity. A high authority score also depends on the number and size of links to other institutions.

What makes an institution a super-spreader?



Note: The thickness of the links shows the volume of payments between institutions (incoming and outgoing). The node size reflects the number of counterparties.

Source: Danmarks Nationalbank.

Note: The methodology is based on León, C., Machado, C., and Sarmiento, M. (2018), Identifying central bank liquidity super-spreaders in interbank funds networks, *Journal of Financial Stability*, 35, 75-92.

not contribute to spreading liquidity in the network, even though these institutions have considerable market shares.

A small core is not a purely Danish phenomenon. Similar studies from Colombia and Hungary show that it is not unusual to have a small, dominant core consisting of a few institutions in an interbank market.² However, the concentration in the Danish interbank market in 2017 was slightly higher than what is shown in the studies on the two foreign interbank markets.

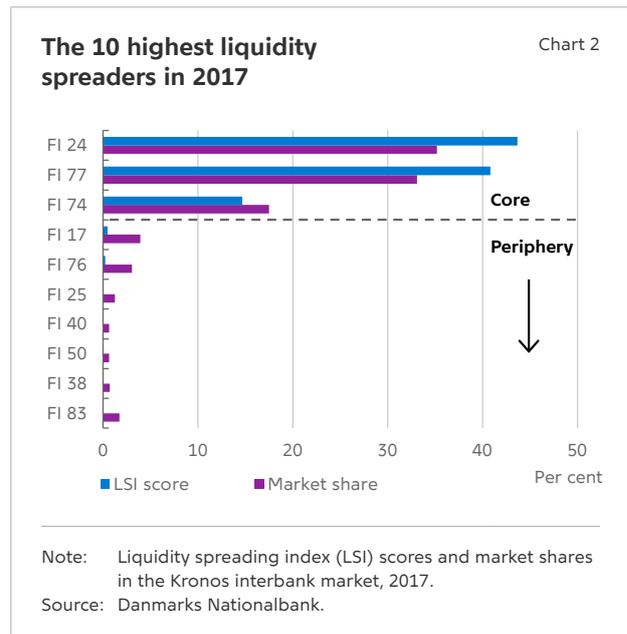
The interbank market has several highly connected institutions and few with locally critical links

There are several highly connected institutions in the interbank market, which helps reduce liquidity risks. At the same time, one institution in particular has bottleneck characteristics.

The higher the number of highly connected institutions in the interbank market, the lower the liquidity risk, as this increases the opportunity for institutions to cover their liquidity requirements via alternative connections in the event of shocks to individual institutions. For example, institutions may choose to maintain a larger number of links in good times to counter the risk of having difficulty establishing new links in bad times.

In Chart 3, all market participants have been plotted according to two network measures; one evaluates how highly connected they are, the other identifies bottlenecks, cf. Box 2.

Most of the 88 institutions are placed in the lower left-hand area of Chart 3, which means that they are neither bottlenecks nor particularly highly connected. The trend line in the chart shows that more highly connected institutions are to a great-



er extent bottlenecks as the probability of linking peripheral participants rises with the number of links.

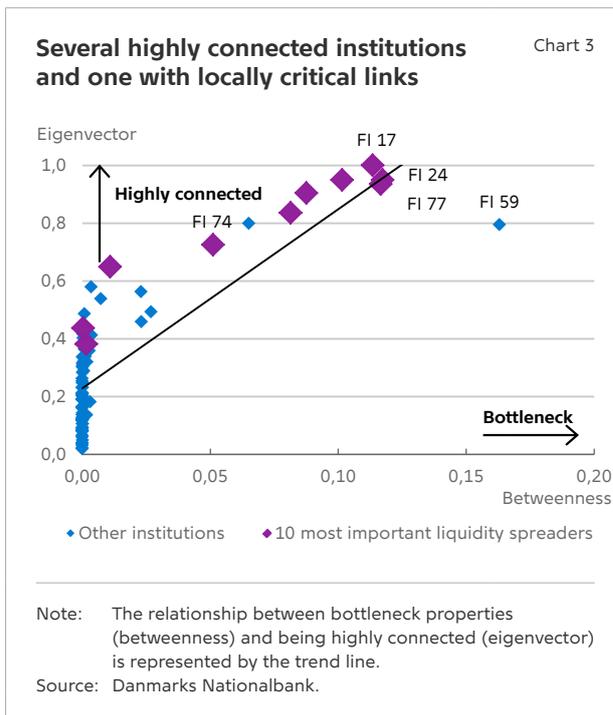
Not surprisingly, the most highly connected institutions are also among the 10 highest liquidity spreaders (shown in purple). There is a very high degree of interconnectedness between the liquidity spreaders. Consequently, the number of links to the rest of the network determines which institutions are deemed to be most highly connected.

FI 17 is the most highly connected institution. But as it is only the 4th highest liquidity spreader, this institution is not part of the core of the interbank market. The connective structure of FI 17 does not give it a central position in the network, since a number of other institutions are almost as highly connected. This means that a shock to one institution of this group of highly connected institutions might not affect others since less connected institutions may cover their liquidity requirements via alternative connections.

² See León, C., Machado, C., and Sarmiento, M. (2018), Identifying central bank liquidity super-spreaders in interbank funds networks. *Journal of Financial Stability*, 35, 75-92, and Bodnár, L. (2017), Network properties and evolution of the Hungarian RTGS over the past decade (No. 132). MNB Occasional Papers.

A small number of institutions have considerably higher bottleneck properties than the rest of the market participants. That is because they link up isolated groups or individual institutions with the rest of the network. FI 24 and FI 77 are both highly connected core institutions and examples of institutions that are used by a group of isolated market participants as entry points to the rest of the network.

FI 59 has higher bottleneck properties than its connectedness indicates. At the same time, FI 59 is not among the 10 most important liquidity spreaders. This means that FI 59 has unique links to a group of isolated peripheral institutions. These peripheral institutions are dependent on FI 59 in order to interact with the rest of the network. So shocks to FI 59 may have negative implications for this isolated group.



Critical links

Box 2

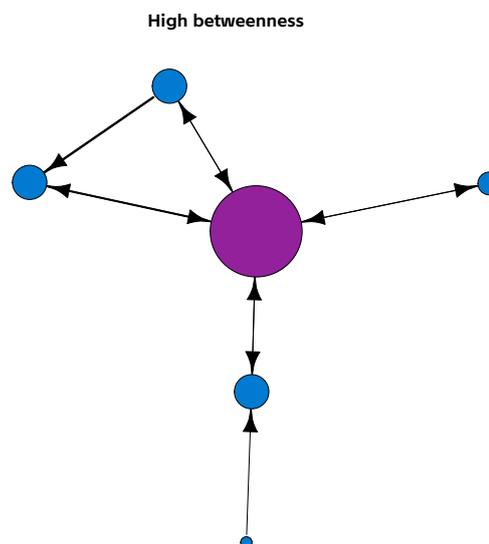
(1) Bottlenecks in the network

Bottlenecks can be identified by measuring the *betweenness* of the institutions. Betweenness measures whether an institution acts as a bottleneck by being positioned between other institutions and how often the institution is part of the shortest link between two other institutions in the network. In the chart below, the purple node has a high betweenness score as it is positioned between the five blue nodes. For any blue node to reach another blue node, it must in most cases go via the purple node. This means that the purple node is a bottleneck if no other participants can replace it.

(2) Highly connected institutions

When identifying the particularly highly connected institutions in a network, it is often insufficient to merely consider the number of counterparties. In qualitative terms, there can be a substantial difference between being connected to a counterparty in a central or less central position. Consequently, not only the connections of the institution itself, but also those of its counterparties are taken into account. Connectedness measures whether a central institution either has links to many other institutions or it is very closely linked to a few other central institutions. This is described by the network measure *eigenvector centrality*.

What makes an institution a bottleneck?



Note: The thickness of the links shows the volume of payments between institutions (incoming and outgoing). The node size reflects the number of counterparties.

Source: Danmarks Nationalbank.

Note: The methodology is based on Bodnár, L. (2017), Network properties and evolution of the Hungarian RTGS over the past decade (No. 132). MNB Occasional Papers.

Awareness of interconnectedness in the interbank market is important for financial stability

The structure of a (financial) network is important in terms of how the interdependence between participants might be a source of risk. If a central participant leaves the network, this can affect that participant's connections, which in turn entails a risk that can cascade further in the network. This potential contagion effect and the risk that the interbank market freezes in times of crisis make it important to monitor interconnectedness in the interbank market in the interest of financial stability. At the same time, the structure of the Danish interbank market with a small dominant core emphasise the importance of having robust central participants.

Focus on interconnectedness has increased since the financial crisis, and international organisations such as the Bank for International Settlements³ and

the European Banking Authority⁴ have worked to find indicators for measuring the interconnectedness of institutions. Such indicators are also included in their recommendations regarding the designation of systemically important financial institutions, SIFIs. In Denmark, SIFIs are designated on the basis of three indicators which do not explicitly measure interconnectedness.⁵

In connection with the resolution of financial institutions it is also essential to take into account whether the institution plays a key role in the interbank market in order to avoid contagion effects. Consequently, the authorities' work to prepare resolution plans – internationally and in Denmark – including mapping whether an institution performs critical functions in the financial system.⁶

3 Cf. Bank for International Settlement, Global systemically important banks: assessment methodology and the additional loss absorbency requirement, November 2011.

4 Cf. EBA guidelines 2014-10 – 16 December 2014

5 Cf. section 308(2) of the Danish Financial Business Act.

6 Cf. Commission Delegated Regulation (EU) 2016/1075.

ABOUT ANALYSIS



As a consequence of Danmarks Nationalbank's role in society we conduct analyses of economic and financial conditions.

Analyses are published continuously and include e.g. assessments of the current cyclical position and the financial stability.

The analysis consists of a Danish and an English version. In case of doubt regarding the correctness of the translation the Danish version is considered to be binding.

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FINANCIAL STABILITY