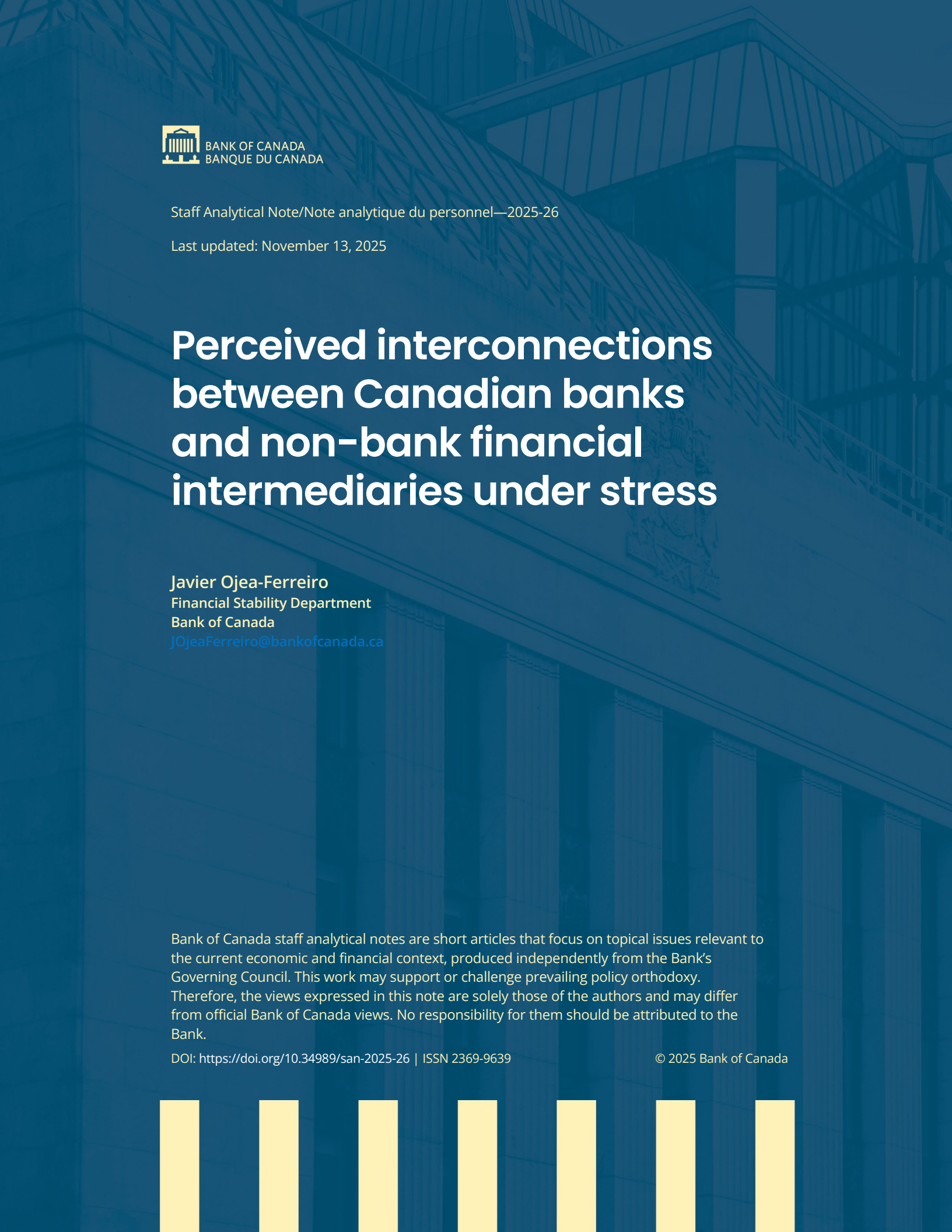

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Perceived interconnections between Canadian banks and non-bank financial intermediaries under stress

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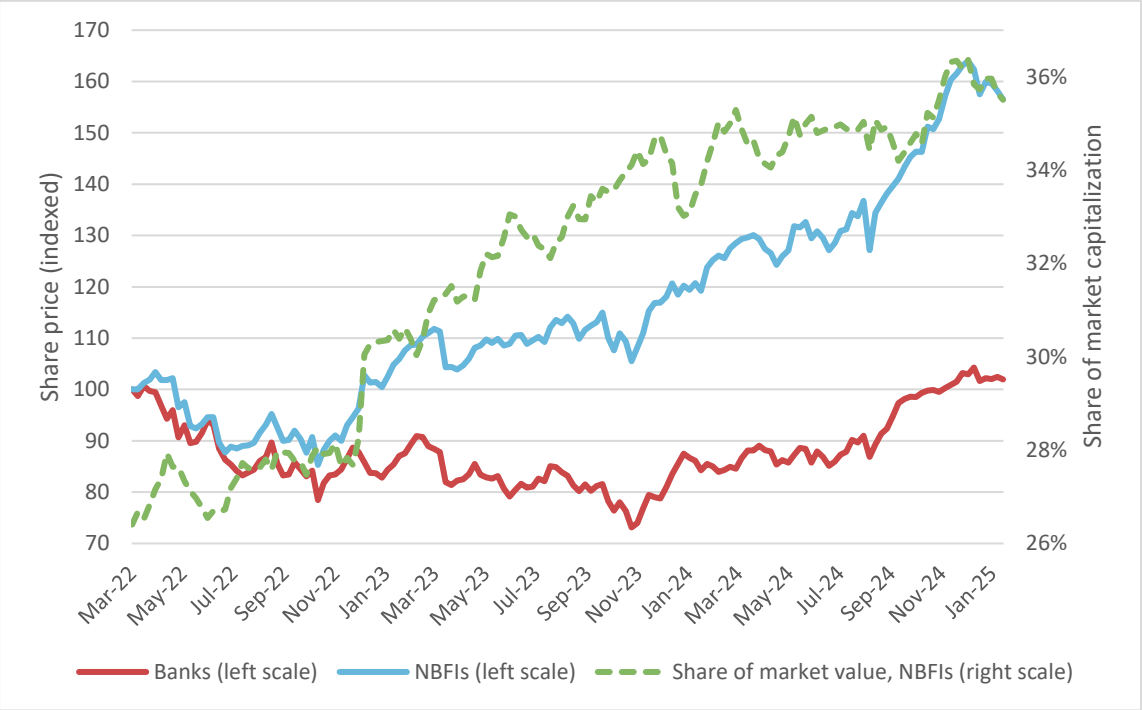
Introduction

Non-bank financial intermediaries (NBFIs)—such as investment funds, insurance companies and pension funds—play an increasingly important role in financing the real economy and in managing the savings of households (Gómez Navas Acevedo and Thorn 2025). In fact, the stock market capitalization of Canadian NBFIs has grown more than 60% since 2022 but has stayed mostly flat for banks (**Chart 1**). As a result, non-bank financial intermediaries now account for more than one-third of the total equity valuation of the Canadian financial sector. Yet compared with banks, NBFIs are less strictly regulated, carry more leverage and are more financially interconnected (BIS 2025). Thus their central role, paired with their increased vulnerability, pose a potential threat to the financial system (FSB 2024).

Chart 1: Market capitalization of NBFIs has grown much more than that of banks since March 2022

Index: March 2022 = 100



Note: NBFI is non-bank financial intermediaries.
Sources: LSEG Eikon and Bank of Canada calculations
Last observation: January 2025

In this note, I assess the interconnections between banks and NBFIs in Canada as revealed by their co-movement in stock market prices. In particular, I study investor perceptions of large tail losses in valuations, i.e., low-probability but plausible scenarios leading to strong declines in equity prices. Market-perceived linkages between the two types of financial institutions are reflected in the co-movements of their stock returns. I assess these linkages using two market-based measures:

- the relative sensitivity of banks' equity prices to extreme outcomes for NBFIs compared with extreme outcomes within the banking sector

- the distribution of banks' returns, depending on the financial system's performance associated when tail risk materializes for banks

I find the following:

- Perceived interconnections between Canadian banks and NBFIs have increased leading up to the COVID-19 pandemic and have since stabilized (this is similar to findings for the United States; see Acharya, Cetorelli and Tuckman 2024).
- Interconnections appear to be most pronounced between large banks and NBFIs, consistent with observations in other jurisdictions (Franceschi et al. 2023). This confirms that large banks hold a systemic position within Canada's financial system.
- Investors' perceptions of interconnections between banks and various NBFI segments—such as insurance, mortgage lending or investment management—have converged over time to record-high levels (similar to findings for the United States; see Aradillas Fernandez, Hiti and Sarkar 2024).
- The secured credit line extended to Home Trust—a non-bank mortgage lender that encountered severe liquidity challenges in April 2017—led to a reduction in the likelihood of joint tail risks between mortgage companies and banks during this period of stress.

Identifying perceived interconnections between banks and NBFIs

I study how Canadian NBFIs' tail events might be associated with systemic risk by looking at stock market expectations. For example, if markets believe that financial firms' returns are mainly driven by common factors, then adverse news about one financial institution conveys adverse information about all of them, and their stock prices are likely to fall simultaneously. In this note, I focus on tail risks—rare but plausible extreme losses—as perceived by market participants. In particular, I explore how sensitive the tail risk faced by banks is to downside risk in the NBFI sector. If tail risks tend to happen at the same time for banks and for NBFIs, this means that investors perceive both events to be highly interconnected. Such perceived tail interconnections—known as the informational contagion channel—could amplify shocks within the financial system.

To assess the perceived level of interconnection between banks and NBFIs during extreme events, I compute a metric of relative tail sensitivity. This measure, called the *ratio of tail sensitivities* or *RTS*, has two components:

- Numerator—the change in the tail risk of banks, calculated as the increase in their worst-case equity loss, when NBFIs are simultaneously under distress. This is a measure of *inter-sectoral* linkages.
- Denominator—the change in the tail risk of banks when other banks are also in trouble. This is a measure of *intra-sectoral* linkages.[1]

[1] This is also known as the Delta conditional value-at-risk (Delta CoVaR) in the literature.

The RTS has the following interpretation:

- A high value (close to 100%) implies that inter-sectoral linkages are as important as intra-sectoral linkages, suggesting strong interconnections between banks and NBFIs.
- A low value implies that the risk of an adverse event jointly impacting banks and NBFIs is relatively low, suggesting limited perceived interconnections between banks and NBFIs.

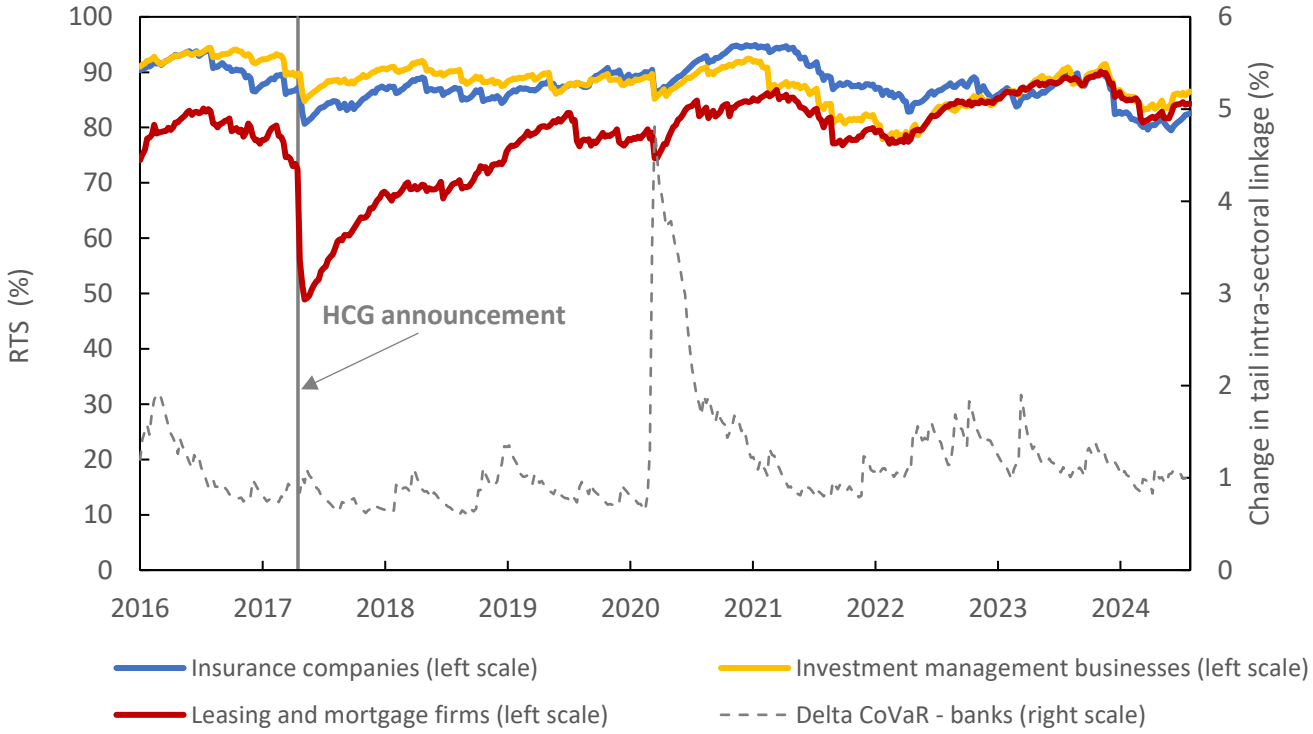
My measure captures how financial institutions behave during tail events by looking at correlations in those extreme cases. It is based on conditional events and offers an agnostic view without implying any causal interpretation.[2] It also allows systemic risk to be tracked and monitored in real time by capturing market reactions to tail events using high-frequency data.

Equity prices suggest Canadian banks have become more interconnected with NBFIs

Chart 2 displays, on the left axis, the RTS between banks and three segments of NBFIs: leasing and mortgage firms, insurance companies and investment management businesses. The normalization of the *inter-sectoral* linkages by the *intra-sectoral* linkages in the banking sector smooth volatility patterns, putting the focus on relative changes. The tail *intra-sectoral* linkage (**Chart 2**, dashed line, right axis) is partially driven by volatility, since higher volatility increases the magnitude of extreme losses. My measure of relative tail sensitivity puts in context the market-perceived tail interconnections across sectors. For example, during periods of high volatility, such as the COVID-19 pandemic, bank tail losses (**Chart 2**, dashed line, right axis) increased by up to 4 percentage points, while the RTS across banks and NBFIs (**Chart 2**, solid lines, left axis) did not vary as much.

[2] A conditioning event might be a good proxy for a scenario triggered by other factors, without being the cause of the change in the data pattern. The methodology remains agnostic about the source of contagion and the effects on regulatory ratios, which could be diverse for different financial institutions. For instance, the SRISK metric (Brownlees and Engle 2017) can be interpreted as the risk of undercapitalization. But this is a banking metric less relevant for NBFIs, where the liquidity ratio or funding ratio play a key role.

Chart 2: The ratio tail of sensitivities drops after the HCG stress event



Note: The dashed line indicates the increase in median losses for the banking sector whenever it performs in the lower half of its outcome, i.e., below its median outcome. Solid lines indicate the ratio (in percent) of the median Delta conditional value-at-risk (CoVaR) of banks when a non-bank financial intermediary (NBFI) sector performs below its median outcome compared with the dashed line. The change in the tail risks of banks when NBFIs experience losses is between 70% to 90% of the change in the tail risks when the stress is within the banking sector. RTS is the ratio tail of sensitivities. HCG is Home Capital Group, the parent company of Home Trust, which experienced severe funding stress in 2017 and for which HCG announced it had established a secured credit line.

The perceived interconnections between Canadian banks and NBFIs increased in the period leading up to the COVID-19 pandemic and stabilized after. This suggests that markets perceive Canadian NBFIs as being as highly tail-connected to banks as the tail dependence they perceive across banks. Similar results were obtained for the United States by Acharya, Cetorelli and Tuckman (2024).[3]

Recent years have seen a convergence in the perceived interconnections of banks and different segments of NBFIs. Insurance companies and investment management businesses exhibited a strong likelihood of tail co-movements with banks, peaking at 90% during the COVID-19 outbreak. This implies that stress events in these segments were perceived in a similar way as the tail response of deposit-taking institutions. While the index for leasing and mortgage firms was historically lower, it has since converged with that of the other NBFI segments amid recent monetary policy tightening.

The RTS offers real-time tracking of changes in investor expectations of joint tail events. For example, in April 2017, Home Trust—a federally regulated mortgage lender and a subsidiary of Home Capital Group—experienced severe funding stress. On April 26, 2017, Home Capital Group

[3] To ease comparison, **Chart A-1** in the appendix presents average values corresponding to the same break points used by Acharya et al. (2024).

announced that it had secured a collateralized credit line against its mortgage portfolio (Brown and Veenstra 2018). As a result of this market-based solution, the liquidity stress episode was largely viewed as idiosyncratic to Home Capital Group, with limited perceived contagion to other banks.[4] This episode translates to a reduction of RTS for the leasing and mortgage segment from 80% to 50% (**Chart 2,** vertical line). Note that our indicator would also capture investors' perceptions of the role of regulatory interventions to prevent systemic spillovers into other banks.

During extreme events, large banks tend to face systemic stress, whereas smaller banks are more likely to experience idiosyncratic losses

Using a reverse stress-testing approach, I examine how extreme losses in different types of banks align with broader stress in the financial system. I start by looking at each bank's tail return—specifically the average stock return they experience during the most severe 20% of all outcomes. This measure, known as the expected shortfall (ES), allows me to see what is happening beyond a worst-case event. This provides a better picture of extreme realizations[5] and makes the ES an excellent complement to the RTS measure. I focus on the tail scenario that generates the ES for each bank and examine which other institutions appear to be under stress in this same scenario, identifying co-movements or emerging patterns. This does not tell me what caused the losses, but it does show whether those extreme losses tend to occur in isolation or alongside stress in other parts of the financial system. By working backward from extreme losses in banks and analyzing which institutions are jointly affected, I gain a clear view of how vulnerabilities in banks may align with financial stress in other types of financial institutions.

I divide the ES for each bank into four categories, depending on who else is experiencing stress at the same time:

- when most banks are also in trouble, this is an episode of ***intra-sectoral* stress**
- when most NBFIs are also in trouble, this is an episode of ***inter-sectoral* stress**
- when banks and NBFIs are also in trouble, this is a ***systemic* event** across both types of institutions
- when most other financial institutions are not in trouble, this is an ***idiosyncratic* event**

When banks experience their most severe market losses, the patterns of stress in NBFIs can vary widely, highlighting the diverse ways that stress can manifest across financial sectors. I perform a historical breakdown for all banks and report aggregated results for large banks (domestic systematically important banks, or D-SIBs) and smaller banks (small and medium-sized banks, or SMSBs). Panels a and b in **Chart 3** illustrate how the different categories of stress contribute to the ES of D-SIBs and SMSBs, respectively. In each panel, the black line represents the

[4] See Bank of Canada, "Box 1: Recent Funding Stress at Home Capital Group," *Financial System Review* (June 2017): 3.

[5] In mathematical terms, this property is known as *coherence* (see Acerbi and Tasche 2002). It means that, unlike VaR-type measures that focus on a single point, this property allows us to assess the average behaviour of returns in the tail of the distribution.

ES and the coloured areas break down the expected tail returns based on the types of stress scenarios described earlier. Some key differences emerge between the two groups:

- Systemic stress—involving banks and NBFIs—makes up a larger share of ES for D-SIBS (about 70% to 80%) than for SMSBs (around 45% to 55%) (**Chart 3**, panels a and b, orange areas).
- Idiosyncratic stress—when most other institutions are not under stress—makes up a larger share of ES for SMSBs (around 30% to 40%) than for D-SIBs (around 15%) (**Chart 3**, panels a and b, blue areas).

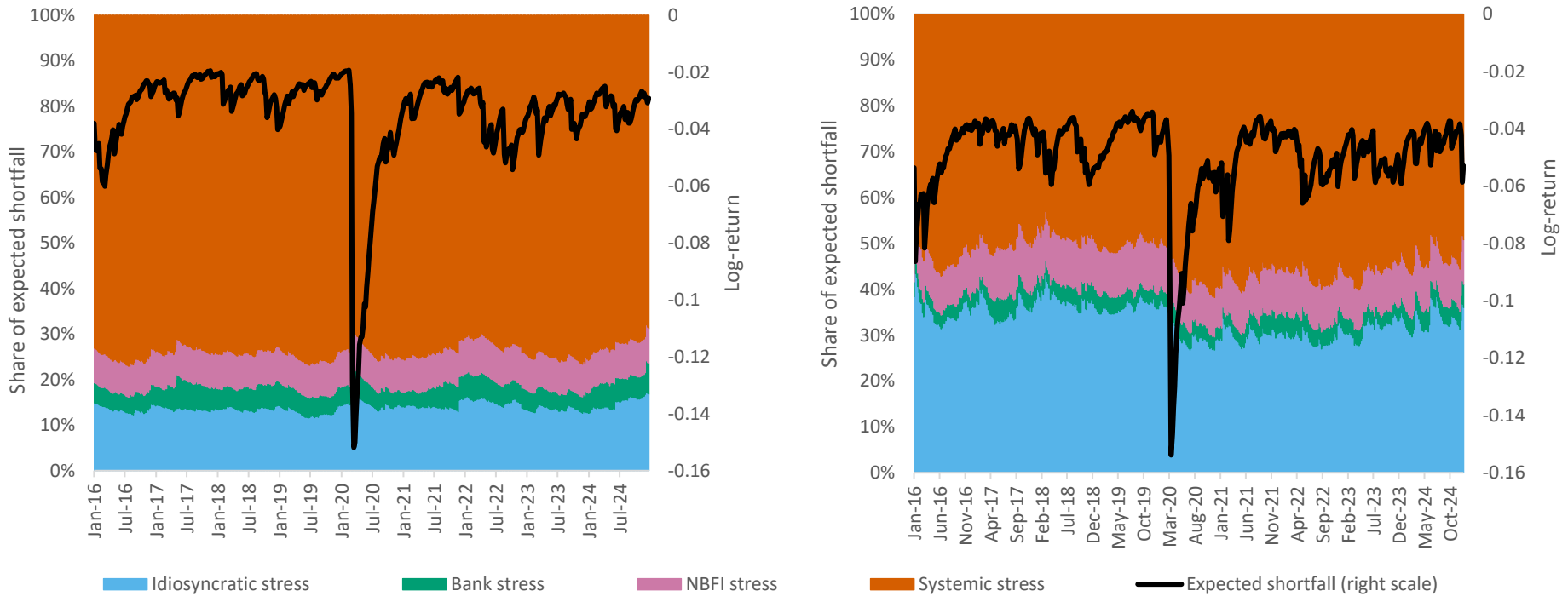
This suggests that bad stock performances of larger banks are more likely associated with troubles in the NBFI segment, while smaller banks have a larger share of idiosyncratic events in their tail loss. The larger asset exposures, funding linkages and derivative exposures of D-SIBs, compared with SMSBs, might be behind the stronger tail dependence between D-SIBs and NBFIs (Franceschi et al. 2023).

Chart 3: The largest share of total expected shortfall varies by bank type and stress scenario

Composition of aggregate market-weighted expected shortfall, by type of stress scenario

a. Domestic systemically important banks

b. Small and medium-sized banks



Note: NBFI is non-bank financial intermediary. The solid black line indicates the average weekly return of domestic systemically important banks (panel a) and small and medium-sized banks (panel b) when the returns are below the lowest quintile. Left axes indicate the percentage of those losses that are happening under different stress scenarios for banking (green), NBFIs (pink), both (orange) or none of those sectors (blue).
Source: Bank of Canada calculations

Conclusion

I introduce two ways to examine how extreme losses in banks and non-bank financial institutions (NBFIs) in Canada are linked. First, I look at how much banks' performance during bad times is influenced by risks in NBFIs compared with risks within the banking sector itself. Second, I group expected losses into four categories based on shared stress, showing that banks' ties to NBFIs are largely driven by the central role of large banks. Overall, my findings underscore the importance of monitoring the bank–NBFI nexus during periods of financial stress, as their risks have become more closely linked in recent years.

Appendix A: Data

Table A-1: Listed Canadian institutions in the sample

Code	EB/ET classification	Company common name	Group
BAM.TO	Investment management companies	BROOKFIELD ASSET MANAGEMENT LTD	Investment FIs and CCPs
BMO.TO	D-SIBs	Bank of Montreal	Banks
BNS.TO	D-SIBs	Bank of Nova Scotia	Banks
CF.TO	Investment dealers (independent)	Canaccord Genuity Group Inc	Investment FIs and CCPs
CHW.TO	Leasing and finance companies (excl. auto and real estate companies)	Chesswood Group Ltd	Leasing and mortgage FIs
CIX.TO	Investment management companies	CI Financial Corp	Investment FIs and CCPs
CM.TO	D-SIBs	Canadian Imperial Bank of Commerce	Banks
CWB.TO	SMSBs	Canadian Western Bank	Banks
CYB.TO	Investment management companies	Cymbria Corp	Investment FIs and CCPs
ECN.TO	Mortgage finance companies	ECN Capital Corp	Leasing and mortgage FIs
EFN.TO	Leasing and finance companies (excl. auto and real estate companies)	Element Fleet Management Corp	Leasing and mortgage FIs
EQB.TO	Mortgage finance companies	EQB Inc	Leasing and mortgage FIs
FFH.TO	Insurance companies	Fairfax Financial Holdings Ltd	Insurance FIs
FN.TO	Mortgage finance companies	First National Financial Corp	Leasing and mortgage FIs
GSY.TO	Mortgage finance companies	goeasy Ltd	Leasing and mortgage FIs
GWO.TO	Insurance companies	Great-West Lifeco Inc	Insurance FIs
HCG.TO^I23	Mortgage finance companies	Home Capital Group Inc	Leasing and mortgage FIs
IAG.TO	Insurance company	iA Financial Corporation Inc	Insurance FIs
IFC.TO	Insurance companies	Intact Financial Corp	Insurance FIs
IGM.TO	Investment management companies	IGM Financial Inc	Investment FIs and CCPs
LB.TO	SMSBs	Laurentian Bank of Canada	Banks
MFC.TO	Insurance companies	Manulife Financial Corp	Insurance FIs
MKP.TO	Mortgage finance companies	MCAN Mortgage Corp	Leasing and mortgage FIs
NA.TO	D-SIBs	National Bank of Canada	Banks
ONEX.TO	Investment management companies	Onex Corp	Investment FIs and CCPs
POW.TO	Insurance companies	Power Corporation of Canada	Insurance FIs
PRL.TO	Clearing houses	Propel Holdings Inc	Investment FIs and CCPs
RY.TO	D-SIBs	Royal Bank of Canada	Banks
SII.TO	Investment management companies	Sprott Inc	Investment FIs and CCPs
SLF.TO	Insurance companies	Sun Life Financial Inc	Insurance Fis
TD.TO	D-SIBs	Toronto-Dominion Bank	Banks
TF.TO	Mortgage finance companies	Timbercreek Financial Corp	Leasing and mortgage FIs
VBNK.TO	SMSBs	VersaBank	Banks
X.TO	Clearing houses	TMX Group Ltd	Investment FIs and CCPs

Note: FI is financial institution; CCP is central counterparty clearing house; D-SIB is domestic systemically important bank; SMSB is small and medium-sized bank. Start and end dates for equity prices vary by institution. The Office of the Superintendent of Financial Institutions' EB/ET category is associated with the corresponding main North American Industry Classification System sector obtained from LSEG Eikon.

Appendix B: Technical details

Data

The empirical analysis uses unbalanced weekly equity prices for 34 Canadian financial institutions from April 1990 to July 2024. The sample includes:

- 9 deposit-taking institutions (DTIs)—Canada's six largest banks and three small and medium-sized banks
- 9 investment companies and clearing houses
- 7 insurance companies
- 9 leasing and mortgage companies, including Home Capital[6]

The classification follows the Office of the Superintendent of Financial Institution's (OSFI's) match between the North American Industry Classification System (NAICS) main classification and OSFI's EB/ET groups.[7] To simplify the nomenclature, I use the term *banks* instead of *deposit-taking institutions*. Market data and NAICS classification are obtained from LSEG Eikon.

Measures

I use the conditional value-at-risk (CoVaR) introduced by Adrian and Brunnermeier (2016). I compute a quantile of the equity returns for one financial institution conditional on the performance of another institution. CoVaR is defined as the threshold below which the β-percent worst stock returns of institution i occur, given that institution j is experiencing returns in its lowest α-percent tail,[8] i.e.,:

$$P\left(r_{i,t} \leq CoVaR_{i|j,t}(\beta) \middle| r_{j,t} \leq VaR_{i,t}(\alpha)\right) = \beta.$$

The difference $CoVaR_{i|j,t}(\beta) - VaR_{i,t}(\beta)$ indicates the change in downside risk for institution i when some information about institution j is known, which provides a measure of the sensitivity of the tail returns for institution i to a tail risk event with probability α for institution j.

The **ratio of tail sensitivities** (RTS) is defined as the median percentage of changes in the returns' tail across all the DTIs, comparing the tail change to non-bank financial intermediaries' (NBFIs') tail risk against their tail change to other DTIs' tail risk. A value close to 100% indicates that the tail risk co-movement of DTIs to NBFIs tail events is as high as that of DTIs to other DTIs. Negative values suggest that tail risks of NBFIs and DTIs move in opposite directions, denoting a low probability of joint tail events in those sectors. **Chart B-1** shows the average values of RTS for different NBFI segments to the banking sector during

[6] Data from CWB.TO were cleaned for the week of June 10, 2024, when the National Bank of Canada announced the all-share deal on CWB.TO, increasing the equity price by more than 60% on that date.

[7] See Appendix I in OSFI (2023).

[8] This definition follows the mathematical definition of Girardi and Ergun (2013) due to the flaws in backtesting and dependence properties of the original CoVaR definition as pointed out by Mainik and Schaanning (2014).

different time periods, using the same breaking points as Acharya, Cetorelli and Tuckman (2024).

Chart B-1: Perceived tail interconnections between banks and non-bank financial intermediaries peaked during the COVID-19 pandemic

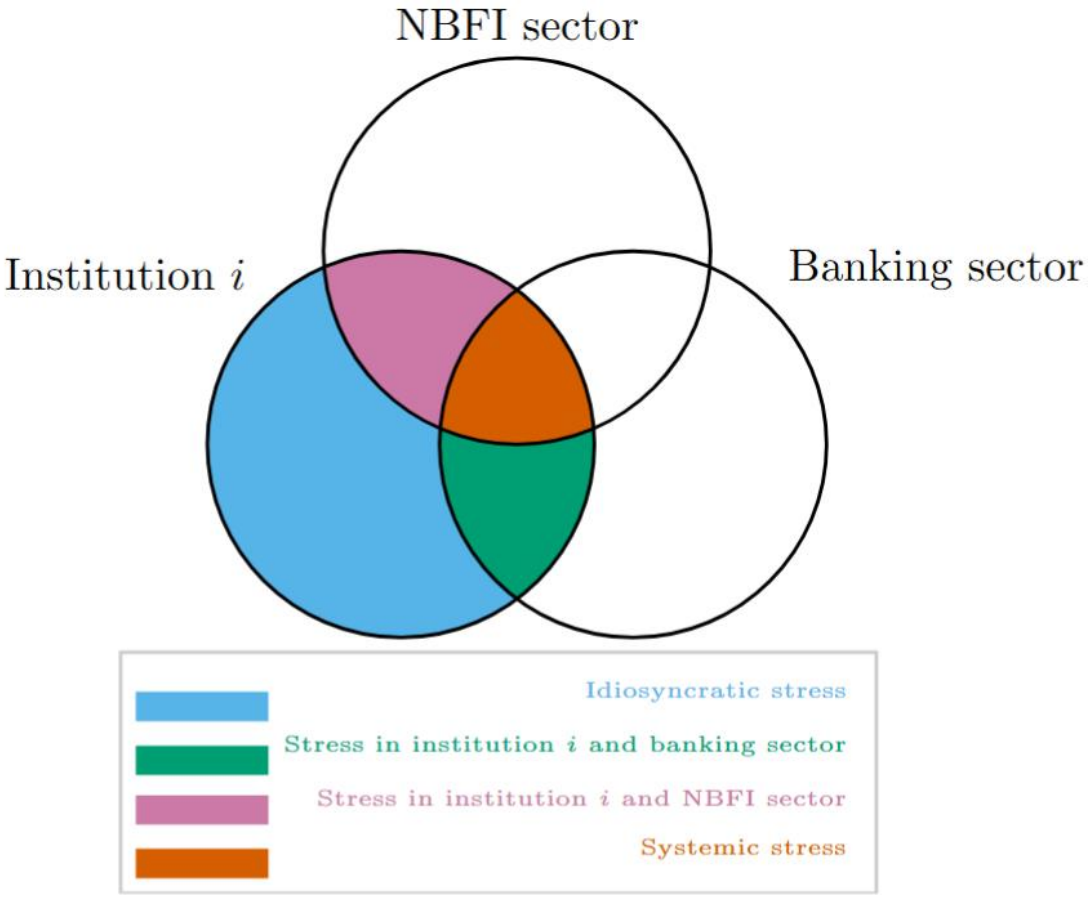
Note: The periods noted in the chart are as follows: pre-global financial crisis (GFC), January 1, 2000 to July 31, 2007; GFC, August 1, 2007 to October 31, 2009; post-GFC, November 1, 2009 to November 30, 2014; Oil price shock, December 1, 2014 to June 30, 2016; United States quantitative tightening (USQT) and Home Capital Group (HCG) event, July 1, 2016 to December 31, 2019; COVID-19 pandemic, January 1, 2020 to October 31, 2021; post-pandemic, November 1, 2021 to July 31, 2024. Break points are selected consistently with Acharya, Cetorelli and Tuckman (2024).

The **expected shortfall** (ES) is the average return of a financial institution below a certain threshold, which is usually associated with a quantile. This average return could be built as a weighted mean of different expected returns under different sector scenarios adjusted by the conditional probability of those scenarios, i.e.,:

$$
\begin{aligned}
&E\left(r_{i,t} \middle| r_{i,t} \leq VaR_{i,t}(\alpha)\right) \\
&= \overbrace{E\left(r_{i,t} \middle| r_{i,t} \leq VaR_{i,t}(\alpha), r_{banks,t} > VaR_{banks,t}(\alpha), r_{NBFI,t} > VaR_{NBFI,t}(\alpha)\right) * P\left(r_{banks,t} \leq VaR_{banks,t}(\alpha), r_{NBFI,t} > VaR_{NBFI,t}(\alpha) \middle| r_{i,t} \leq VaR_{i,t}(\alpha)\right)}^{Idiosyncratic\ part} \\
&+ \overbrace{E\left(r_{i,t} \middle| r_{i,t} \leq VaR_{i,t}(\alpha), r_{banks,t} \leq VaR_{banks,t}(\alpha), r_{NBFI,t} > VaR_{NBFI,t}(\alpha)\right) * P\left(r_{banks,t} \leq VaR_{banks,t}(\alpha), r_{NBFI,t} > VaR_{NBFI,t}(\alpha) \middle| r_{i,t} \leq VaR_{i,t}(\alpha)\right)}^{bankspart} \\
&+ \overbrace{E\left(r_{i,t} \middle| r_{i,t} \leq VaR_{i,t}(\alpha), r_{banks,t} > VaR_{banks,t}(\alpha), r_{NBFI,t} \leq VaR_{NBFI,t}(\alpha)\right) * P\left(r_{banks,t} > VaR_{banks,t}(\alpha), r_{NBFI,t} \leq VaR_{NBFI,t}(\alpha) \middle| r_{i,t} \leq VaR_{i,t}(\alpha)\right)}^{NBFI\ part} \\
&+ \overbrace{E\left(r_{i,t} \middle| r_{i,t} \leq VaR_{i,t}(\alpha), r_{banks,t} \leq VaR_{banks,t}(\alpha), r_{NBFI,t} \leq VaR_{NBFI,t}(\alpha)\right) * P\left(r_{banks,t} \leq VaR_{banks,t}(\alpha), r_{NBFI,t} \leq VaR_{NBFI,t}(\alpha) \middle| r_{i,t} \leq VaR_{i,t}(\alpha)\right)}^{Systemic\ part}
\end{aligned}
$$

This decomposition allows us to categorize the expected tail return into components associated with systemic events, sector-specific stress and purely idiosyncratic factors. The Venn diagram in **Figure B-1** shows how those four regions of stress, identified by different colours, are non-overlapping. Each circle indicates a stress scenario, understood as having returns below a certain threshold, for institution *i*, the banking (DTI) sector or the NBFI sector. The overlapping and non-overlapping areas indicate the different areas in which I could decompose the tail return of institution *i*.

Figure B-1: An illustration on the decomposition of tail returns of institution i into different stress scenarios



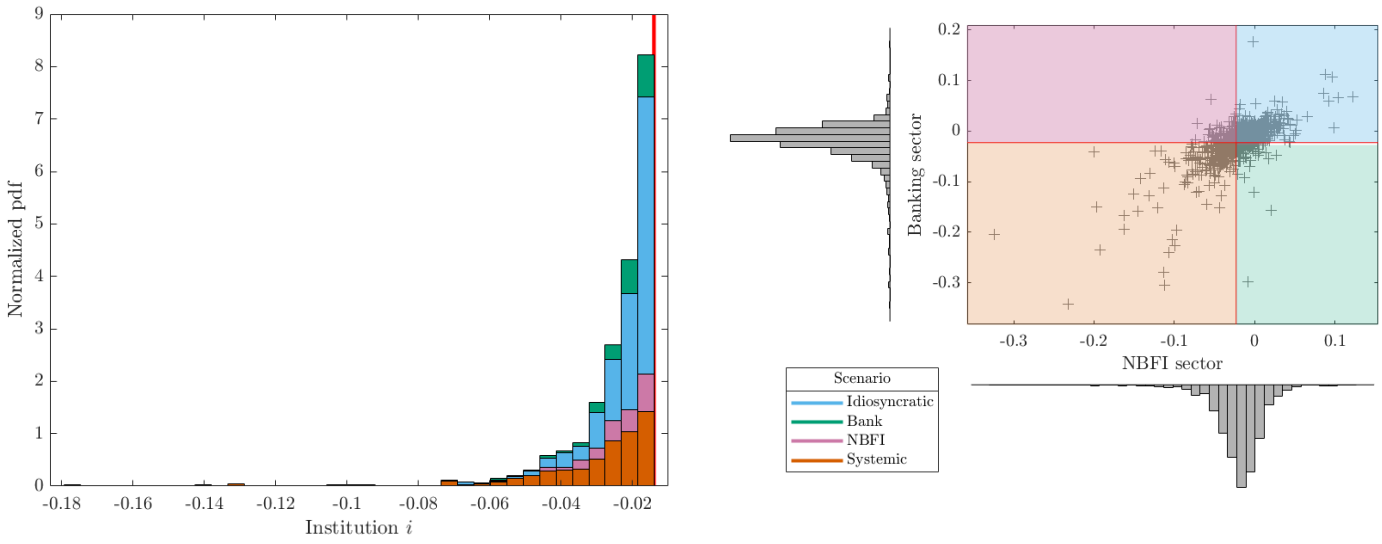
Note: Each large circle in this Venn diagram represents the tail risk of institution i (left circle), non-bank financial institution (NBFI) sector (top circle) and banking sector (right circle) respectively. The tail risk of institution i can be divided into four non-overlapping segments of I. The blue area indicates the share of the tail risk of institution i where neither the banking sector or the NBFI sector are in their tail. The green area indicates the share of tail risk of institution i where also the banking sector is in the tail but the NBFI sector is not. The pink area indicates the share of tail risk of institution i where also the NBFI sector is in the tail but the banking sector is not. The orange area indicates the share of tail risk of institution i where both banking and NBFI sectors are in their left tails.

Chart B-2 shows how the average tail return of financial institution i (shown in panel a) could be divided into four areas: joint stress on the banking and NBFI sectors, single stress on the banking or the NBFI sector, or no stress on the overall financial sector (panel b). The share of ES under each scenario depends on how probable those scenarios are when institution i is in its tail and how worse the expected return would be when those scenarios materialize.

Chart B-2: Decomposition of expected shortfall by area of stress

a: Institution *i*'s tail returns

b: Financial system's returns when institution *i* is in its tail



Note: NBFI is non-bank financial intermediary
Source: Bank of Canada calculations

Model

Constructing these measures requires identifying the joint distribution of returns across all financial institutions, a complex task due to the high-dimensionality of the dataset, known in the econometric literature as the "curse of dimensionality." To overcome this issue, I rely on a latent bi-factor nested model (Krupskii and Joe 2015), which captures both segment-specific factors (such as banks, insurance, investment or leasing and mortgage) and a common factor across segments. This approach significantly reduces the number of parameters to be estimated. I characterize the relationship between the financial institutions' returns and the latent factors using a skewed-*t* distribution (Demarta and McNeil 2005) reflecting stylized facts about the nonlinearities in extreme events. Furthermore, the correlation structure evolves over time following a generalized autoregressive score (GAS)-driven model (Creal, Koopman and Lucas 2013), which reduces to many well-established models in financial econometrics while capturing additional information in the data.[9] For more details on the econometric background, please refer to Ojea-Ferreiro (2025).

[9] Koopman, Lucas and Scharth (2016) find that GAS specification leads to similar predictive performance than state-space models and outperforms autoregressive conditional models, reducing computational cost.

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