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August 22, 2024

Approved By
European Department

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CONTENTS

PRODUCTIVITY SHOCKS TO THE PHARMACEUTICAL SECTOR AND THE DANISH ECONOMY[1]

The pharmaceutical industry in Denmark has grown rapidly in recent years. This chapter discusses the macroeconomic impact of the pharmaceutical sector. The analysis focuses on Novo Nordisk, the leading pharmaceutical company in Denmark, and its productivity impact on the rest of the economy. Empirical evidence suggests only weak correlations between productivity shocks at Novo Nordisk and overall economic growth, as well as between Novo Nordisk's productivity and that of other firms. However, we find evidence of a significant within-industry spillover effect in the pharmaceutical sector.

A. Introduction

1. The pharmaceutical industry in Denmark has grown at a rapid pace in recent years. Since 2005, the real gross value added (GVA) of pharmaceuticals has increased sixfold (Figure 1). This extraordinary surge in real GVA over the past two years reflects increased export demand for new weight-loss drugs developed by Novo Nordisk, Denmark's leading pharmaceutical company.

2. To assess the implications of the pharmaceutical booms on the Danish macroeconomy, two structural characteristics are worth highlighting.

- First, Danish large multinational enterprises (MNEs) have become increasingly reliant on "merchanting and processing (M&P)," as evidenced by the increased exports that never cross Danish borders (Box 1). In the pharmaceutical sector, the bulk of the value of the drugs is attributable to the intellectual property embedded in them, and pharmaceutical companies use contract manufacturers abroad for production.

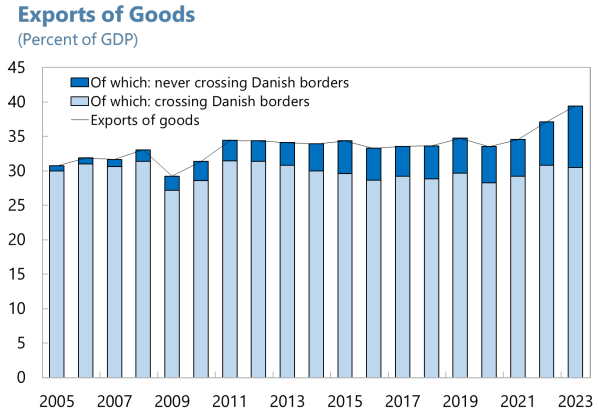
- Second, the expansion of the pharmaceutical sector has been mainly driven by a significant increase in labor productivity. The level of labor productivity in the pharmaceutical sector has increased more than threefold since 2005, compared to a 20 percent increase for all industries (Figure 1).

3. Against this backdrop, exploring how productivity shocks in the pharmaceutical industry have impacted Denmark's economic growth presents an interesting question. A priori, it is not clear to what extent strong productivity growth in the pharmaceutical sector, which substantially relies on foreign production, would boost overall Danish economic growth. Therefore, we first establish the quantitative relationship between productivity shocks at pharmaceutical companies and the real GDP growth. In this light, our analysis also more broadly covers large Danish MNEs using M&P. Next, we turn to the microfoundation of the relationship by investigating if productivity shocks in a dominant firm like Novo Nordisk have spillover effects to other firms, both

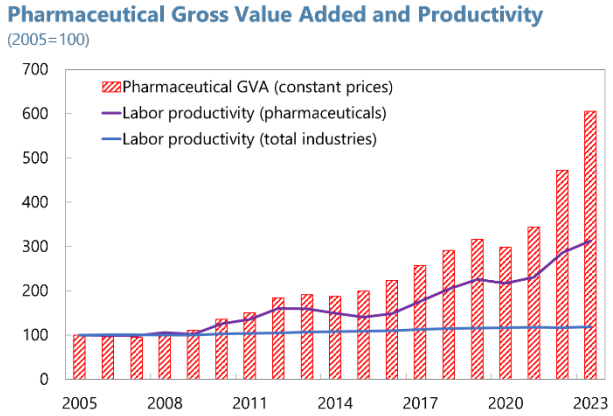
[1] Prepared by Takuji Komatsuzaki with support from Fuda Jiang (all EUR) and useful inputs from the IMF's Statistics Department. The authors thank participants of the workshop held at the Danmarks Nationalbank for useful discussions and comments.

within and outside the pharmaceutical industry. We address these questions empirically using firm-level data in Denmark.

Figure 1. Selected Indicators for Good Exports and Pharmaceutical Industry



Sources: Statistics Denmark, Haver Analytics, and IMF staff calculations



Sources: Statistics Denmark, Haver Analytics, and IMF staff calculations

4. The rest of this chapter is organized as follows. Section B briefly summarizes the stylized facts related to the Danish pharmaceutical sector and the macroeconomy. Section C presents the empirical models and results. Section D concludes.

Box 1. Danish Exports that Do Not Cross Border[1]

As illustrated in the main text, Danish companies' exports that do not cross border are becoming increasingly important. The exports from Danish companies' production abroad are classified into merchanting and processing, depending on whether they own the intermediate inputs. In both cases, the exports from the foreign production are counted as the Danish exports in the Balance of Payment Statistics although the goods never cross the Danish border.[2] Processing by large manufacturers (including pharmaceuticals) drive the trend increase in the foreign production.

Increases in the foreign production warrant attention in interpreting aggregate statistics.

- Foreign production combines factor inputs from Denmark and from the country where the production takes place. Danish factor inputs are heavier in intangible assets (intellectual property rights, sales expertise, etc.) and lighter in labor.
- As a result, foreign production has higher labor productivity and lower employee compensation.
- Increases in foreign production suggest that the labor productivity growth at the national aggregate level may not necessarily reflect labor productivity growth in the domestic economy, and that the output gap based on aggregate output may overstate capacity pressures in the labor market.

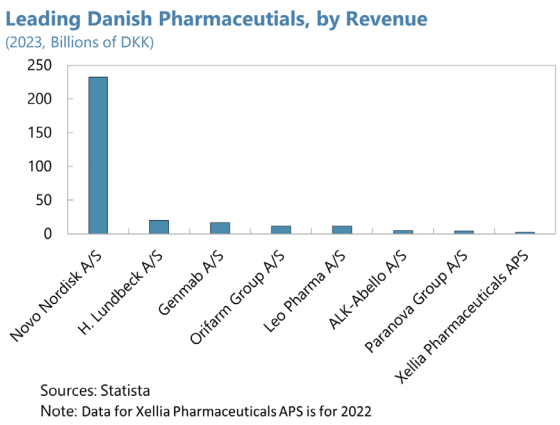
[1] This box draws on Productivity Board (2024a), Productivity Board (2024b), and Statistics Denmark (2019).

[2] If the goods produced by the Danish companies abroad are sold in Denmark, the sale is recorded as final consumption. This accounts for a small share of total foreign production, however.

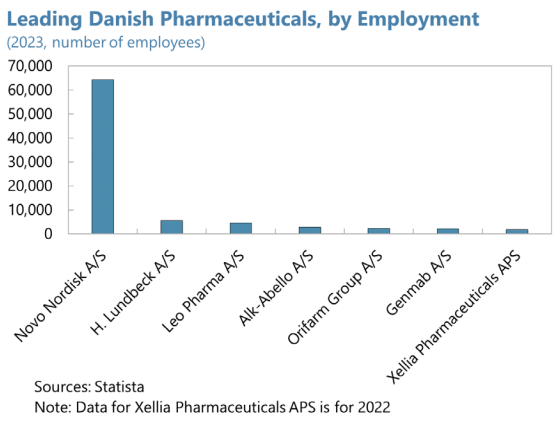
B. Danish Pharmaceutical Sector and the Macroeconomy

5. Denmark has a strong pharmaceutical industry. Novo Nordisk stands as the largest pharmaceutical company in Denmark and ranks among the top 20 largest pharmaceutical companies globally by revenue. It is a dominant company in the pharmaceutical industry, whether measured by sales or employment (Figure 2). For decades, Novo Nordisk has been one of Denmark's largest companies in Denmark, ranking in the top ten for sales among all Danish companies. Its presence has grown over time, especially rapidly in the last few years, with its sales as a share of Denmark's GDP increasing from 1 percent in the early 1990s to 8.3 percent in 2023.[2] A surge in foreign demand for its new drugs for diabetes and obesity is behind its exceptional growth in recent years. To meet the strong demand, Novo Nordisk is expanding its production capacity both in Denmark and abroad.

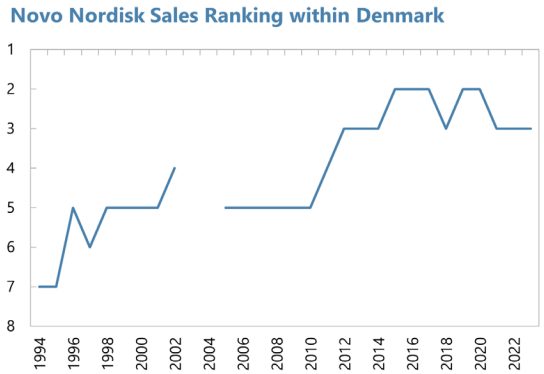
Figure 2. Novo Nordisk: Selected Indicators



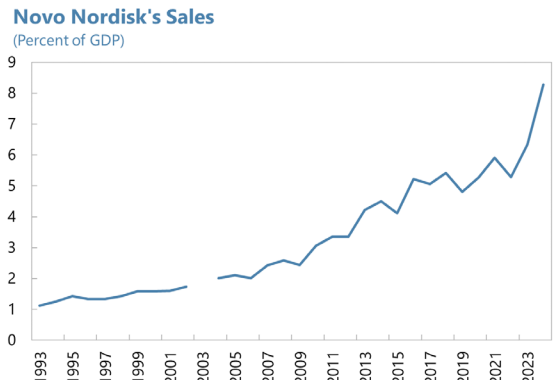
Sources: Statista
Note: Data for Xellia Pharmaceuticals APS is for 2022



Sources: Statista
Note: Data for Xellia Pharmaceuticals APS is for 2022



Sources: Orbis and IMF staff calculations
Note: financial and energy firms are excluded



Sources: Orbis, Haver and IMF staff calculations

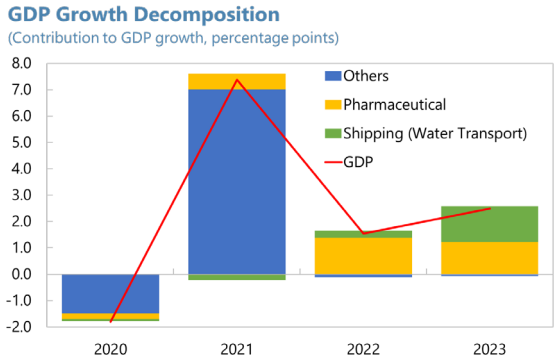
[2] Despite its recent growth, relative size of Novo Nordisk is not comparable to that of Nokia in Finland in the 2000s. In 2003, Nokia's sales were 26 percent of Finland's GDP (Gabaix 2011).

6. The pharmaceutical industry has increased its contributions to the growth of real GDP and exports and, to a lesser extent, corporate income taxes; however, its impact on employment has been relatively limited (Figure 3).

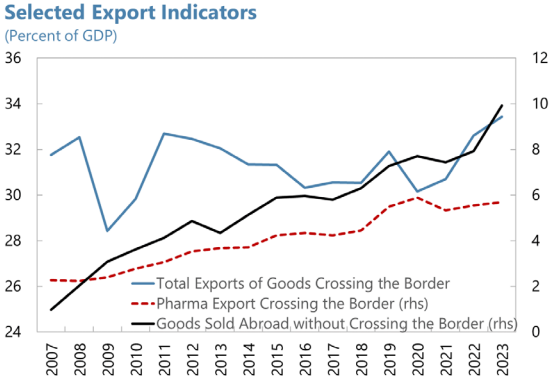
- *Real GDP growth* (top left chart). The growth decomposition highlights the extraordinary contribution of the pharmaceutical sector in 2022 and 2023. The pharmaceutical sector contributed about 10 percent to real GDP growth during 2020–21, with its contributions surging to 90 percent and 50 percent in 2022 and 2023, respectively.

- *Exports* (top right chart). A rapid growth in exports by the pharmaceutical sector is evident. Danish exports, originating from Denmark, have fluctuated around 29–33 percent of GDP over the past 15 years (blue line). Meanwhile, pharmaceutical exports have increased steadily from around 2 percent of GDP to 6 percent of GDP since 2007 (red dotted line). Exports not crossing the border (Box 1) have grown even faster, increasing from about 1 percent of GDP to about 10 percent of GDP (black solid line).

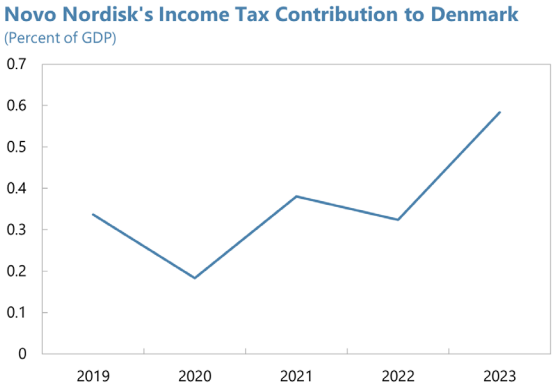
Figure 3. Macroeconomic Impact of the Pharmaceutical Industry



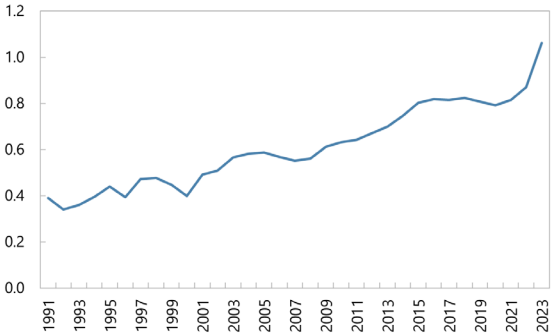
Sources: Statistics Denmark, Danmarks Nationalbank, Haver Analytics, and Fund staff estimates



Sources: Statistics Denmark and IMF staff calculations



Sources: Novo Nordisk Annual Reports and IMF staff calculations



Sources: Statistics Denmark and IMF staff calculations

- *Tax Revenue* (bottom left chart). Corporate income tax payments by Novo Nordisk to the Danish government has doubled in the last 5 years, increasing from about 0.3 percent of GDP in 2019 to 0.6 percent of GDP in 2023.

- *Employment* (bottom right chart). The share of employment in the pharmaceutical industry has shown a long-term increasing trend, yet the level of employment remains relatively low. This is attributed to the industry's heavy reliance on knowledge and the fact that a significant portion of production takes place abroad. Consequently, its contribution to domestic employment is smaller than its contribution to value-added (Box 1). The pharmaceutical industry accounts for 6.7 percent of nominal value added, while its share in employment is around 1 percent.

C. Empirics: Shocks to Novo Nordisk and MNEs and their Impact on the Danish Economy

7. Two sets of regressions are run using firm-level data. The first set estimates the impact of labor productivity shocks at Novo Nordisk and other MNEs on the real GDP growth. The second set of regressions assesses the spillover effects of labor productivity from Novo Nordisk to other firms within the country. The data source is Orbis, a worldwide database that includes firm-level income statements and balance sheets for both listed and unlisted companies. The first set of regressions spans from 1993 to 2022, while the second set covers 1995 to 2022, both at annual frequencies. The coverage period for the second set is shorter due to the need to have sufficient number of companies in the dataset.[3]

How Much Have Shocks to Novo Nordisk and Other MNEs Impacted Denmark's Real GDP Growth?

8. The regression specification is as follows:

$$ln(GDP_t) - ln(GDP_{t-1}) = \alpha + \beta_1 ScaledShocks_t + \beta_2 ScaledShocks_{t-1} + \beta_3 ScaledShocks_{t-2} + \varepsilon_t$$

Where real GDP growth is regressed on ScaledShocks and their lags. Estimation methodology is OLS and ε_t represents residuals. The specification follows Gabaix (2011), which proposes that idiosyncratic firm-level shocks can explain an important part of movements in the aggregate economy when the firm is sufficiently large. ScaledShocks is size-weighted, firm-specific labor productivity shocks. These are constructed as follows:

(i) Calculate firm-level labor productivity growth as annual changes in sales per employee.

$$\text{ProductivityGrowth}_{j,t} = \ln\left(\frac{\text{Sales}_{j,t}}{\text{Employees}_{m,t}}\right) - \ln\left(\frac{\text{Sales}_{j,t-1}}{\text{Employees}_{m,t-1}}\right)$$

[3] The number of companies in the dataset exceeds 100 in 1995. The number of companies increases over time, exceeding 2000 in 2012 and 4000 in 2017.

(ii) De-mean the firm-level labor productivity growth to remove the economy-wide effect to derive firm-specific labor productivity shocks.

$$ProductivityShocks_{j,t} = ProductivityGrowth_{j,t} - \frac{1}{N}\sum_{j=1}^{N} ProductivityGrowth_{j,t}$$

(iii) Scale the firm-specific labor productivity shocks by the size of the firm measured by sales.

$$ScaledShocks_{j,t} = \frac{Sales_{j,t-1}}{GDP_{t-1}} ProductivityShocks_{j,t}$$

9. Two types of firm-level productivity shocks are considered. The first is related to Novo Nordisk. The second type of labor productivity shock is calculated as cumulative firm-specific labor productivity shocks to the largest firms, aimed at broadly capturing the shocks to large MNEs. These shocks are constructed by aggregating ScaledShock of the top-10 firms each year. Table 1 lists the top-10 firms in selected years.

Table 1. Denmark: Top-10 Firms in Denmark by Sales, 1995 and 2022

	1995		2022	
Rank	Name	Industry	Name	Industry
1	Lauritzen Fonden Holding ApS	Transporting and storage	A.P. Moller - Maersk A/S	Admin. and support service
2	Aktieselskabet Potagua	W and R trade	Maersk A/S	Transport and storage
3	FLSmidth & Co. A/S	Manufacturing	Novo Nordisk A/S	Manufacturing
4	ISS A/S	Admin. and support service	Energi Danmark A/S	Electricity, gas, steam air conditioning supply
5	Novo Nordisk A/S	Manufacturing	Vestas Wind Systems A/S	Professional, scientific and technical activities/ Manufacturing
6	Carlsberg A/S	Manufacturing	Orsted A/S	Electricity, gas, steam air conditioning supply
7	Berendsen A/S	Other services activities	ISS A/S	Admin. and support service activities
8	Dupont Nutrition Biosciences ApS	Manufacturing	Selfinvest ApS	W and R trade
9	Arla Foods Amba	Manufacturing	Carlsberg A/S	Manufacturing
10	Monberg & Thorsen A/S	Construction	Salling Group A/S	W and R trade

Source: Orbis and the Danish authorities.
Note: Financial and energy firms are excluded, following the literature. Exact industries excluded follow Jannati (2020).

10. The regression results are presented in Table 2.

- We found weak evidence that Novo Nordisk's productivity shock is positively associated with GDP growth (Column 1). The estimated coefficients for ScaledShocks for the first and second lags are positive, with the latter being statistically significant at the 10 percent level.

- We found stronger evidence that the productivity shock to the top-10 MNEs and economic growth are positively associated (Column 2). Coefficients for ScaledShocks are positive both contemporaneously (at the 5 percent significance level) and for the second lag (at the 10 percent significance level). Using the Sales-to-GDP ratio of the top-10 MNEs for 2021, the estimated model suggests that a 1.85 percent increase in the labor productivity were associated with a 0.3 percentage points increase in real GDP growth on average during 1993–2022.[4]

11. The weak statistical evidence related to Novo Nordisk's productivity shock (Column 1) may be attributed to limited data. It should be noted that Novo Nordisk was considerably smaller in size during the earlier part of the sample period. As Novo Nordisk continues to grow and more data accumulates, we may detect stronger statistical associations between Novo Nordisk's productivity shocks and economic growth, similar to what was found for the top-10 MNEs.

Table 2. Denmark: Regression Results: Impact of Firm-Specific Shocks on Real GDP Growth

	(1) Real GDP growth	(2) Real GDP Growth
ScaledShocks(Novo)$_t$	-0.00795	
	(-0.53)	
ScaledShocks(Novo)$_{t-1}$	0.0113	
	(0.92)	
ScaledShocks(Novo)$_{t-2}$	0.0236*	
	(1.75)	
ScaledShocks(Top 10)$_t$		0.00336**
		(2.53)
ScaledShocks(Top 10)$_{t-1}$		-0.0000102
		(-0.00)
ScaledShocks(Top 10)$_{t-2}$		0.00365*
		(1.87)
Constant	1.704***	1.819***
	(3.61)	(5.15)
N	25	30
R^2	0.169	0.201

Note: t statistics in parentheses, * p<0.1, ** p<0.05, *** p<0.01.

Does the Shock to Novo Nordisk Have Spillovers to Other Firms?

12. The regression specification is as follows:

[4] See Annex for more detailed explanation.

$$ScaledShocks(Other)_{j,t} = \alpha_j + \beta_1 ScaledShocks(Novo)_{i,t-1} + \beta_2 ScaledShocks(Novo)_{i,t-1} * P\_dummy + \beta_3 X_{j,t-1} + \varepsilon_{j,t}$$

ScaledShocks(Other) refers to the level of size-weighted, firm-specific labor productivity shocks for non-top 10 companies (as defined in paragraph 6). This variable is regressed on Novo Nordisk's productivity shock (identical to Novo Nordisk's productivity shocks in the previous regression) and firm-level control variables in the previous year, together with firm-fixed effects. The specification follows Jannati (2020), which estimates geographical spillovers of productivity shocks from dominant companies in the U.S. to the smaller firms that are geographically close to them. The firm-level control variables ($X_{j,t-1}$) include the firms' lagged firm-specific labor productivity shocks, cash flows, leverage, loss, and size (see Annex for precise definition of the variables). In the extension of this basic specification, the interaction of the Novo Nordisk firm-specific shock and the pharmaceutical industry dummy (P_dummy) is added to estimate the additional spillover impact of being in the same industry as Novo Nordisk ("within-industry effects").

Table 3. Denmark: Regression Results: Impact of Firm-Specific Shocks to the Smaller Firms[1]

	(1) ScaledShocks(Other)$_t$	(2) ScaledShocks(Other)$_t$
ScaledShocks(Novo)$_{t-1}$	0.000339	0.000259
	(1.11)	(0.82)
ScaledShocks(Novo)$_{t-1}$* P_Dummy		0.00962**
		(2.30)
Constant	1.022	1.009
	(0.81)	(0.80)
N	7745	7745
R^2		

Note: t statistics in parentheses, * p<0.1, ** p<0.05, *** p<0.01.
[1] Coefficients for the firm-level control variables (X) is omitted from the table to economize on space. The full regression table is shown in the Annex.

13. The empirical analysis suggests that the spillover effect on the broader economy is small and uncertain, while the within-industry spillover effect is strong (Table 3).[5]

- Correlations between Novo Nordisk's productivity shocks and those of other firms are found to be quite weak. The estimated coefficient is positive but small (0.0003) and not statistically significant (Column 1). This indicates limited and uncertain spillover effects on the broader economy.

- A model in Column 2 includes the interaction term. Consistent with Column 1, the estimated coefficient of Novo Nordisk's productivity shock is small (0.0003) and not statistically significant.

[5] See Annex for more detailed explanation.

However, the estimated coefficient for the interaction term is positive (0.009) and statistically significant at the 5 percent level.

- Using the size of the companies in 2022, the estimates suggest that, on average, a one percentage point increase in labor productivity of Novo Nordisk was associated with a 0.75 percentage point increase in labor productivity of other pharma companies. The strong within industry spillover effects may provide some evidence that Novo Nordisk's R&D activities have externality effects within the pharmaceutical industry.

D. Conclusions

14. The pharmaceutical industry has substantial and increasing influence on the Danish economy. Its contribution to real GDP growth has been extraordinary over the past two years, and it significantly contributes to exports. Employment in the pharmaceutical sector remains low, while its contributions to tax revenues have increased from low levels.

15. Empirical evidence is mixed. The analysis suggests that productivity shocks at Novo Nordisk and Denmark's overall economic growth appear to be positively correlated, albeit with lags, but the evidence is relatively weak. This may be due to a lack of sufficient data, considering that we found stronger evidence of positive correlations between the top-10 MNEs and Denmark's GDP. While the spillover effect of Novo Nordisk's productivity on the broader economy is small and uncertain, there is a strong within-industry spillover effect in the pharmaceutical sector.

16. These findings suggest there is limited risk that Denmark's booming pharmaceutical company would become its "Nokia." Although the pharmaceutical sector will be a key driver of growth, most of its production occurs overseas under Danish ownership. As a result, its linkages with the rest of the domestic economy, in terms of employment and supply chains, are somewhat limited. The empirical results also indicate limited spillover effects through productivity channels. However, the empirical results may underestimate the influence of Novo Nordisk due to limited data.

Annex I. Technical Details

A. Interpretation of Regression Coefficients

The regression coefficient in (2) in Table 2 suggests that 100 units increase in ScaledShocks(Top 10)t is associated with 0.34 percentage point increase in real GDP growth. Recall that

$$ScaledShocks(Top\ 10)_t = \sum_{j=1}^{10} \frac{Sales_{j,t-1}}{GDP_{t-1}} ProductivityShocks_{j,t}$$

In 2021, sum of top-10 firms' sales was 54 percent of GDP. Assuming the top-10 firms have the same level of productivity shocks in 2021 for simplification, 100 units increase in ScaledShocks(Top 10)t translates to 1.85 percent increase in labor productivity. As a result, 1.85 percent increase in labor productivity by top 10 firms is associated with 0.34 percentage point increase in real GDP growth.

The regression coefficient for Novo Nordisk firm-specific shock in (1) in Table 4 suggests that one unit increase in weighted Novo Nordisk labor productivity shock leads to 0.0003 unit increase in weighted "other firms" shock, statistical significance issue aside. Therefore:

$$\Delta ScaledShocks(Other)_t = 0.0003 \Delta ScaledShocks(Novo)_t$$

Recall that

$$ScaledShocks(Novo)_t = \frac{Sales_{Novo,t-1}}{GDP_{t-1}} ProductivityShocks_{Novo,t}$$

$$ScaledShocks(Other)_t = \frac{Sales_{Other,t-1}}{GDP_{t-1}} ProductivityShocks_{Other,t}$$

Using 6.3 percent Sales to GDP ratio for Novo Nordisk and 0.03 percent of sales to GDP ratio of "other firms" in the sample for 2022, one percent labor productivity shock to Novo Nordisk is associated with 0.06 percent of labor productivity shock to other firms next year.

Similarly, the regression coefficient for pharmaceutical industry interaction term in (2) in Table 4 suggests that one unit increase in weighted Novo labor productivity shock has 0.00962 unit increase additionally in weighted pharmaceutical industry "other firms". Using 0.08 percent of Sales to GDP ratio for pharmaceutical industry "other firms", one percent of labor productivity shock to Novo is associated with 0.75 percent additional increase in labor productivity shock to other firms in the pharmaceutical industry next year.

B. Additional Information on the Second Set of Regressions

Annex I. Table 1. Denmark: List of Firm-Level Control Variables

Control variable	Calculation
Cash flows	Cash flows from operating activities, divided by total assets
Leverage	Sum of short-term and long-term debts, divided by total assets
Loss	Dummy variable that takes the value of 1 when operating income is negative and otherwise.
Size	Natural logarithm of total assets

Annex I. Table 2. Denmark: Regression Results: Impact of Firm-Specific Shocks to the Smaller Firms

	(1) ScaledShocks(Other)$_t$	(2) ScaledShocks(Other)$_t$
ScaledShocks(Novo)$_{t-1}$	0.000339	0.000259
	(1.11)	(0.82)
ScaledShocks(Other)$_{t-1}$	-0.295***	-0.297***
	(-4.53)	(-4.59)
Cash_flow_asset$_{t-1}$	-0.349	-0.337
	(-1.04)	(-1.02)
Leverage$_{t-1}$	0.268**	0.256**
	(2.30)	(2.14)
Loss$_{t-1}$	-0.0501	-0.0462
	(-0.76)	(-0.70)
Size$_{t-1}$	-0.0720	-0.0709
	(-0.97)	(-0.95)
ScaledShocks(Novo)$_{t-1}$* Pharma_Dummy		0.00962**
		(2.30)
Constant	1.022	1.009
	(0.81)	(0.80)
N	7745	7745
R^2		

Note: t statistics in parentheses, * p<0.1, ** p<0.05, *** p<0.01.

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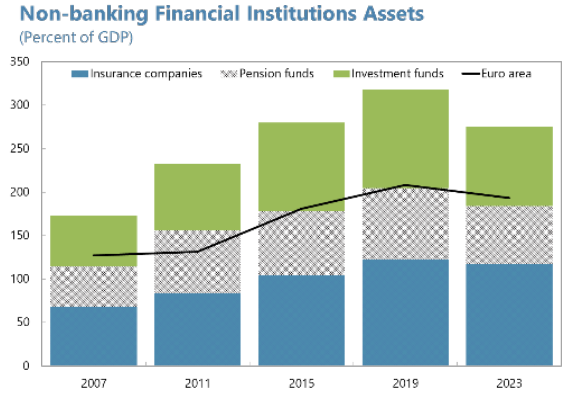
VULNERABILITIES AND RISKS IN DENMARK'S NONBANK FINANCIAL INSTITUTIONS[1]

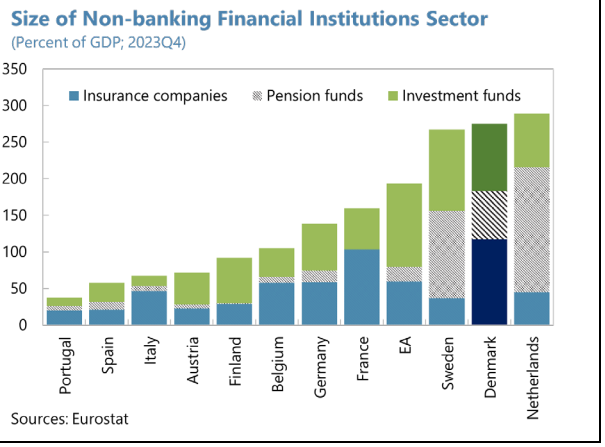
Denmark's nonbank financial institutions (NBFI) sector has substantially increased in size since the Global Financial Crisis (GFC), becoming an important part of the financial system. Systemic risk associated with NBFIs have been contained but warrants close monitoring, especially regarding leverage, liquidity buffers, and interconnectedness. There are important mitigating factors that reduce systemic risk stemming from NBFIs in Denmark. Strengthening of systemic risk assessment and policy framework for NBFIs is warranted and could include developing a systemic risk assessment framework covering both banks and NBFIs and an ensuing system-wide stress testing framework.

A. Introduction

1. Denmark's NBFI sector has tripled in size since the GFC, becoming an important part of the financial system. The NBFI sector, which comprises insurance companies, pension funds, and investment funds, now accounts for almost 300 percent of GDP, making Denmark one of the countries with the largest NBFI sectors in the EU. The increase in size stemmed from significant gains from investment returns and valuation, increased household assets, as well as a search for yield and tighter regulations for banks (Claessens, 2024). As a result, the share of NBFIs in the total assets of the financial system increased from less than 30 percent in 2007 to almost 45 percent in 2023.

Figure 1. Size of the NBFI Sector





2. While there are benefits to the increased role of NBFIs, they may also come with vulnerabilities and risks. On the one hand, NBFIs can complement banks in supporting the real economy through improved risk-sharing, which can help reduce systemic risk (Langfield and Pagano 2016, Claessens 2017). On the other hand, the increased role of NBFIs can expose vulnerabilities associated with interconnectedness, liquidity, and leverage. Higher interconnectedness generally

[1] Prepared by Burcu Hacibedel and Mariusz Jarmuzek. The authors thank participants of the workshop held at the Danmarks Nationalbank for useful discussions and comments.

enhances the resilience of the system subject to a smaller magnitude of shocks (Allen and Gale, 2000), but contagion can become a concern with larger shocks, posing a systemic risk threat (Gai and others 2011, Acemoglu and others 2013). Liquidity challenges can arise when companies sell assets in a downturn and search for yield in an upturn, with amplification stemming from increasing liquidity exposures through margin calls on derivatives (Claessens, 2024). Leverage can act in a procyclical manner and amplify market stress. The interaction between interconnectedness, liquidity, and leverage can generate amplifying negative feedback loops and systemic stress.

3. This chapter assesses systemic risk in Denmark's NBFI sector. Key questions that are addressed include (i) What are the key vulnerabilities associated with NBFIs? (ii) How do they interact with prevalent risks? and (iii) What can be done by policymakers to address these vulnerabilities and risks? To address these questions, the study first documents the growth of the NBFI sector in Denmark and then identifies its key vulnerabilities and risks. Furthermore, the study sheds some light on policy options to address the identified vulnerabilities and risks, drawing on international experiences.

B. Vulnerabilities

4. There has been an increased focus on monitoring financial vulnerabilities in NBFIs for advanced economies. According to the FSB (2021) and the IMF (2017), financial vulnerabilities represent the accumulation of imbalances, which if interacted with shocks, may lead to systemic disruption. Reflecting financial stability risks associated with NBFIs identified in the literature, the IMF (2023) and the FSB (2023) have highlighted asset prices, leverage, liquidity, and interconnectedness as key vulnerabilities that warrant close monitoring in advanced economies. In this context, the Fed (2024) has recently emphasized the need to monitor systemic risk stemming from NBFIs, especially in terms of liquidity and interconnectedness. Finally, the ESRB (2022), the IMF (2024), and the ECB (2024) have also singled out vulnerabilities associated with commercial real estate (CRE) for NBFIs in European economies.[2]

Asset Prices

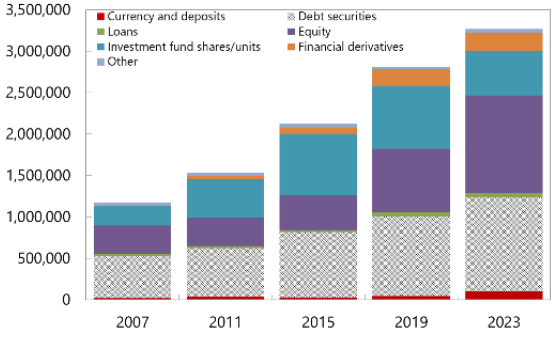
5. There are sizeable exposures to asset prices. Drawing on the FSB (2021), high exposure to debt securities and equities makes Danish NBFIs susceptible to market risk because of potential marked-to-market losses and volatility, incomplete hedging, and misalignment in collateral values. Zooming in on debt securities exposures, there has been a significant asset allocation to covered bonds issued by mortgage credit institutions (Box 1). This indirectly exposes NBFIs to fluctuations in real estate markets, although direct exposures in terms of property holdings are relatively small. Insurance companies and pension funds face exposures to investment funds, with investment funds being increasingly exposed to each other. This in turn increases their susceptibility to amplification in market volatility.

[2] Analysis of vulnerabilities is based on data sourced from sectoral accounts published by Danmarks Nationalbank and Eurostat respecting their definitions of sectors.

Figure 2. Asset Holdings

Asset Holdings of Insurance Companies

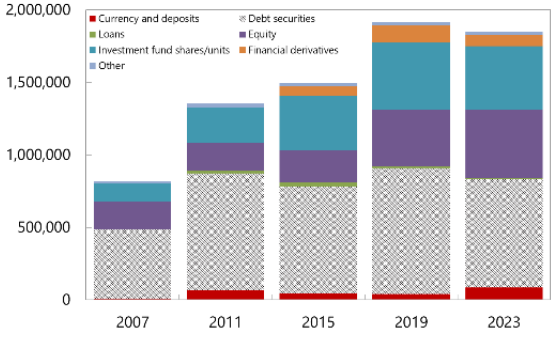
(Millions of DKK)



Sources: Eurostat and DN

Asset Holdings of Pension Funds

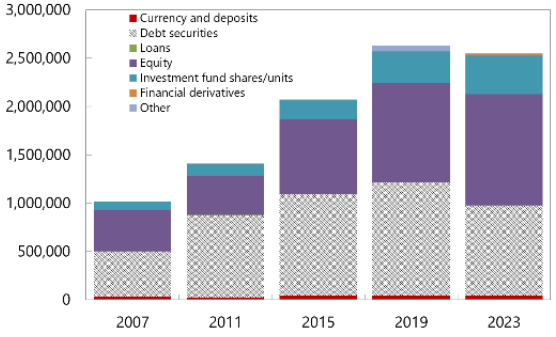
(Millions of DKK)



Sources: Eurostat and DN

Asset Holdings of Investment Funds

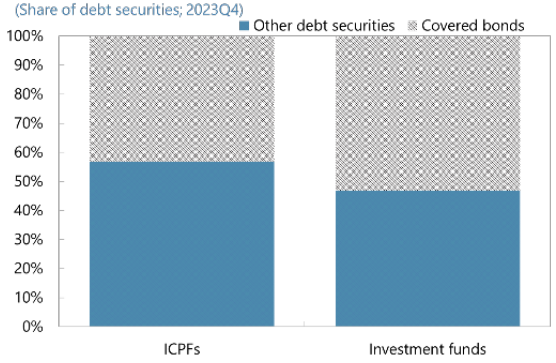
(Millions of DKK)



Sources: Eurostat and DN

Covered Bonds

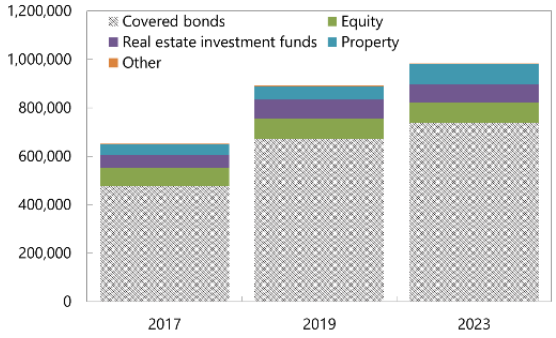
(Share of debt securities; 2023Q4)



Sources: DN

Exposure of ICPFs to Real Estate

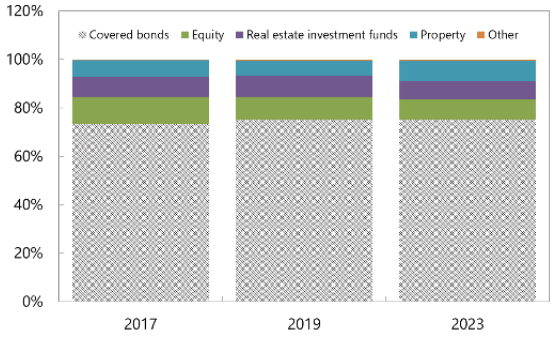
(Millions of DKK)



Sources: EIOPA

Real Estate Investments

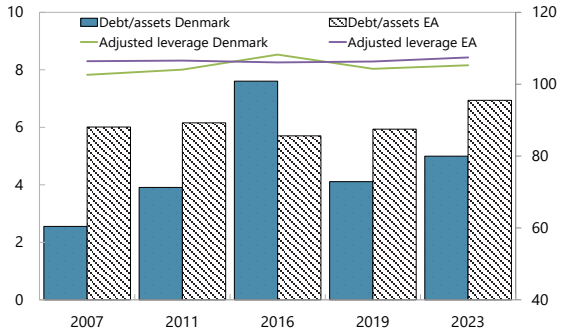
(Share of total real estate investments)



Sources: EIOPA

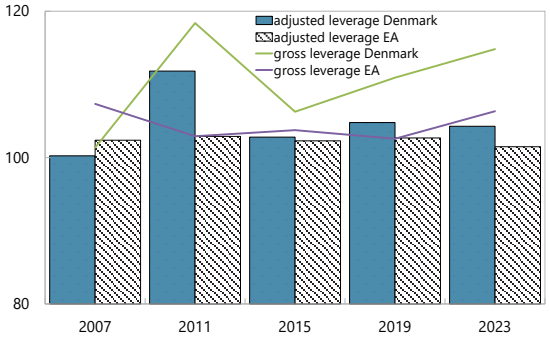
Figure 3. Leverage

Leverage of Insurance Companies
(Percent)



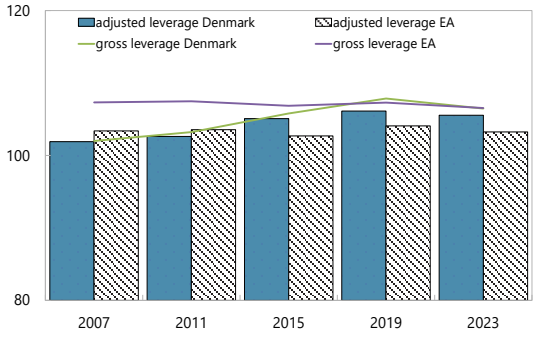
Sources: Eurostat, DN

Leverage of Pension Funds
(Percent)



Sources: Eurostat, DN

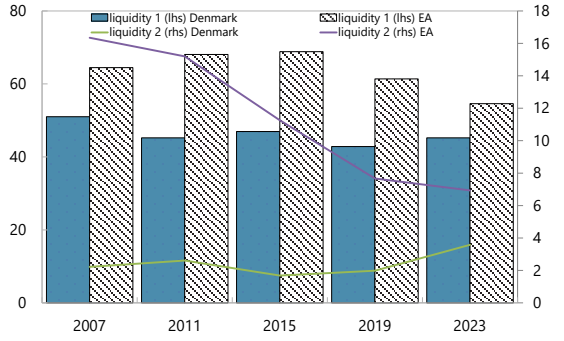
Leverage of Investment Funds
(Percent)



Sources: Eurostat, DN

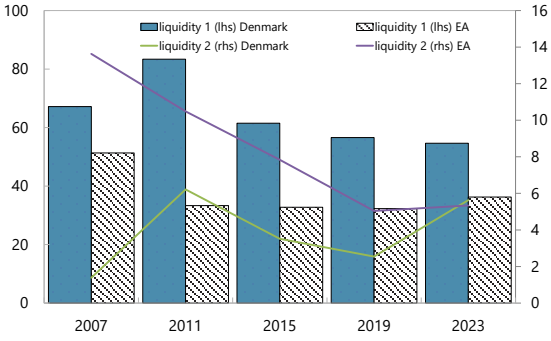
Figure 4. Liquidity

Liquidity of Insurance Companies
(Percent)



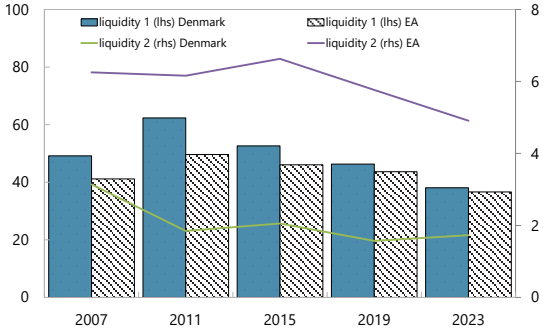
Sources: Eurostat, DN

Liquidity of Pension Funds
(Percent)



Sources: Eurostat, DN

Liquidity of Investment Funds
(Percent)



Sources: Eurostat, DN

Leverage

6. While leverage has increased, its level does not seem to be excessive. The concept of leverage for insurance companies and pension funds is less established compared to banks and investment funds, so there is no common definition for them (EIOPA, 2018). For insurance companies, a general measure of leverage defined as a ratio of debt to assets (IAIS, 2022) suggests an increase in leverage for Denmark since the GFC, but its level tends to be lower compared to the EA average.[3] For pension and investment funds, we employ a measure of leverage defined as a ratio of assets under management to net asset values (gross leverage), with adjusted leverage excluding derivatives (ESMA, 2024). These measures show that leverage has increased but only slightly above the EA average in these two segments.

Liquidity

7. Liquidity buffers are sizeable if covered bonds are included as part of liquid assets. Following the EIOPA (2018) and the ESRB (2018), liquidity buffers are proxied as a share of cash, deposits, and debt securities, including covered bonds (liquidity 1), and cash and deposits (liquidity 2) in total assets. The liquidity 1 indicator suggests that the liquidity buffer is above the EA average for pension funds and at par for investment funds. However, the liquidity buffer of insurance companies in Denmark falls short of that in the EA average. When excluding debt securities, the liquidity 2 indicator indicates that liquidity buffers are lower compared to the EA average, especially for investment funds, but converging to the EA average levels for all the segments.

Interconnectedness

8. There is a high degree of domestic and cross-border interconnectedness.

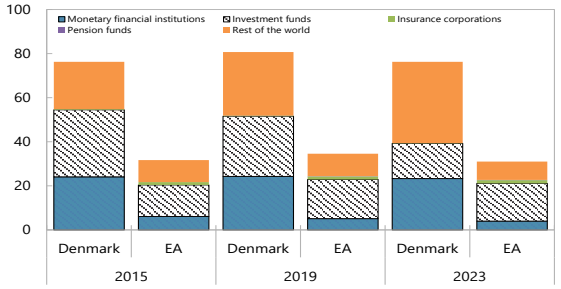
- Domestic interconnectedness is defined in terms of exposures of NBFI segments vis-à-vis the domestic financial sector. For insurers and pension funds in Denmark, there is a significant interdependence with investment funds, such that market pressures forcing investment funds to sell their assets could impact insurers and pension funds. The latter may need to sell their assets as well, amplifying the cycle and triggering an adverse feedback loop. In addition, Danish NBFIs are more interconnected with banks through holdings of covered bonds compared to the EA average (EIOPA, 2023), potentially making them more susceptible to real estate markets and market pressures.
- Cross-border interconnectedness is defined in terms of exposures of NBFI segments vis-à-vis the rest of the world. For insurers and investment funds, a substantial portion of their cross-border asset allocation is in equities and debt securities, exposing them to fluctuations in the global financial markets. Furthermore, there is also substantial interdependence with the rest of the world through large exposures to a few countries such as the U.S., the UK, Luxembourg, and Ireland. This raises the issue of common exposure and transmission of market shocks from abroad.

[3] EIOPA (2018) suggests additional indicators as proxies of leverage for insurance companies.

Figure 5. Interconnectedness

Interconnectedness of Insurance Companies

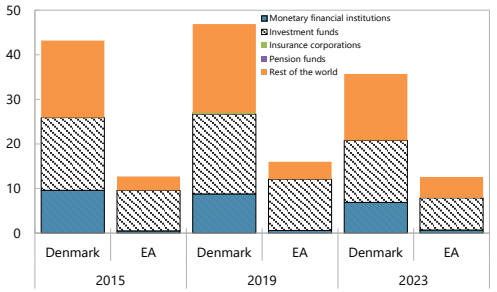
(Percent of GDP)



Sources: Eurostat

Interconnectedness of Pension Funds

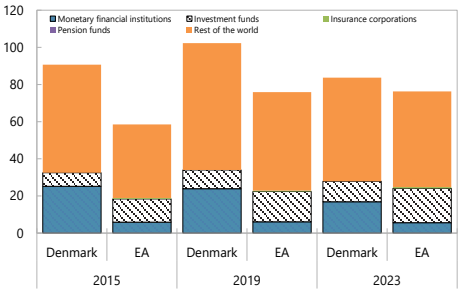
(Percent of GDP)



Sources: Eurostat

Interconnectedness of Investment Funds

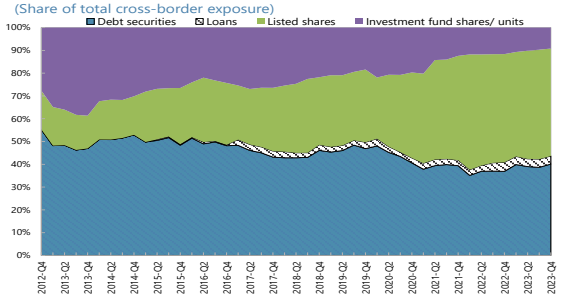
(Percent of GDP)



Sources: Eurostat

International Interconnectedness of Insurance Companies

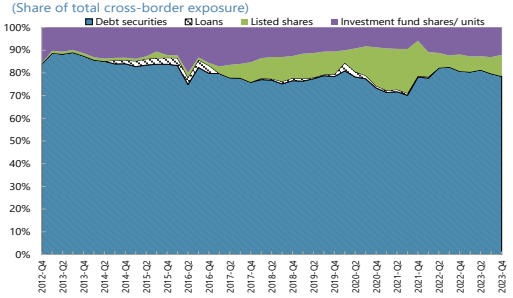
(Share of total cross-border exposure)



Sources: Eurostat

International Interconnectedness of Pension Funds

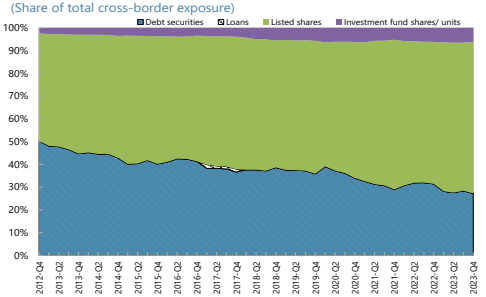
(Share of total cross-border exposure)



Sources: Eurostat

International Interconnectedness of Investment Funds

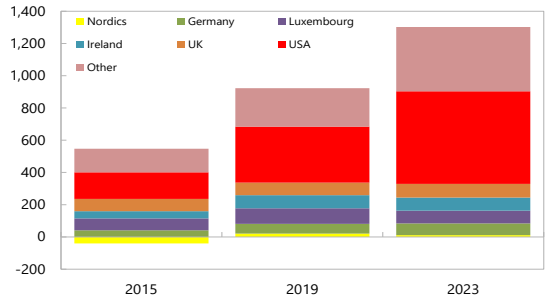
(Share of total cross-border exposure)



Sources: Eurostat

Cross-border Investments of Life Insurance Companies

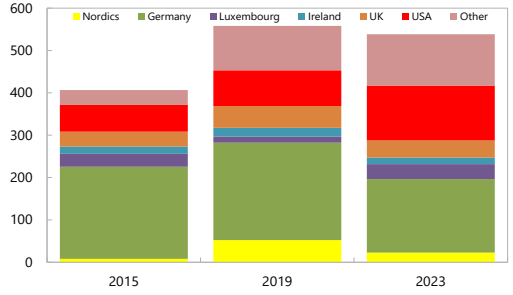
(Billions of DKK)



Sources: DN

Cross-border Investments of Pension Funds

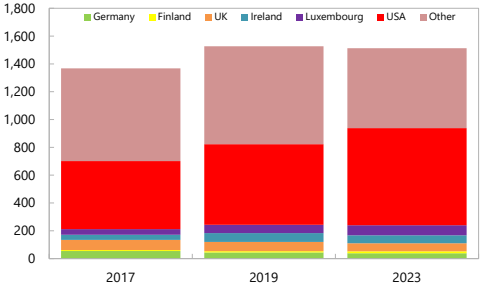
(Billions of DKK)



Sources: DN

Cross-border Investments of Investment Funds

(Billions of DKK)



Sources: DN

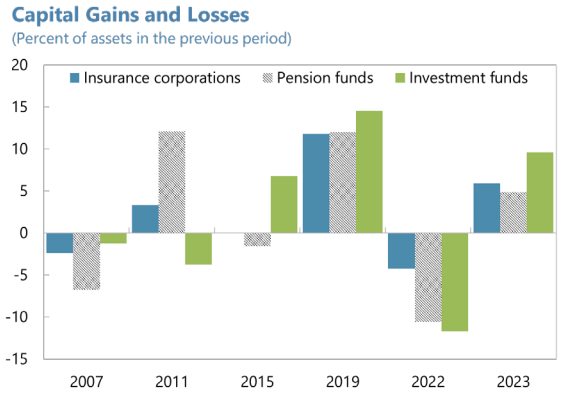
C. Risks

9. An integral element of systemic risk assessment involves identifying key risks. While vulnerabilities may increase the likelihood that a shock leads to systemic disruption in the financial system, systemic stress is unlikely to occur without the substantial materialization of a shock (FSB, 2021). The EIOPA (2024) and the ESRB (2024) have identified market and credit risks as the main risks for NBFIs in the EU countries. In addition, Denmark might also be subject to a macro-financial risk attributed to a sizeable wealth effect (IMF, 2018, see below), with the joint materialization of these risks potentially being particularly detrimental. If these risks were to materialize, they could test the resilience of the Danish financial system. Annex 1 presents a stylized illustration of interdependencies within the financial system of an advanced economy, providing insights into the role of NBFIs in shock propagation during stress episodes.

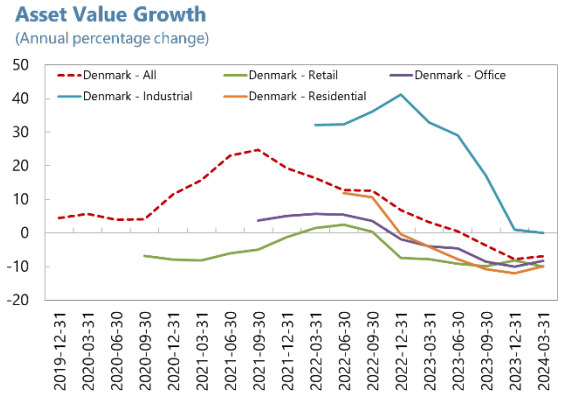
Market Risk

10. There is still an elevated, albeit declining, market risk for global and European markets associated with the potential for disorderly falls in asset prices. Asset prices may drop because of tight financing conditions and muted growth prospects, which could be amplified by the materialization of geopolitical risks (see IMF, 2024; ESRB, 2024; and EIOPA, 2024). In Denmark, the high exposure of NBFIs to market risk, along with their significant domestic and cross-border interconnectedness, could potentially translate into market stress, leading to subpar NBFI performance. Another risk that may arise is related to CRE for which the cycle may have not yet turned, and therefore, could still potentially experience further stress. There have already been two recent stress episodes that tested the resilience of the Danish NBFIs: the GFC and a sharp financial monetary policy tightening in 2022, which resulted in significant losses incurred by NBFIs. However, the system proved to be resilient.

Figure 6. Market Risk



Sources: Eurostat



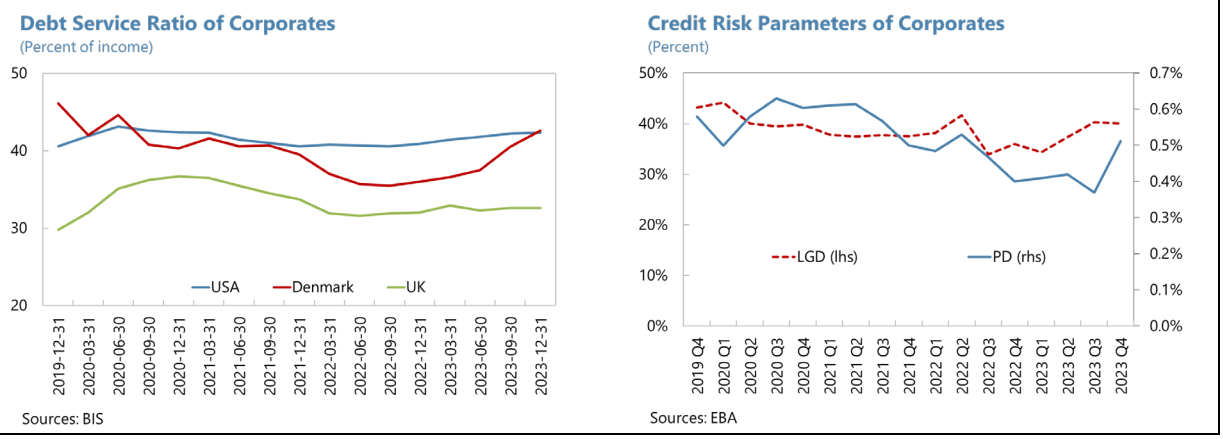
Sources: MSCI

Credit Risk

11. Corporate credit risks remain. The DN (2024) reports that higher interest rates made it more challenging for some Danish corporates to service their debt with earnings, especially in such

sectors as industry, construction, trade, and real estate. This is confirmed by corporate credit risk parameters, including probability of default and loss given default (EBA, 2024). While equity prices have continued to rise over the past couple of years, should economic circumstances surrounding the corporate sector deteriorate in Denmark and key advanced economies, downward pressure on equity markets would resurface. This could, in turn, adversely affect the value of equities held by Danish NBFIs.

Figure 7. Credit Risk



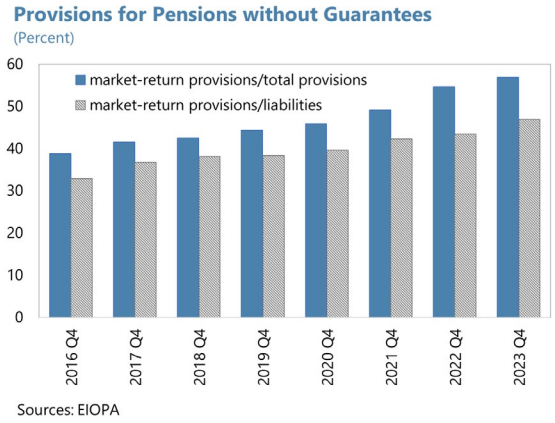
Macro-Financial Risk

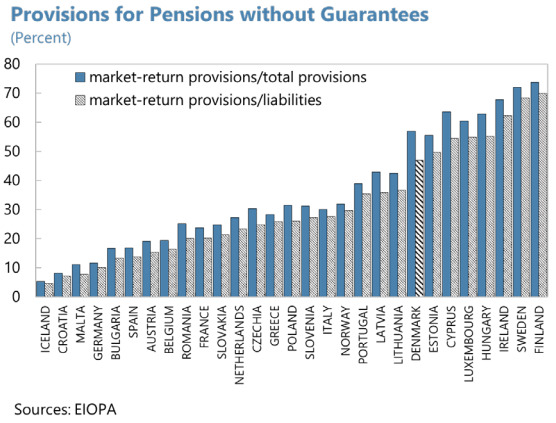
12. Denmark could potentially be prone to a significant wealth effect. Danish households have very large assets combined with a high level of household debt (IMF, 2018). Under an adverse scenario involving losses in household wealth, Denmark is estimated to be markedly impacted in terms of private consumption, reflecting a strong wealth effect (Hviid and Kuchler, 2017). This effect is stronger for Denmark than for most of other advanced economies, especially when combining the financial asset and housing wealth effects (Slacalek, 2009). This is confirmed by the experience of the GFC showing that household consumption in Denmark dropped by more than 6 percent in 2008 (Andersen and others, 2016).

D. Mitigating Factors

13. There are critical mitigating factors that reduce systemic risk stemming from NBFIs in Denmark. Pension companies hold one of the highest shares of non-guaranteed market return products in Europe: these products account for about 50 percent of total liabilities. This significantly mitigates the impact of market and credit risk materialization on their solvency and liquidity position. In addition, while there is a significant exposure to real estate markets, it is primarily an indirect exposure, mainly through covered bonds, which have demonstrated considerable resilience even during stress episodes (Box 1). This resilience has played an important role for the liquidity risk management of investment funds, given their sizable holding of covered bonds. Lastly, NBFIs play a limited role in the credit market, with their credit provision accounting for only around 10 percent of GDP.

Figure 8. Mitigating Factors





E. Policy Options

14. The authorities could consider strengthening their systemic risk assessment and policy framework for NBFIs. Specifically, the authorities could (i) consider developing a comprehensive systemic risk assessment framework covering both banking and nonbanking institutions and (ii) consider developing a system-wide stress testing framework combining banking and nonbanking institutions.[4]

Systemic Risk Assessment

15. Implementing a comprehensive systemic risk assessment framework that covers both banks and NBFIs is crucial for countries with sizeable and interconnected financial systems. Central banks in advanced economies and international financial institutions have expanded the coverage of vulnerabilities and risks in NBFIs in their systemic risks assessment exercises.

- Financial stability reviews now routinely include systemic risk assessments for NBFIs, as seen in the reports from the Central Bank of Ireland (2024), the Bank of England (2024), and the Bank of Canada (2024).

- In the Netherlands and Sweden, where the NBFI sector is as sizable as in Denmark, the Dutch Central Bank (2024) and the Riksbank (2024) explicitly and extensively discuss emerging risks associated with NBFIs.

[4] In addition, there are ongoing policy initiatives to develop a macroprudential policy toolkit for NBFIs at the EU level (EC, 2024). For insurance companies and pension funds, the EIOPA has proposed incorporating macroprudential perspective into the Solvency II framework. The currently considered options include introducing dividend restriction or suspension, adding powers to reinforce liquidity position, and introducing temporary redemption rights for policy holders (EIOPA, 2021). The EIOPA (2020) also proposed to consider adding capital surcharge for systemic risk and introducing concentration thresholds. For investment funds, there are proposals aiming at addressing systemic risks related to liquidity mismatches and leverage (ESRB, 2017, 2020, 2022), which include activity-based measures, entity-based measures, and liquidity management tools. Furthermore, there are also ongoing efforts to address risks associated with margining practices and risk management of central counterparties (EC, 2022).

- The FSB (2021) has built a framework relying on a set of indicators covering asset prices, leverage, liquidity, and domestic and cross-border interconnectedness. The Central Bank of Ireland (2023) publishes a comprehensive heatmap gauging systemic risk arising from NBFIs as part of the Systemic Risk Pack at least once a year.

Stress Testing

16. An integral element of systemic risk assessment embedding NBFIs also includes developing a system-wide stress testing framework. In line with the EC (2010), both the FSB (2021) and the EIOPA (2019) advocate for system-wide stress tests to gauge the impact of NBFIs on systemic risk.

- ESMA (2019, 2020) provides guidelines for developing a stress-testing liquidity framework for investment funds.

- The ECB (2024) has recognized an important role played by NBFIs in their systemic risk assessments. They have started making explicit quantitative assessments of risks associated with NBFIs.

- The BoE (2023) has launched a stress test combining banks and NBFIs, with the latter including insurers, pension funds, investment funds, and central counterparties. The key objectives of the exercise are to enhance understanding of the risks posed by and to NBFIs and the behavior of NBFIs and banks in stress. This includes analyzing the drivers of such behaviors and investigating how these behaviors, along with market dynamics, can amplify market shocks and potentially pose risks to financial stability. Importantly, the efforts are carried out in collaboration with microprudential supervisors.

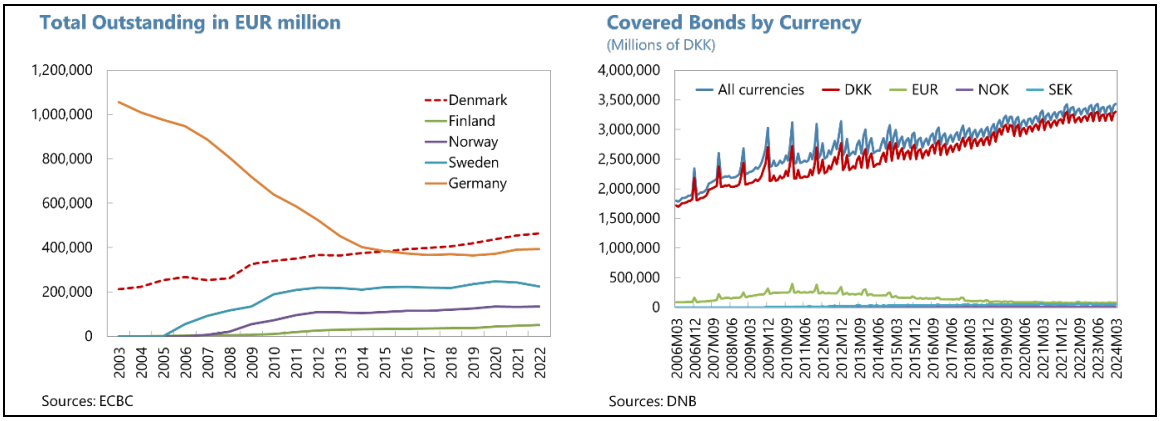
F. Conclusions and Policy Considerations

17. Systemic risk associated with NBFIs in Denmark appears to have been contained but requires close monitoring. Denmark's NBFI sector has substantially increased in size since the GFC, becoming an important part of the financial system. While there are benefits of the increased role of the NBFI sector, they may come with risks. Supervisors need to closely monitor leverage, liquidity buffers, as well as domestic and cross-border interconnectedness. Importantly, there are mitigating factors that reduce systemic risk stemming from NBFIs in Denmark. These include a high share of non-guaranteed market-return products and NBFIs' limited direct exposure to real estate markets and credit extension.

18. Strengthening of systemic risk assessment and policy framework for NBFIs is warranted. Many central banks in advanced economies and international financial institutions have expanded the coverage of vulnerabilities and risks in NBFIs in their systemic risk assessment exercises. Given the identified vulnerabilities and prevalent risks in Denmark, the authorities could consider developing a comprehensive systemic risk assessment framework covering both banks and NBFIs, which would subsequently pave the way for developing a system-wide stress testing framework combining banking and nonbanking institutions.

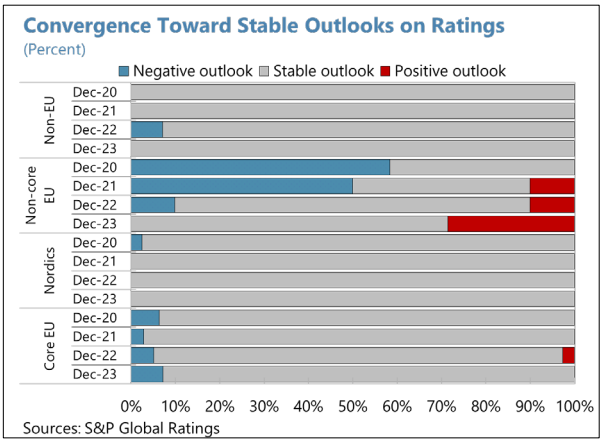
Box 1. An Overview of the Danish Covered Bond Market

Denmark's covered bond market is globally the largest with an outstanding issuance of €436 billion (about 123 percent of GDP) as of end-2023. Unlike other covered bond markets in Europe, it is predominantly denominated in Danish Krone (DKK), with 96.8 percent of the total outstanding, while Euro (EUR) and Swedish Krona (SEK) each account for 1.6 percent. The market is divided into callable bonds, bullet bonds, and floaters with or without a cap. Although there is a high number of securities, most of the market value is concentrated in a few large series, with the majority issued by three large banks.



Compared to other European mortgage systems, the Danish system stands out in several areas. The Danish match funding is a notable difference and forms the basis of Danish covered bond legislation. The legislation complies with European standards and is among the most stringent, especially regarding the asset liability management risk. Mortgage banks offer pass-through products, thus eliminating the credit and market risk. The pass-through principle also implies that Danish mortgage borrowers may terminate their loans by buying back the mortgage bonds that fund their loans in the bond market and delivering them to their mortgage bank. This option, known as the delivery option or the buyback option, applies to all mortgage bonds, whether they are callable or non-callable. Risk ratings have remained stable even when other European markets experienced ratings deterioration in recent years. In this respect, Danish covered bonds are considered safe assets and have never defaulted.

Credit ratings of covered bonds have generally been stable, with over 90 percent of issuers maintaining a stable or positive rating outlook. This stability is further reinforced by additional notches that provide buffers against potential downgrades of the issuer's credit rating. Thus, while covered bonds are structured to minimize risk through dual recourse and are generally well-rated, their safety is not absolute and is closely tied to the financial health and credit rating of the issuers. Tracking the interconnectedness risk is of key importance.



The Danish covered bond market follows the guidelines and principles set out by the European Covered Bond Council (ECBC). The asset pool consists of both residential and commercial real estate with maximum loan-to-value limits at 80 percent and 60 percent, respectively. Overcollateralization exceeds the ECBC's minimum requirement of 2 percent; however, there is no official limit on commercial real estate assets in the asset pool.

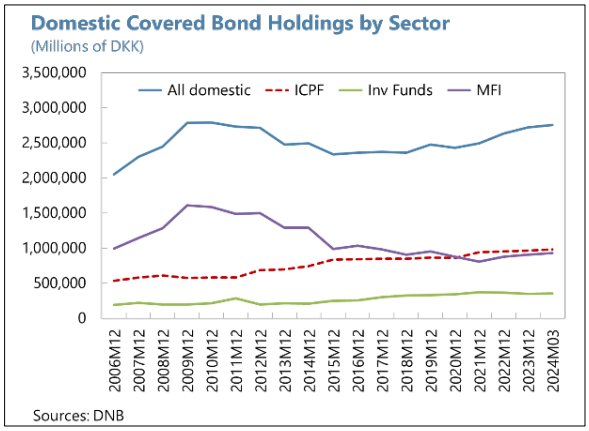
While covered bonds have had low risk with no default to date, they have not gone through global crises unscathed. During the global financial crisis (GFC) in 2008, the Danish covered bond market experienced a sudden liquidity dry-up, and as a result, the Danmarks Nationalbank intervened to ensure continuity in the market.

Box 1. An Overview of the Danish Covered Bond Market (concluded)

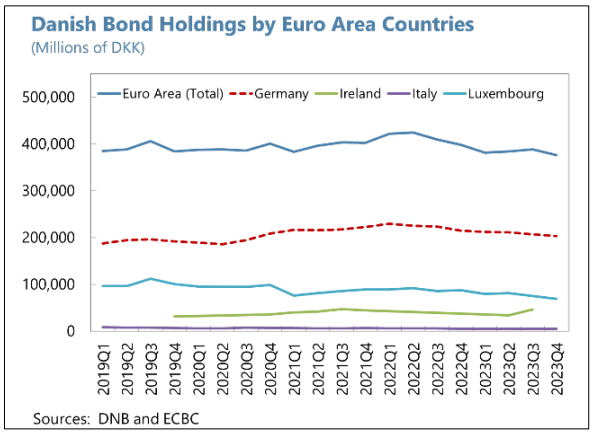
Buchholst, Gyntelberg, and Sangill (2010) show that, despite this liquidity shock, covered bonds behaved similar to government bonds in turmoil periods. Similarly, at the onset of the Covid pandemic in 2020, covered bonds experienced a widening of spreads, indicating reduced liquidity and trading; however, the market recovered rapidly.

Since the GFC, there have been two significant changes in the Danish covered bond market concerning the investor profile: a change in the domestic investor base and an increased presence of foreign investors.

Domestic investors' covered bond holdings have increased to GFC levels in March 2024 at about DKK 2.8 billion. The sectoral composition has changed, particularly among banks (MFI), insurance companies and pension funds (ICPF), and investment funds. Banks decreased their share from 58 percent in 2009 to 34 percent in 2024, while ICPFs' share increased from 21 to 35 percent during the same period. Investment funds experienced a smaller increase from 9 to 13 percent.



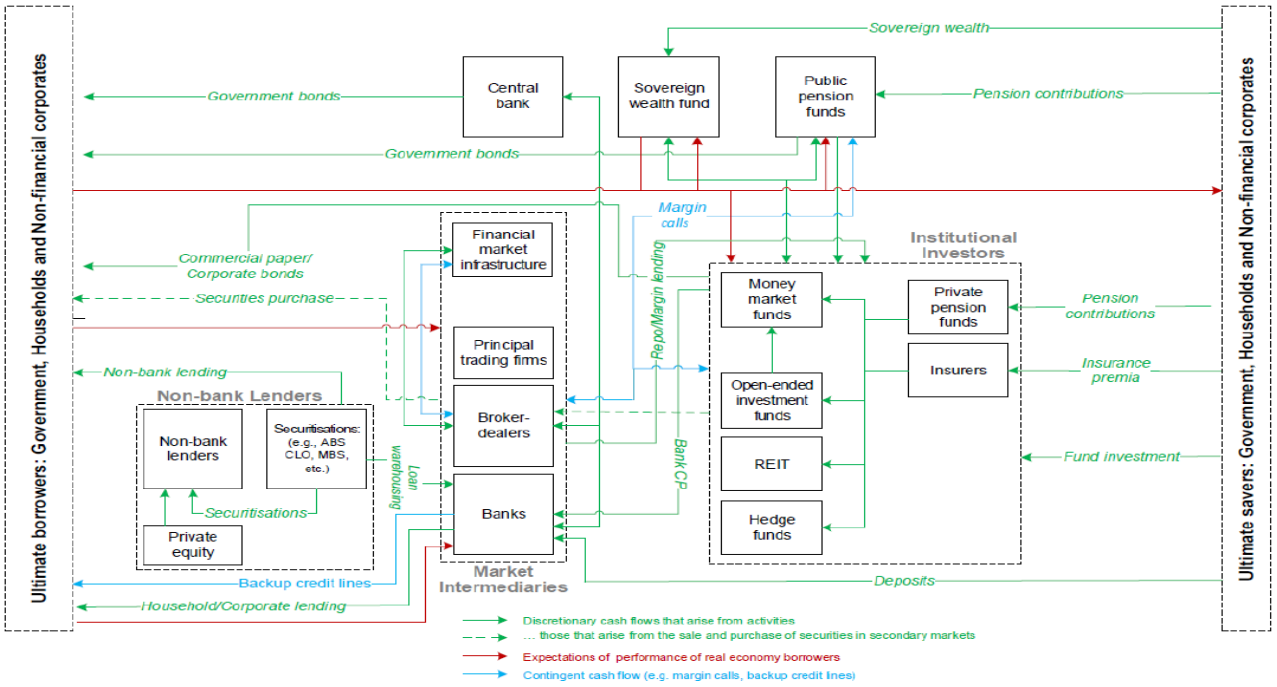
Secondly, foreign ownership of Danish covered bonds has notably increased since the GFC. Since 2008, the share of foreign holdings rose significantly from 9 to 25 percent of total outstanding Danish covered bonds. This is slightly lower than its peak at 33 percent of total covered bonds in 2020 and 2021. Euro Area countries constitute about 56 percent of foreign holdings with the largest investments sourced from Germany, Luxembourg, Ireland, Italy and Finland as of end-2023. Asian countries, in particular Japan, have also increased their holdings. The currency mismatch risk is low, considering that about 96 percent of the covered bonds are denominated in DKK, implying that foreign holdings are mostly DKK-denominated.



Overall, Denmark's covered bond market remains stable with changes in its underlying dynamics. Any vulnerabilities and risks should continue to be monitored by the authorities to contain the systemic risk, including the continuous review of the macroprudential policy stance, to safeguard the financial system.

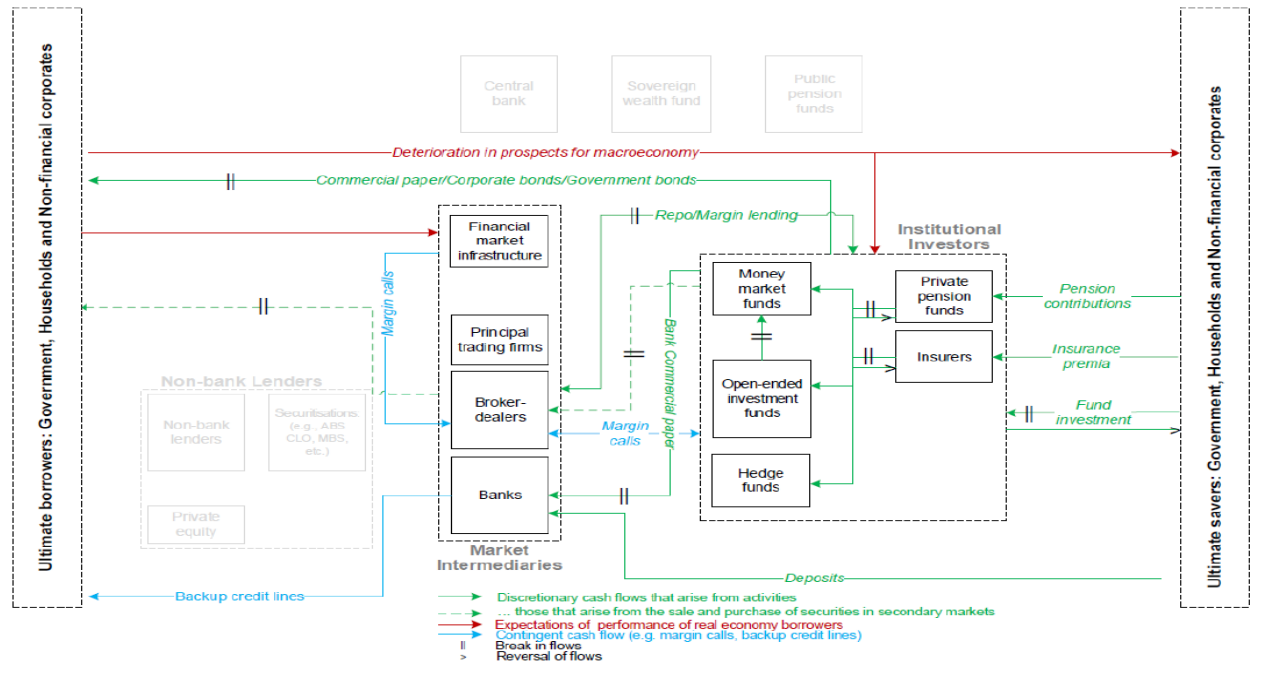
Annex I. Interconnectedness of the Financial Sector

Interconnectedness of NBFIs for a Stylized Advanced Economy



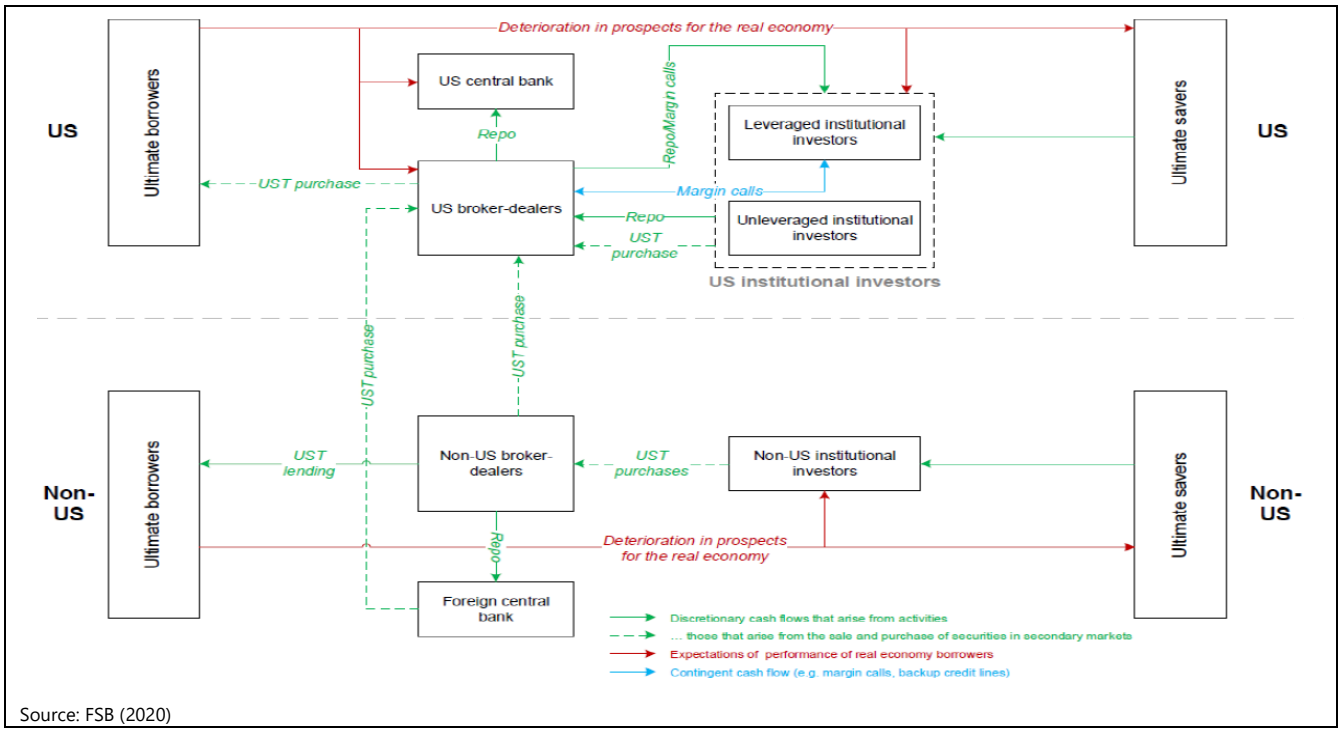
Source: FSB (2020)

Propagation Through Short-Term Funding Markets



Source: FSB (2020)

Propagation Through Core Government Bond Markets



Source: FSB (2020)

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