3. HOW DO BANKS AND INVESTMENT FUNDS REACT TO INTEREST RATE SHOCKS? EVIDENCE FROM LUXEMBOURG

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ABSTRACT

This study provides an assessment of how banks and investment funds in Luxembourg react to interest rate shocks and whether there are differences in their respective reactions. We adopt the local projections approach following Jordà (2005) in order to link the response of bank or investment fund balance sheets to both shocks in both short- and long-term interest rates. Results suggest that banks and investment funds react differently depending on whether the shock arises from the short-term interest rate or from the long-term interest rate. More specifically, following shocks to the short-term interest rate total assets contract more among banks than among investment funds. However, the opposite is observed for shocks to long-term interest rates.

We also assess the impact on different types of bank loans such as loans to non-financial corporations (NFCs), loans to households, mortgage loans, interbank loans and loans to other financial institutions (OFIs). We find that the volume of lending to NFCs and OFIs experience a negative and persistent decline following an increase in the short-term interest rate. This finding is consistent with the credit channel of monetary policy transmission.[43]

Finally, to disentangle which types of investment funds might be more affected by increases in the interest rate, we investigate how responses differ across investment funds specialised in the money market, equity, or bonds, as well as mixed funds, real estate funds and hedge funds. Results suggest that investment funds specialised in money market instruments, equities, derivatives and other debt securities with short maturity are more sensitive to short-term interest rate shocks, while investment funds that invest more in long-maturity debt securities tend to be more affected by shocks to the long-term interest rate.

1. INTRODUCTION

The Covid-19 crisis had a global impact on economic activity. Many segments of the economy were almost completely shut down, resulting in supply shortages and major disruptions in the supply chain. This led to an increase in prices, particularly in sectors dependent on shipping. In addition, the war in Ukraine led to a significant increase in energy prices as well as high volatility in energy markets. These developments contributed to a significant and persistent rise in inflation. As a result, many central banks have increased interest rates, ending the period of very accommodative monetary policy. The new macro-financial environment characterized by higher interest rates and inflation may have significant effects on the financial sector. While Luxembourg bank profitability benefitted from higher net interest income, there was also an increase in provisioning.

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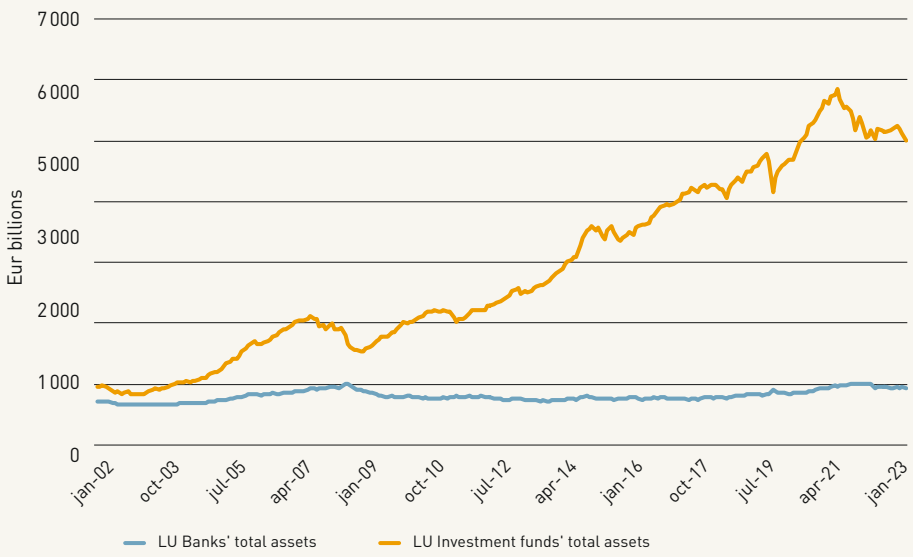
43 Bernanke and Gertler (1995) describe the credit channel as two separate mechanisms, namely the balance sheet (or net worth) channel, which focuses on the impact of interest rate changes on borrowers' balance sheets and income statements, and the bank lending channel that captures the effect of interest rate changes on banks' supply of loans.

Interest rate increases can also affect the value of asset portfolios held by non-banks, in particular bond funds since higher interest rates mechanically affect bond yields. The increase in yields results in valuation losses, also for other assets that are sensitive to interest rates.

Rising interest rates affected total assets of Luxembourg banks and investment funds. With regard to banks, their total assets were 954 billion euros at the end of 2021 but declined to 938 billion euros at the end of 2022, a contraction of -1.62%. Regarding investment funds, total net assets declined 14% from 2021 to 2022 (Figure 1).

Figure 1:
Bank and investment fund total assets in Luxembourg



Source: BCL Statistics.

Investment fund share valuations may also be affected by higher interest rates as funds' debt securities holdings are interest rate sensitive. For example, interest rates and bond prices are inversely related, so when monetary accommodation ends, bond prices decline. In a higher interest rate environment, new bonds are issued at lower prices (i.e. higher yields) and older bonds issued at lower interest rates become less valuable. This is because investors can purchase new bonds with higher interest rates, thereby receiving a better return on investment. The interest rate dynamics can therefore have important valuation effects for funds.

This study assesses how banks and investment funds in Luxembourg have responded to the higher interest rate environment. The assessment adopts two types of interest rate shocks. The first one relates to short-end yield curve shocks and represents changes in the short-term nominal interest rate, while the second focuses on the long-end of the yield curve and is approximated by changes in long-term interest rates (i.e. in 10-year German Bunds). Since the responses to both the short- and long-term rates could be heterogeneous across different asset classes, we explicitly distinguish between the effects on banks and investment funds based on loan counterparties and types of investment fund.

Our analysis adopts the local projections method developed by Jordà (2005). The interest rate shocks are identified using Altavilla *et al.* (2019)'s approach with a focus on changes in high-frequency data around interest rate events. The results highlight that both banks and investment funds' assets are sensitive to interest rates shocks and suggest that bank and investment fund balance sheets contract when monetary accommodation ends. However, banks' and investment funds' balance sheets react differently and depend on whether the shock is to the short- or long-term interest rate. In other words, short- and long-term interest rate shocks result in different impacts on their portfolio exposures. Banks tend to be more impacted by positive short-term interest rate shocks than by long-term rate shocks. More specifically, following a positive short-term rate shock, the decline in the total assets of banks is more pronounced and more persistent than following a positive long-term rate shock.

On the contrary, even if the initial decline in the total assets of investment funds following a positive short-term rate shock is smaller than that for banks, the response of total assets of investment funds following a positive long-term rate shock is more substantial. We also highlight the heterogeneity of responses according to the different counterparty types for bank loans (i.e. loans to households and loans to NFCs) as well as across the different types of investment funds in Luxembourg.

This study has several contributions. First, it provides a comprehensive assessment of the potential risks related to increases in interest rates in Luxembourg for both the banking and investment fund sectors. In this context, the study examines the effects of higher interest rates on the bank lending channel. According to the bank lending channel, higher interest rates will increase the opportunity cost of holding deposits and will reduce bank lending on account of the relative shortfall in funding sources, especially deposits. Several studies support the relevance of the bank lending channel (see for example Altunbas *et al.* (2009) or Holm-Hadulla and Thürwächter (2021)). However, since the increase in the total assets of the non-bank intermediaries over the last decades, the bank lending channel may have become less relevant (Beck *et al.* (2016)).

The literature on the effect of interest rate shocks on non-bank balance sheets is still limited. One strand of the literature explores the risk-taking channel or search for yield behaviour, as in Borio and Zhu (2012). The risk-taking channel relates to a behavior such that, based on following changes in central bank policy rates and a higher risk appetite, investors seek assets and investment strategies that generate higher returns. The data covers the period from 2021 until October 2023 and therefore captures the effects of the recent normalization of monetary policy by major central banks. Our results may therefore help in assessing the effects of tighter financial conditions on the Luxembourg financial sector.

The rest of the paper is structured as follows. Section 2 provides an overview of the literature on the transmission of interest rate shocks to bank and non-bank balance sheets. In Section 3, we present the data and the methodological approach. Section 4 presents and discusses our empirical results and Section 5 concludes.

2. REVIEW OF THE LITERATURE

The literature on the effects of interest rate shocks is divided into two strands. The first, focuses on banks' balance sheet responses to an interest rate shock. The credit channel theory describes how changes in the interest rate may affect borrower and bank behaviour via the external finance premium. According to Bernanke and Gertler (1995), the external finance premium, defined as the difference in cost between funds raised externally through equity or debt and internally generated funds via earnings, plays a key role in understanding the impact of interest rates on economic agents. The credit channel theory covers two transmission mechanisms, namely the balance sheet or net worth channel, which focuses on the potential impact of changes in interest rates on borrowers' balance sheets and income statements, and the bank-lending channel that captures the possible effect of interest rates on banks' supply of loans. The bank-lending channel stipulates that higher interest rates reduce the credit allocated to the economy by banks, which amplifies the interest rate and asset price channels (Bernanke and Blinder (1992), Bernanke *et al.* (1996), Kashyap *et al.* (1993), Kashyap and Stein (1994), Iacoviello (2005), among others). The IMF Global Financial Stability Report of October 2016 entitled "Monetary Policy and the Rise of Non-bank Finance total assets" provides an assessment of the effects of higher interest rates on non-bank assets. The underlying rationale behind this study is that lower

interest rates result in households shifting their savings out of bank deposits and into the higher yielding liabilities of investment funds, thereby increasing funds' total assets.

The work of Banegas *et al.* (2016) suggests that when the interest rate is low, there are outflows from equity funds and inflows into bond funds, at least in the case of the U.S. Similarly, Hau and Lai (2016) study the responses of equity and money market funds to changes in interest rates in Europe, finding that investors rebalance their portfolios from money market funds towards equity funds in a low interest rate environment. This finding is in line with Bubeck *et al.* (2018), who show that interest rate shocks lead to large asset price and exchange rate effects with a shift of euro area investors into riskier assets. Kaufman (2020) finds that there is an expansion of investment fund balance sheets following lower interest rates in the U.S.

More recently, Holm-Hadulla *et al.* (2023) find evidence that tighter financial conditions, captured by short-term and long-term interest rate shocks, affect bank and investment fund balance sheets differently. Specifically, for short-term interest rate shocks in the euro area, banks exhibit a slightly swifter and more persistent reaction, while for long-term interest rate shocks, investment funds show a stronger and more persistent decline in their total assets.

While our study also examines bank and investment fund responses to both short-term and long-term interest rate shocks, we focus on for the case of Luxembourg. Additionally, we also disentangle the responses of different types of lending (for example loans to non-financial corporations, loans to households, mortgage loans, interbank loans and loans to other financial intermediaries), as well as several types of investment funds (money market funds, equity, bond, mixed, real estate and hedge funds) to interest rate shocks.

3. METHODOLOGY AND DATA

A. EMPIRICAL METHODOLOGY

This section describes the econometric method used to study the effects of the higher interest rate environment on bank and investment fund balance sheets in Luxembourg. We follow Jordà (2005) and adopt the local projections (LP) method, which is common in the literature. For example, Holm-Hadulla *et al.* (2023) recently study a similar question for euro area banks and investment funds using the LP approach.

The LP approach provides impulse response functions (IRFs) via the estimation of regression models that are robust to misspecification and autocorrelation issues. The model estimated in this study is as follows:

$$\boldsymbol{y}(t+h) = \alpha(h) + \beta(h) * \mathbf{IntRate}(t) + \lambda(h) * \mathrm{X(t)} + \varepsilon(t+h)$$

with $\boldsymbol{t}$ and $\boldsymbol{h}$ denoting month and horizon of the IRFs with $0 \leqslant \boldsymbol{h} \leqslant 24$, respectively. $\boldsymbol{y}$ is the dependent variable, namely the logarithm of total bank and investment fund assets, respectively. **IntRate** is the short- and long-term interest rate shocks, and X is a set of Luxembourg specific variables such as real GDP, the GDP deflator , the country level indicator of financial stress (i.e. the CLIFS), the Luxembourg unemployment rate, the Euro STOXX 50 index and the EUR/USD exchange rate, etc. ε is the error term. Additionally, we use the Newey-West standard errors to account for heteroscedasticity and serial

autocorrelation. According to Jordà (2005), the Newey-West correction is similar to the Monte Carlo standard errors from VAR models. All the variables enter in logarithms, except interest rates variables, which are in percent. For the control variables, we include many of them with a lag in order to account for endogeneity. We provide more details in the next section.

B. DATA

To investigate banks and investment funds' responses to interest rate shocks, we draw on several sources of data. First, we use data on bank and investment fund balance sheet size (in terms of total assets) from the Central Bank of Luxembourg (BCL).[44] The data for the interest rate shocks come from the euro area Monetary Policy Event-Study Database of Altavilla *et al.* (2019). This dataset is constructed using high-frequency time series to measure changes in interest rates, sovereign yields, stock prices and exchange rates.

We follow Jarocinski and Karadi (2020), Holm-Hadulla *et al.* (2023) and utilize two types of interest rate shocks, which capture both short-term and long-term interest rate shocks. For the short-term interest rate shocks, we use the surprises in 3-month Overnight Index Swap (OIS) rates, as well as surprises in the 10-year German sovereign yields for long-term rate shocks. The 3-month OIS rates are a proxy for the short-term interest rate since these rates directly impact the short-end of the yield curve, while the 10-year German yields are good proxies for the long-term interest rate as they directly affect the long-end of the yield-curve. Making the distinction between short-term and long-term rate shocks allows us to identify the effects on banks and investment funds in Luxembourg at the different interest rate horizons.

To disentangle between interest rate and central bank information shocks as highlighted by Jarocinski and Karadi (2020), we consider only those OIS interest rates and 10-year German yields that are negatively correlated with the surprises in stock prices as measured by the Euro STOXX 50 index.

With respect to control variables, we include real GDP and the GDP deflator for Luxembourg.[45] However, because these two variables are quarterly in frequency, we linearly interpolate them in order to obtain monthly data. In addition, we also use the Country Level Index of Financial Stress (CLIFS) for Luxembourg taken from the ECB's Statistical Data Warehouse (SDW), and the monthly seasonally adjusted unemployment rate from STATEC. As for the lending cost for non-financial corporations (NFCs), we calculate it as the difference between the average of short, medium and long-term interest rates and the 1-month OIS rate in the spirit of Holm-Hadulla *et al.* (2023).

We also control for surprises in the Euro STOXX 50 index and EUR/USD exchange rates. These variables are likely to be relevant for investment funds' inflows and outflows. Indeed, we find that the exposure of the investment fund sector to exchange rate risk is primarily due to the EUR/USD exchange rate as the share of Luxembourg investment fund assets denominated in US dollars represents the majority share of the sector's total assets.[46] Therefore, any depreciation of the euro with respect to the US dollar is likely to result in an increase in investment funds' net asset value (NAV).

[44] https://www.bcl.lu/fr/statistiques/series_statistiques_luxembourg/11_etablissements_credit/11_05_Tableau.xlsxhttps://www.bcl.lu/fr/statistiques/series_statistiques_luxembourg/13_fonds_investissement/13_02_Tableau.xls

[45] The data come from the Statistical Data Warehouse of ECB using respectively the series: MNA.Q.Y.LU.W2.S1.S1.B.B1GQ._Z._Z._Z.EUR.LR.N and MNA.Q.N.LU.W2.S1.S1.B.B1GQ._Z._Z._Z.IX.D.N

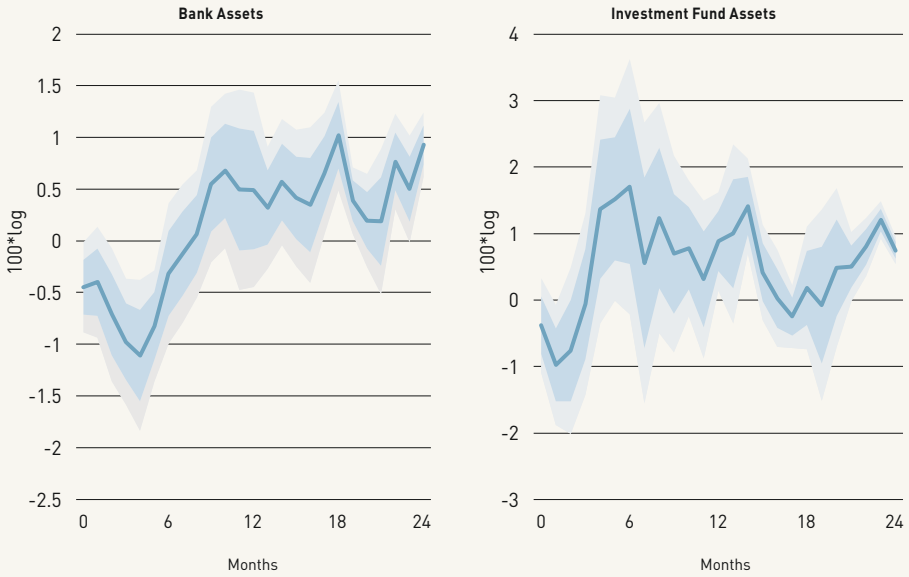
[46] Revue de la Stabilité Financière 2022.

To better understand the effects of interest rate shocks on investment funds, we examine the effect of both the short- and long-term interest rate shocks on different types of investment funds, namely money market funds, equity, bond and mixed funds, real estate funds and hedge funds. We also look at how different types of loans such as loans to NFCs, households, mortgage lending, interbank lending and lending to other financial intermediaries respond to interest rate increases.

Our final sample consists of monthly data for all variables and spans the period from January 2002 to October 2023.[47]

With regard to the selection of the optimal number of lags to be included in the regression models, we apply the Akaike information criterion (AIC), Bayesian information criterion (BIC), and the Hannan and Quinn information criterion (HQIC) lag-order selection statistics. However, the main criterion for selecting the optimal number of lags remains the AIC. We find that for the surprises in the 3-month OIS rates (i.e. the short-term rate shock) the optimal number of lags is 2 according to all three criteria (namely the AIC, SBIC and HQIC). For the surprises in the 10-year German yields, which capture long-term rate shock, the optimal number of lags is found to be 3 based on the AIC. For the logarithm of real GDP and GDP deflator, the optimal number of lags is 4 under all three criteria. For the surprises in the Euro STOXX 50 index and EUR/USD exchange rate, the optimal number of lags is 0 under all criteria. For the variable capturing the level of financial stress in Luxembourg as measured by CLIFS, the optimal number of lags is 4 according to the AIC. Similarly for the lending rate for NFCs, the optimal number of lags is 4 based on the AIC. The next section provides the results.

Figure 2:
Bank and investment fund responses to a 1pp short-term interest rate shock



Source: BCL.

Note: 68 % (blue-shaded areas) and 90 % (gray-shaded areas) confidence bands displayed.

4. RESULTS

A. RESPONSES OF BANKS AND INVESTMENT FUNDS

This section investigates the bank lending and risk-taking channels of interest rate shock transmission in Luxembourg. Figure 2 shows the impulse response functions (IRF) for banks and investment funds following a short-term interest rate shock. Tables 1 and 2 detail the impacts of short- and long-rate shocks on banks and investment funds, respectively. The total assets of banks and investment funds significantly contract after a short-term rate shock. However, there are differences in their responses. First, the initial response of banks

[47] The data is limited until October 2023 because interest rate surprises are not available after this period. However, the model and results will be updated when the Euro Area Interest rate Event-Study will be updated.

is greater than for investment funds. Immediately following a 1 percentage point positive short-term interest rate shock, banks' total assets contract by 0.45%, corresponding to a contraction of 3 billion euros. In contrast, the immediate response of investment funds is a decline of 0.38%, corresponding to a contraction of 19.03 billion euros in total assets. Second, a 1 percentage point increase in the 3-month OIS rate results in a maximum decline of 1.11% of banks' total assets around the fourth month, which corresponds to a contraction of more than 10.44 billion euros. However, for the investment funds, the same shock results in a maximum decline of 0.976% after 1 month following the short-term interest rate shock. Banks therefore appear to be more adversely affected by an increase in the short-term interest rate compared to investment funds.

Table 1 :

Bank responses to a 1pp short- or long-term interest rate shock

	H = 0	H = 1	H = 2	H = 3	H = 4	H = 5	H = 6	H = 7	H = 8	H = 9	H = 10	H = 11	H = 12
OIS 3 M	-0.45	-0.40	-0.71	-0.98*	-1.11*	-0.83*	-0.32	-0.13	0.07	0.55	0.68	0.50	0.49
	0.27	0.33	0.39	0.37	0.44	0.33	0.41	0.41	0.38	0.46	0.46	0.59	0.57
DE 10 Y	-0.43	0.11	-0.05	-0.31	-0.47	-0.44	-0.55	-0.25	-0.10	0.03	0.30	0.89	0.94
	0.37	0.36	0.35	0.30	0.35	0.49	0.56	0.48	0.48	0.45	0.42	0.46	0.49

	H = 13	H = 14	H = 15	H = 16	H = 17	H = 18	H = 19	H = 20	H = 21	H = 22	H = 23	H = 24
OIS 3 M	0.32	0.57	0.41	0.35	0.65	1.02**	0.39	0.20	0.19	0.77*	0.50	0.93**
	0.36	0.37	0.40	0.46	0.36	0.32	0.20	0.27	0.43	0.28	0.31	0.19
DE 10 Y	0.49	0.35	0.20	0.17	0.38	0.44	0.32	0.00	-0.13	0.16	0.15	0.32
	0.41	0.30	0.42	0.76	1.23	1.17	0.90	0.59	0.61	0.30	0.48	0.53

Note: BCL calculations. Standard errors in parentheses.
**** p<0.01, ** p<0.05, * p<0.1. Newey-West standard errors are in parentheses. Note that all the regression specifications include control variables with their respective lags, namely the logarithm of real GDP and GDP deflator, non-financial corporations' lending rate, the Luxembourg level of financial stress (CLIFS), unemployment rate and the EuroStoxx50 index.*

Table 2 :

Investment fund responses to short- or long-term interest rate shocks

	H = 0	H = 1	H = 2	H = 3	H = 4	H = 5	H = 6	H = 7	H = 8	H = 9	H = 10	H = 11	H = 12
OIS 3 M	-0.38	-0.98	-0.76	-0.06	1.37	1.52	1.71	0.56	1.23	0.70	0.78	0.31	0.88
	0.43	0.55	0.76	0.83	1.04	0.93	1.17	1.28	1.05	0.90	0.62	0.72	0.45
DE 10 Y	0.02	-0.97	-1.48	-1.04	-0.63	-0.73	-0.61	0.07	0.37	0.29	-0.04	0.42	-0.26
	0.55	0.70	0.82	1.05	1.13	0.97	0.93	0.85	0.69	0.59	0.79	0.56	0.65

	H = 13	H = 14	H = 15	H = 16	H = 17	H = 18	H = 19	H = 20	H = 21	H = 22	H = 23	H = 24
OIS 3 M	1.00	1.41**	0.42	0.02	-0.25	0.18	-0.08	0.49	0.51	0.80*	1.20***	0.75**
	0.82	0.44	0.44	0.44	0.29	0.56	0.87	0.72	0.32	0.27	0.17	0.13
DE 10 Y	-0.76	-0.93	-0.51	-0.34	1.45	0.94**	0.09	0.30	-0.83*	0.76**	0.87	1.70*
	0.60	0.87	1.11	1.34	0.89	0.28	0.60	0.83	0.33	0.21	0.53	0.57

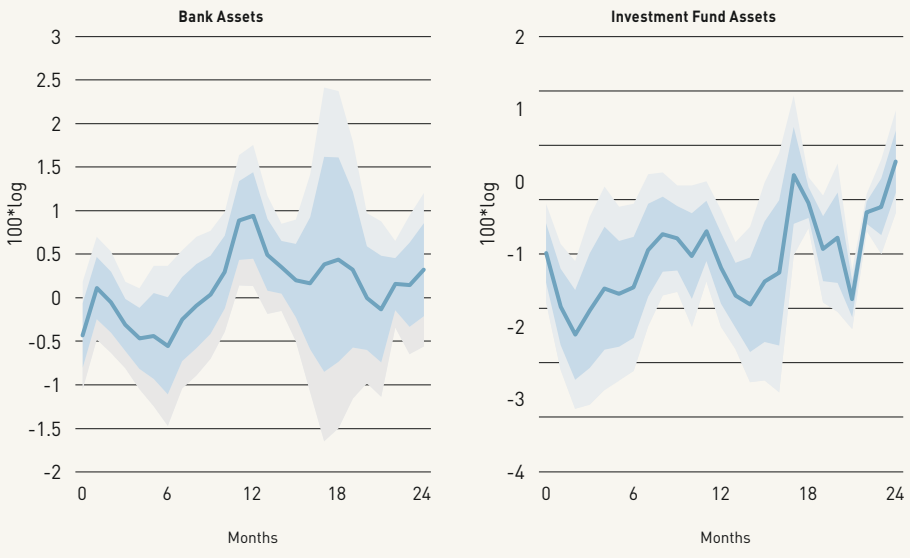
Note: BCL calculations. Standard errors in parentheses.
**** p<0.01, ** p<0.05, * p<0.1. Newey-West standard errors are in parentheses. Note that all the regression specifications include control variables with their respective lags, namely the logarithm of real GDP and GDP deflator, non-financial corporations' lending rate, the Luxembourg level of financial stress (CLIFS), unemployment rate, the EUR/USD exchange rate and the EuroStoxx50 index.*

Figure 3 shows the responses of banks and investment funds following a long-term interest rate shock. The results suggest that, compared to banks, investment funds respond more rapidly and are more sensitive to an increase in the long-term interest rate. Following a 1 percentage point positive long-term rate shock, investment funds' total assets contract by a maximum of 1.48% around the second month after the shock while banks' total assets contract by a maximum of 0.47% fourth months after the shock.

These results of our analysis are consistent with the literature and underscore the relevance of both the bank lending and risk-taking channels of interest rate transmission. We highlight that both short-term and long-term interest rate shocks have an impact on the banking and the investment fund sectors in Luxembourg. However, as previously mentioned, banks and investment funds react differently to such shocks. Specifically, banks are more sensitive to short-term interest rate shocks, whereas investment funds are more sensitive to long-term interest rate shocks.

The results shown in Figures 2 and 3 highlight some of the key differences in the responses of banks and investment funds to interest rate shocks. These differences may be partly explained by the respective balance sheet structures of banks and investment funds in Luxembourg. Precisely, the asset-side of banks consists primarily of loans, debt securities, and other types of assets, while the asset-side of investment funds' consists of debt securities and other types of assets. On the liability side, banks hold deposits and debt securities, as well as other types of liabilities[48], whereas investment funds mostly hold fund shares on their liability-side. These key differences are important for understanding how banks and investment funds react to interest rate shocks.[49]

Figure 3:
Banks' and investment funds' response to a 1pp shock in the long-term interest rate shock



Source: BCL.
Note: 68% (blue-shaded areas) and 90% (gray-shaded areas) confidence bands displayed.

For banks in Luxembourg, interbank loans represent the largest share of banks' assets. The second largest portion of banks' asset composition is customer loans (e.g. loans to households, non-financial corporations (NFCs)) and loans to other financial intermediaries, followed by debt securities. Luxembourg banks are therefore likely to be more sensitive, on average, to a short-term interest rate shock, in line with the credit channel hypothesis. To illustrate the importance of this channel, we examine the responses of different types of bank loans to short-term interest rate shocks.

[48] Other types of liabilities refer to bank borrowing from other institutions, including reserves, etc.
[49] In the euro area, banks and investment funds operate under different business models. For example, loans comprise more than 60% of bank assets but less than 10% for investment funds. However, debt securities make up roughly 40% of investment fund assets and only 10% of bank assets. ECB Work stream on non-bank financial intermediation in the euro area: implications for interest rate transmission and key vulnerabilities.

In Luxembourg, investment funds are inclined to allocate their resources in debt securities that have longer maturities, which is likely to enhance the term premium they earn from their bond investments. Consequently, changes in the long-term interest rate that affect the long end of the yield curve are likely to have an impact on the investment fund sector. However, there might be some differences in the effect on funds in Luxembourg depending on the type of investment. We therefore undertake a more granular analysis of funds' responses to interest rate shocks by distinguishing the responses across different types of investment funds.

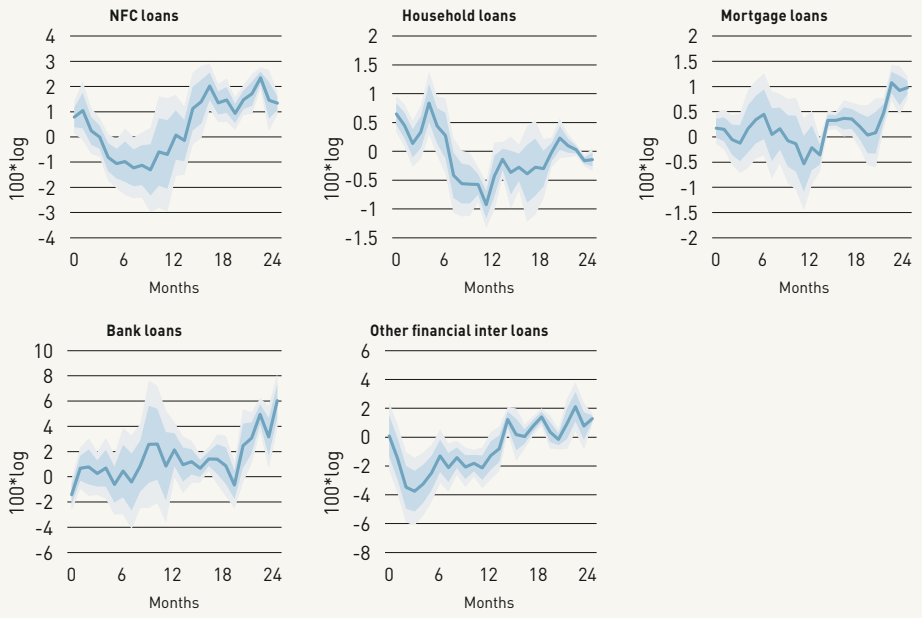
B. HETEROGENEITY OF INTEREST RATE SHOCK RESPONSES ACROSS THE DIFFERENT TYPES OF INVESTMENT FUNDS AND LOAN COUNTERPARTIES

In this section, we examine how investment funds react to interest rate shocks depending on their type. In addition, we also look at how the response of banks following an interest rate shock may affect lending to the different bank loan counterparties.

With regard to banks, Figures 4 and 5 show that banks' lending to the different loan counterparties (i.e. NFCs, household[50] This situation also increases the external finance premium. In addition to an increase in the external finance premium for NFCs and other financial intermediaries tends to contract more than loans to other counterparties. This finding is likely due to the balance sheet structure of Luxembourg banks, which tend to hold a large share of interbank loans followed by loans to NFCs and to other financial intermediaries. Therefore, it is understandable that short-term interest rate shocks primarily affect lending to NFCs and to other financial institutions (OFIs). This decrease in NFCs' lending might also be related to the fact that households cancel or postpone their purchases when interest rates increase, which decrease demand for consumer loans leading to a decrease in demand for goods and services produced by NFCs. Moreover, higher interest rates imply less demand for credit by NFCs, which is partly attributable to the adverse effects on their profits. These results favour the credit channel hypothesis.

Figure 4:

Responses after a short-term interest rate shock according to loan counterparty



Source: BCL.

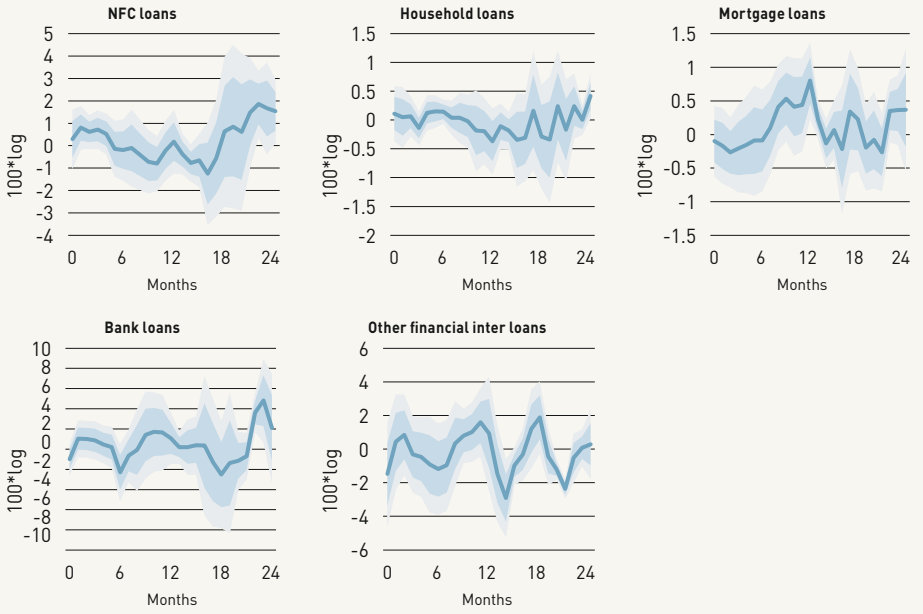
Note: 68% (blue-shaded areas) and 90% (gray-shaded areas) confidence bands displayed.

[50] Lending to households consists on consumer loans and other loans. It excludes mortgage loans.

According to Bernanke and Gertler (1995), monetary policy also has an impact on borrowers' financial positions. A tighter monetary policy stance can weaken borrowers' balance sheets in at least two ways. First, to the extent that borrowers have outstanding short-term or floating-rate debt, rising interest rates directly increase debt servicing costs, reducing net cash flows and weakening a borrower's financial position. Second, higher interest rates are also associated with declining asset prices which, among other things, decrease the value of borrowers' collateral. As borrower's net financial position weakens and the value of their collateral diminishes the external finance premium increases, making it harder for them to access credit. Similarly, a tighter monetary policy can have an impact on the supply of bank loans by decreasing the amount of credit allocated to borrowers.[51] This situation also increases the external finance premium. In addition to an increase in the external finance premium for NFCs and other financial intermediaries due to higher interest rates, the balance sheet and banking lending channels, it is important to recall that loans to other financial intermediaries also depend on the broader evolution of financial markets.[52]

Figure 5:

Responses after a long-term interest rate shock according to loan counterparties



Source: BCL.

Note: 68 % (blue-shaded areas) and 90 % (gray-shaded areas) confidence bands displayed.

Regarding long-rate shocks as shown in Figure 5, lending to the various counterparties does not seem to significantly contract following a long-term interest rate shock. It is worth noting that, following a long-rate shock, loans to NFCs tend to contract, but with a lag of more than one year.

Figures 6 and 7 show that investment funds, depending on the type of fund, (i.e. money market, equity, bond, mixed, real estate and hedge funds) react differently to interest rate increases.

[51] In Luxembourg, this process is often due to demand-side factors according to the Bank Lending Survey (BLS).

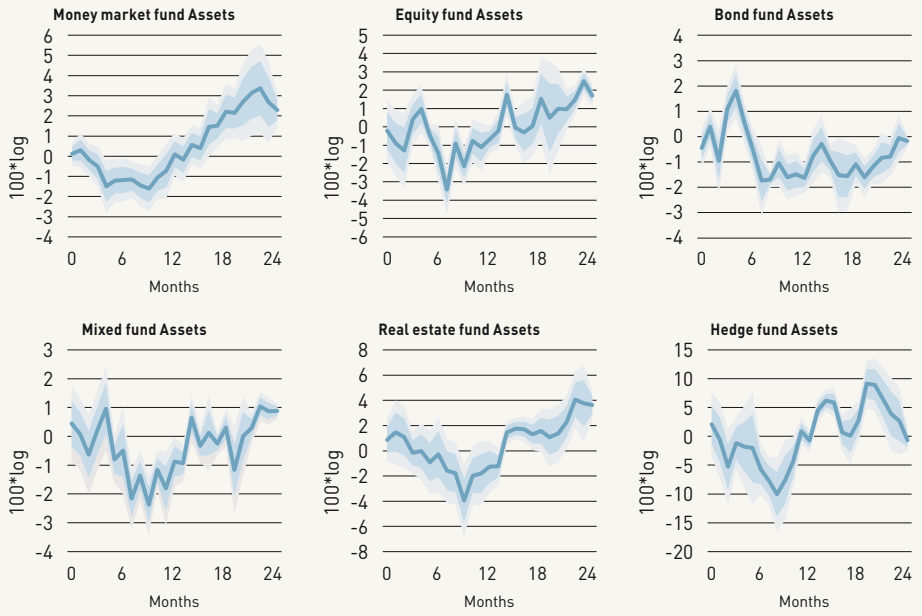
[52] For example, when interest rates increase, it may become more expensive for banks to borrow money, which could lead to higher interest rate pass through on loans to other financial intermediaries. In addition, if banks perceive that the financial markets are becoming less liquid, they may be more hesitant to lend money to other financial intermediaries, which could exacerbate liquidity mismatch.

According to Figure 6, a 1 percentage point increase in the short-term interest rate results in a deeper decline of around 1.74% and 2.38% for the total assets of bond and mixed funds, respectively. On the other hand, following a 1 percentage point short-rate increase, the total assets of equity funds, real estate funds and hedge funds decline by a maximum of 3.42%, 3.94% and 10%, respectively. This finding suggests that investment funds that mostly invest in debt securities with longer maturities, such as bond and mixed funds, are less impacted by short-term interest rate shocks. However, funds that invest in equities, derivatives with shorter maturities (such as money market funds, and hedge funds) tend to be more affected by short-rate shocks. Therefore, the results suggest that the more a fund is exposed to short-maturity debt, the more it is likely to be impacted by short-rate shocks.

Figure 7 highlights that, after an increase in the long-term interest rate, equity funds, real estate funds and hedge funds are not materially impacted. However, bond funds and mixed funds experience a significant contraction following shocks to the long-term interest rate.

Figure 6:

Responses after a short-term interest rate shocks according to investment fund types

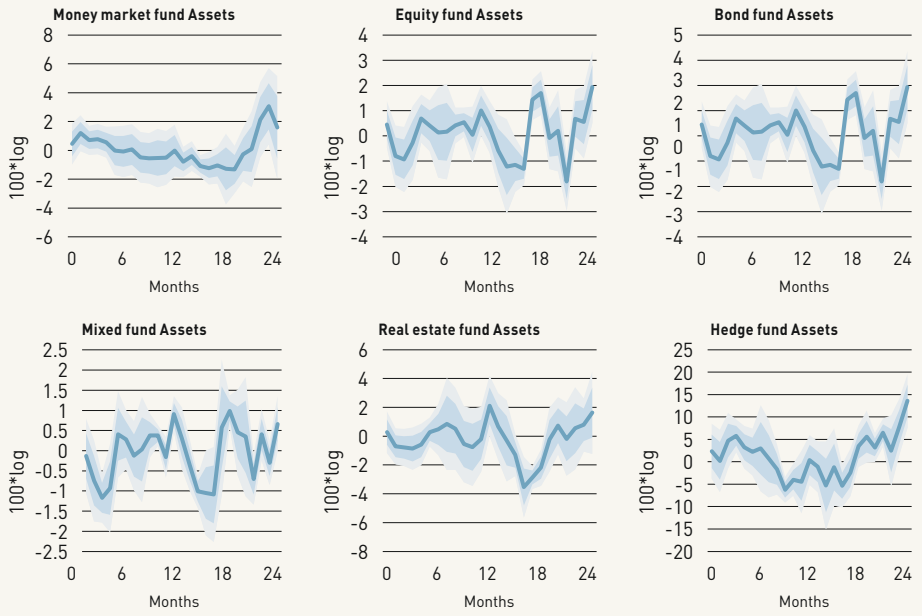


Source: BCL.

Note: 68% (blue-shaded areas) and 90% (gray-shaded areas) confidence bands displayed.

Figure 7:

Responses after a long-term interest rate shocks according to investment fund types



Source: BCL.

Note: 68% (blue-shaded areas) and 90% (gray-shaded areas) confidence bands displayed.

5. CONCLUSION

The objective of this study was to assess how banks and investment funds in Luxembourg react to interest rate shocks. The study is important from a financial stability perspective given the end of the period of monetary accommodation. The subsequent tightening of financial conditions has been swift and significant as central banks have acted to contain high and persistent inflation. In view of the need to monitor developments in the investment fund sector, and given the amount of total assets under management, assessing how different fund types respond to interest rate shocks is relevant for financial stability in Luxembourg.

This empirical exercise, having used the local projections approach to assess the impact of both short-term and long-term interest rate shocks, suggests that a 1 percentage point increase in the 3-month OIS rate leads to an initial contraction of Luxembourg banks' total assets by 0.45%, while investment fund assets decline by 0.38% following the shock. Based on the impulse response functions, the total assets of banks and investment funds decline by a maximum of 1.11% and 0.98% four months and one month after the short-term interest rate shock, respectively. However, the impact on banks' assets dissipates approximately eight months after the shock. Banks' total assets then recover with a maximum increase of 1.02% around eighteen months following an increase in the short-term interest rate. Following a short-term interest rate shock, the decline in the total assets of Luxembourg investment funds fades after three months, with an eventual increase of 1.41% in total assets after 14 months. This suggests that banks react more strongly to short-term interest rate increases compared to investment funds.

On the other hand, increases in the long-term interest rate, captured by the long end of the 10-year German yield curve, generate a significant contraction in investment funds' balance sheets. The difference between the effects of short and long-term interest rates on bank and investment fund assets can be partly attributed to differences in their balance sheet structure, particularly the composition of the asset side of their balance sheets. More precisely, even if both banks and funds hold debt securities, the presence of loans on the asset side of banks seems to be a key driver of the difference in the responses.

We also undertake a deeper analysis of how banks' lending to NFCs, households, mortgages, banks and other financial institutions and investment funds (by fund type including money market, equity, bond, mixed, real estate and hedge funds) respond to interest rate shocks. Our results suggest that loans to NFCs and to other financial intermediaries are more sensitive to increases in the short-term interest rate, in line with the credit channel hypothesis. In addition, we find that the maturity of securities in which investment funds invest is a determinant of how the different types of investment fund respond to interest rate shocks. More specifically, the more that funds invest in long-term (short-term) securities, the more sensitive they are to longer-term (shorter-term) interest rate shocks.

Finally, the findings outlined in this study confirm that banks and investment funds operating in Luxembourg are less likely to be adversely impacted by interest rate shocks compared to those in other countries as both bank and investment fund balance sheets recover relatively quickly following shocks to the short- and long-term interest rates. In other words, changes in interest rates do not seem to have a material impact on the lending activities of banks, at least on the supply side. Therefore, in an environment of rising rates, the financial sector is expected to continue to fulfill its role in funding the economy. From the borrower's perspective, the results support the interpretation that a decline in lending can primarily be attributed to lower demand for bank loans due to rising interest rates.

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