Security Losses, Interbank Markets, and Monetary Policy Transmission: Evidence from the Eurozone*

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Abstract

Banks that experienced larger losses in their pledgeable securities portfolios following the July 2022 monetary policy tightening became less able to borrow through the interbank market and subsequently reduced their corporate lending, regardless of whether the securities were booked at market or historical value. These effects were less pronounced for banks with abundant collateral and domestic subsidiaries of banking groups, which received liquidity through the group's internal capital market. Our results highlight a collateral channel in the bank-based transmission of monetary policy and show how differences in banking structure can contribute to an uneven transmission of monetary policy.

Keywords: Monetary policy tightening; interbank market; security losses; banking groups; foreign banks

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Banks face inherent liquidity risk due to the maturity mismatch between their assets and liabilities. The value of their collateral holdings determines their borrowing capacity in both interbank markets and from central banks, thereby influencing their ability to extend credit. Through its effect on collateral valuations, changes in monetary policy stance can alter the severity of collateral constraints, thus affecting the bank-lending channel of monetary policy transmission.

Despite its theoretical importance, evidence on the bank-based collateral channel of monetary policy transmission remains limited. This paper fills this gap by exploiting granular credit registry data from the euro area to document the operation of this channel and identify the conditions that amplify its effects.

We rely on the latest episode of monetary policy tightening. In July 2022, the European Central Bank (ECB) raised the policy interest rate in response to increasing inflation. Banks with greater holdings of securities in their portfolios were more exposed to the monetary policy tightening through their losses in the value of the securities they held. Using granular data on interbank lending, we show that banks that experience more significant security losses when monetary policy tightens obtain less credit through the interbank market, indicating that the decrease in the market value of collateral decreased banks' ability to access the interbank market. We observe that, as a consequence, banks extended less credit to firms and that the effects are similar for losses of securities that were booked at market and historical values.

We further document the relevance of the collateral channel exploiting cross-sectional differences between banks. First, we show that only losses in pledgeable securities affect banks access to the interbank market. Other security losses do not matter, indicating that the effects are not driven by a decrease in banks' net wealth. Such an interpretation is further supported by the finding that pledgeable security losses affect negatively only borrowing through the repo market and do not matter for access to the unsecured market. Second, we observe that the ability to borrow through the interbank market decreases to a larger extent for banks that had already pledged a larger proportion of their securities holdings. This again suggests that the effects are driven by a binding collateral constraint limiting banks' ability to insure liquidity shocks.

Finally, we take into account that some banks on our sample are part of banking groups (i.e., have the same holding company), while other are standalone. We conjecture that the former should be able to access liquidity through the internal capital market and consequently be less negatively affected by the loss in value of their collateral. We show that indeed within-group interbank loans partially isolate subsidiaries located in the same country as the headquarters (i.e., domestic sub-

sidiaries) from the effects of security losses. The headquarters and other subsidiaries of the same group extend larger loans to those domestic subsidiaries that have experienced more significant security losses due to the interest rate hike. Integration, however, appears to be incomplete even within the banking group. The foreign subsidiaries located within the eurozone that experience security losses do not obtain loans from other group members and receive less credit when their within-group lenders experience losses. Access to liquidity through the interbank markets and intra-group borrowing affect the credit supply to the corporate sector. Consequently, domestic subsidiaries of a banking group contract their credit supply less than stand-alone banks that experienced a similarly strong adverse shock to the value of their security portfolio. Because of the interbank market segmentations affecting within-group loans, foreign subsidiaries of banking groups are as exposed to monetary policy shocks as stand-alone banks.

We make several contributions to the literature. First, we contribute to the literature that leverages credit registry data to study the transmission mechanism of monetary policy (e.g. Jiménez et al., 2012). A few papers in this literature have exploited heterogeneity in banks' securities holdings to capture cross-sectional differences in exposure to monetary policy shocks (e.g. Greenwald et al., 2024). We are the first to highlight that the effect is driven by reduced access to the interbank market arising from security losses. In addition, we consider within-group reactions to security losses prompted by monetary tightening and their effects on bank lending. Thanks to the granularity of our data, we can contribute to the debate on the circumstances under which decreases in the valuation of securities holdings affect bank lending. We show that even banks that marked their security portfolios as held to maturity and could use historical cost accounting were negatively affected by the interest rate hike because their collateral constraint became more binding limiting access to the interbank market. Accordingly, we provide evidence that the impact of monetary policy through security losses does not merely depend on banks' net wealth and regulatory capital requirements.

Second, we contribute to the literature on the international transmission of bank liquidity shocks. Prior research demonstrates that international banks transmit shocks to their foreign subsidiaries (e.g. Peek and Rosengren, 2000; Schnabl, 2012) and that US banks can access liquidity from foreign subsidiaries during periods of funding stress (Cetorelli and Goldberg, 2012a). Moreover, internal capital markets within global banking groups have been shown to play a crucial role in how liquidity and monetary policy shocks in advanced economies affect lending to emerging markets (Cetorelli and Goldberg, 2012a; Morais et al., 2019). Domestically, multi-market banks

have also been found to transmit positive liquidity shocks within their U.S. branch networks (Gilje et al., 2016) and to transmit negative shocks outside their core markets, defined as areas in which banks do not have branches (Cortés and Strahan, 2017). A strand of this literature studies the lending channel of monetary policy in stand-alone banks and financial conglomerates (e.g. Campello, 2002; Cetorelli and Goldberg, 2012a). We make two important innovations. First, while existing contributions rely on banks' balance sheets to measure outstanding credit, the granularity of our credit registry data allow us to control for corporate credit demand using the **?** methodology. Second, we highlight how access to internal capital markets influences the strength of monetary policy transmission among banks. We distinguish between domestic and foreign subsidiaries of a banking group. We find that being part of a banking group attenuates the effect of monetary policy shocks on domestic subsidiaries' credit supply. However, the headquarters' propensity to provide liquidity to foreign subsidiaries facing security losses is limited. Consequently, foreign subsidiaries remain more exposed to monetary policy shocks and contract lending as much as stand-alone banks. Our results reveal an organizational pecking order within euro area credit groups that, differently from U.S. global banks (Cetorelli and Goldberg, 2012b), do not appear to allocate liquidity according to subsidiaries' investment opportunities.

Finally, we contribute to a growing literature exploring the transmission mechanism of monetary policy within the euro area. Our results highlight a mechanism through which differences in banking structure produce asymmetries in monetary policy transmission emerge in the euro area (Kashyap and Stein, 2000; Beraja et al., 2019). Bank consolidation and the tendency of banking groups to acquire distant banks have often been considered an important channel for achieving a more homogeneous financial structure and an even transmission mechanism of monetary policy across geographical areas of the monetary union. The finding that liquidity is not transferred across borders within banking groups highlights that national deposit insurance and local liquidity pools limit the ability of bank consolidation to integrate capital markets and lead to an even transmission of monetary policy.

1 Data

We exploit different data sources to evaluate whether differences in banking structure affect monetary transmission.

First, we rely on the Securities Holdings Statistics (SHS-G), which provides detailed information on debt security holdings at the ISIN-bank-quarter level. SHS-G offers granular data on security holdings, including the amount held, book value, market value, and the accounting classification of instruments. The accounting classification allows us to differentiate whether the bank applied an accounting standard that classifies the security at amortized cost (book value) or at fair value (marked to market). We focus on fixed-income securities held by banks, issued in the Eurozone, and denominated in euros.

Second, we use loan-level data from the European System of Central Banks' AnaCredit (AC) credit register, established in 2018. AC covers information on borrower characteristics (e.g., location, industry), loan types, and loan terms (e.g., loan size, maturity, interest rate, issuance date). Specifically, we use AC to analyze (i) bank lending to non-financial firms (NFCs) and (ii) interbank lending between Eurozone banks.

Finally, we complement our analysis with data from the Individual Balance Sheet Items (IBSI) database, maintained by the ECB. This database contains monthly-level information on banks granular asset and liability items. We use time-varying variables, such as total assets, deposit-to-total-assets ratio, equity ratio, and liquidity ratio, at the bank subsidiary level.

2 Monetary Tightening and security losses

On July 21, 2022, the ECB increased the three key policy rates by 50 basis points. As a consequence of this decision, the interest rate on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility were increased to 0.50%, 0.75%, and 0.00%, respectively. The initial rate increase was followed by nine interest rate hikes during our sample period that ends in December 2023. Naturally, this tightening cycle led to a repricing of the securities in the banks' portfolios, and banks that held relatively more securities experienced more significant losses.

We observe 2,862 bank subsidiaries belonging to 498 banking groups operating across 19 euro area (EA) countries during the sample period from January 2022 to December 2023 (Figure 1 Panel A). Euro area banks hold a substantial amount of fixed-income securities on their balance sheets,

amounting, on average, to EUR 3.2 billion or 18% of their total assets.

Data from the ECB's SHS-G allows us to compute the losses on banks' security portfolios. Furthermore, the granularity of the SHS-G data allows us to distinguish whether a security is classified as available for sale (AFS) or held to maturity (HTM) in each bank's portfolio. On average as of the end of the first quarter of 2022, we observe that most securities are reported as HTM (65%), while a smaller share (35%) is classified as AFS. This repartition differs from the evidence on bank holding companies (BHCs) in the US, where the 29 largest BHCs classify 60% of their security portfolios as AFS (Greenwald et al., 2024). Thus, since EA banks report most of their securities as HTM they can apply historical cost accounting instead of mark-to-market accounting that applies to AFS securities. The difference in the proportion of AFS and HTM securities in banks' portfolios could be due to institutional differences between the US and EA banking sectors, as well as the fact that our main sample covers a total of 498 banking groups, revealing important aggregate trends as well as cross-sectional variation that goes beyond the largest EA banks.

We use the SHS-G data to compute a bank's overall security losses triggered by monetary tightening as well as its security losses in the AFS and HTM components of its portfolio. We further distinguish between security losses affecting pledgeable securities defined as those accepted as collateral by the ECB and other securities. Securities eligible within the ECB collateral framework are typically also accepted as collateral in the repo market, where lenders impose more stringent requirements in the type of securities accepted as collateral.

We consider securities in the bank's portfolio at the end of the first quarter of 2022, which is well before the monetary policy tightening. Holding constant the bank's security holdings, we cumulate the price changes over the period 2022 Q1 – 2023 Q3 are computed as follows:

$$\text{Security Losses}_{i,t} = \frac{\sum_s \left(\frac{P^s_t - P^s_{2022Q1}}{P^s_{2022Q1}} \times \text{Value Held}^s_{i,2022Q1} \right)}{\text{Total Assets}_{i,2022Q1}} \tag{1}$$

Our measures consider all the losses accruing to a bank on the securities it held just before the monetary tightening up to month t to take into account the effects of all monetary policy decisions. However, as is evident from Figure 2, which plots the dynamics of the losses, most of the losses were realized in the third quarter of 2022, in the aftermath of the first interest rate hike. A key advantage of our detailed security-level data is that it enables us to measure the total value change in a bank's ex-ante securities portfolio by capturing fluctuations in individual security prices. By treating a bank's ex-ante security holdings as fixed, we do not incur the problem that banks more

negatively affected by the monetary policy tightening may opportunistically choose to mark a larger fraction of their security holdings as HTM to avoid mark-to-market accounting for AFS securities (Granja, 2023).

On average, banks suffer security losses of 1% of their total assets or 12% of their total equity. Figure 3, Panel A, further summarizes the distribution of overall losses on security portfolios as a share of total assets, highlighting the significant cross-sectional variation in these losses. In Panel B, we decompose the losses in the HTM and AFS portfolios, holding the classification constant as of the first quarter of 2022, and find that the largest security losses are associated with HTM holdings. HTM losses, on average, amount to 0.84% of total assets (9.8% of total equity), while the mean AFS losses are four times smaller and amount to 0.21% of total assets (2.5% of total equity). In addition to the average losses, we also observe a smaller dispersion of AFS losses, which relates to the fact that EA banks are generally more likely to hold securities as HTM.

There is substantial heterogeneity in security holdings and associated losses across Euro area countries (see Figures 4 and 5). Banks in peripheral countries, such as Italy, Spain, Portugal, and Greece, hold significantly more securities on average than those in core countries like Germany and France. These holdings are concentrated in long-term securities with maturities over three years. Consequently, banks in peripheral countries were more exposed to the ECB's monetary tightening and incurred the largest losses.

In what follows, we exploit this cross-sectional variation to identify the effects of the monetary policy tightening. Specifically, we analyze how changes in the value of those securities subsequently influence the bank's behavior in the interbank market and lending to firms.

3 Stand-Alone Banks and Banking groups within the Euro Area

To evaluate the relevance of collateral channel of the bank-based transmission of monetary policy, we not only exploit cross-sectional differences in security losses that impair a bank's ability to post collateral, but also a bank's ability to substitute the interbank market with liquidity transfers from other subsidiaries of the same banking group. Therefore, we conjecture that banks that are part of banking groups, differently from stand-alone banks, can take advantage of an internal capital market to tap liquidity.

We also consider that while banking groups in the EA encompass subsidiaries in many EA countries, deposit insurance still segments capital requirements and liquidity pools along national

borders. The extent to which these foreign subsidiaries can benefit from an internal capital market is thus an empirical question.

For these reasons, we categorize banks into three distinct groups: i) stand-alone banks, which are not part of any banking group, ii) domestic subsidiaries, which are banks that are part of a banking group and are located in the same country as the headquarters, and iii) foreign subsidiaries, which are banks owned by a foreign banking group. In total, the sample includes 1,832 stand-alone banks, 644 domestic subsidiaries, and 386 foreign subsidiaries.

Table 1 Panel A summarizes the descriptive statistics of the EA banking sector. Domestic and foreign subsidiaries collectively belong to 108 banking groups operating in the EA. On average, there are about 151 banks per country, with a median of 26 banks per country. In a median country, there are ten stand-alone banks, six domestic subsidiaries, and nine foreign subsidiaries. In a median country, banking group subsidiaries belong to 13 banking groups, four of which are headquartered domestically. On average, a banking group owns six subsidiaries and operates in three countries. While banking groups in the EA tend to exhibit a home bias, a significant portion of their assets and corporate loans is held by foreign subsidiaries, accounting for 25% of total assets and 26% of corporate loans, respectively.

Reflecting differences in country size, the distribution of banks is significantly skewed towards the EA Big-4 countries (Germany, Italy, Spain, and France), which together account for around 72% of all banks (see Figure 1 Panel A). In contrast to the median EA country, the vast majority of banks in Big-4 countries are part of a banking group, with 150 subsidiaries compared to 70 stand-alone banks. In addition, Big-4 countries have more than twice as many domestic subsidiaries as foreign ones, with 100 domestic subsidiaries versus 50 foreign ones. These subsidiaries are part of 52 banking groups, 18 of which are headquartered domestically.

While stand-alone banks are significant in numbers, they are typically small and account for a smaller proportion of total assets, corporate lending, and security holdings than subsidiaries of banking groups. Specifically, subsidiaries of banking groups hold, on average, 70% of a country's banking sector assets, with the remaining 30% held by stand-alone banks.

Among subsidiaries, foreign subsidiaries play a crucial role, holding more than a quarter of total assets, while domestic subsidiaries account for 44%. These proportions are similar for corporate lending and securities holdings, with subsidiaries of banking groups representing 67% and 69%, respectively. Foreign subsidiaries are almost as important as stand-alone banks, accounting for 26% of corporate loans and 24% of securities held.

As Figure 1 Panel B highlights, the distribution of domestic and foreign subsidiaries is not homogeneous across the EA. Foreign subsidiaries play a disproportionally more important role in countries with smaller domestic banking systems, such as Portugal, Belgium, Luxembourg, Slovakia, Lithuania, and Estonia, where the share of corporate loans extended by foreign subsidiaries is close to 50%.

These patterns make important to explore to what extent the collateral channel affect banks with and without access to liquidity internal to the banking group and eventual differences in the treatment of domestic and foreign subsidiaries.

4 Monetary Tightening, Interbank Market and Intra-Group Liquidity Provision

4.1 Types of security losses and Interbank Market

4.1.1 Effects of borrowing banks' losses

Euro area banks rely heavily on the interbank market to finance their balance sheets, with an average of 13.8% of bank assets funded through interbank borrowing (see Table 1, Panel B). Even more importantly, the interbank market plays an important role in redistributing liquidity. security losses, reducing the value of a bank's collateral and impairing its ability to access the interbank market, affect negatively the bank's ability to insure liquidity shocks and through this channel may reduce the supply of credit.

To explore how security losses affect a bank's borrowing ability in the interbank market, we estimate the following model by ordinary least squares (OLS), where the dependent variable, Loan Amount$_{b,c,l,h,t}$ is the logarithm of the outstanding interbank credit amount issued by bank l located in country h to bank b based in country c during month t:

$$\text{Loan Amount}_{b,c,l,h,t} = \alpha + \beta \times \text{Security Losses}_{b,t-1} + \delta_{b,l} + \mu_{c,t} + \theta_{h,t} + \epsilon_{b,c,l,h,t} \tag{2}$$

The variable of interest is term Security Losses$_{b,t}$, which denotes the ratio of security losses to total assets of the borrowing bank as described by Equation 1. The variables allows us to capture how starting from August 2022 security losses affected a bank's participation in the interbank market. The vector $\delta_{b,l}$ denotes interactions of borrowing bank and lending bank fixed effects and controls for the strength of the interbank relation. In addition, $\mu_{c,t}$ and $\theta_{h,t}$ are interactions of the borrowing

bank's country and time and the lending bank's country and time fixed effects, respectively, and capture any shocks affecting the borrowing bank's and the lender bank's countries.

Table 2 tests these hypotheses. Column 1 of Panel A, Table 2 shows that banks that experience more significant security losses following the monetary tightening receive less credit in the interbank market. The effect is both statistically and economically significant. A one-standard-deviation increase in borrowing banks' losses is associated with a 3.76% decline in credit received in the interbank market. This result suggests that security losses negatively affect a bank's ability to borrow in the interbank market.

Security losses also affect negatively a bank's net wealth. A decrease in creditworthiness can in turn decrease a bank's ability to access the interbank market. To evaluate to what extent the collateral channel is at place we distinguish between securities that are accepted by the ECB as collateral and other securities. Only the former are accepted as collateral in the interbank market. In column 2, we observe that a decrease in the value of pledgeable securities is associated with a decrease in the amount of funds that a bank is able to borrow in the interbank market. In column 3, we do not observe an analogous effect for non pledgeable securities.

In column 5 we define a bank's collateral utilization rate, as the ratio of its outstanding debt to other banks to the value of its securities in July 2022. Consistent with the collateral channel, we observe that the ability to borrow through the interbank market decreases to a larger extent for banks that are likely to have posted most of their securities as collateral.

Not only do these findings support the collateral channel, but in columns 6 and 7 we observe that security losses have an effect only on the amount that a bank is able to borrow through the repo market. security losses appear to have no effect on banks' access to the unsecured market.

In column 4, we distinguish between security losses in HTM and AFS portfolios. Both AFS and HTM securities appear to negatively affect a bank's access to credit in the interbank market.

Table 3 focuses on losses affecting a bank's pledgeable securities and distinguish between loans that a bank receives from subsidiaries outside and within the banking group (columns 2 and 3). While a bank's ability to borrow from banks outside the banking group substantially decreases when the value of a bank's pledgeable securities decreases, the bank appears to receive large loans from other subsidiaries within the banking group.

The effect is not only statistically but also economically significant. A one standard deviation increase in borrowing banks' losses is associated with a 13.6% increase in credit received from other banks in the same banking group. Thus, decrease in interbank market borrowing for banks

experiencing security losses is entirely driven by lending from banks that do not belong to the same banking group. Intragroup lending has a counteracting effect.

These results provide micro-foundations for the findings of existing literature showing that the outstanding credit on the balance sheets of banks that are part of business groups is less sensitive to monetary policy (Campello, 2002).

4.1.2 Effects of lending banks' losses

To the extent that a bank that has experienced security losses is less able to attract liquidity through the interbank market, it can also become less inclined to extend credit. Given our interest in identifying the collateral channel, we continue to focus on losses affecting pledgeable securities and investigate whether collateral security losses also affect banks' lending behavior. To this end, we estimate equation (1) but focus on the role of the lending bank's ratio of security losses to total assets. Equation (2) describes our empirical model:

$$\text{Loan Amount}_{b,c,l,h,t} = \beta \times \text{Collateral Security Losses}_{l,t-1} + \delta_{b,l} + \mu_{c,t} + \theta_{h,t} + \epsilon_{b,c,l,h,t} \qquad (3)$$

where the key variable of interest is the lending bank's ratio of security losses to total assets $CollateralSecurityLosses_{l,t}$).

Panel B of Table 3 presents the results. We find that security losses not only affect banks' ability to receive credit but also their lending behavior. Banks that experience more significant security losses extend less credit in the interbank market (column 4). The effect is once again statistically and economically significant, with a one-standard-deviation increase in lending banks' losses associated with a 8.9% decrease in their credit supply in the interbank market. Columns 5 and 6 reveal that the effect is entirely driven by loans to subsidiaries outside the banking group. The internal capital market is unaffected by the lending bank's security losses.

All results on the redistribution of liquidity between and within banking groups are confirmed in columns 7 and 8, when we consider together borrowing and lending banks' security losses.

5 Credit Flows Between Domestic and Foreign Subsidiaries of a Banking Group

5.1 Within-Group Lending to Domestic and Foreign Subsidiaries

We ask to what extent the insurance provided by the banking groups differs between subsidiaries. Since we are interested in understanding whether cross-border consolidation through business groups favors an even transmission of monetary policy, we distinguish between domestic and foreign subsidiaries of the banking group. For the within-group lending analysis, we use two different definitions of domestic vs. foreign subsidiaries. First, we define a subsidiary as domestic based on the geo-location of the lending and borrowing banks. The borrowing subsidiary is considered domestic if it is based in the same country as the lending subsidiary, and foreign otherwise. Second, we define a subsidiary as domestic with respect to the headquarters. In this case, a subsidiary is considered domestic if it is based in the same country as its banking group headquarters, and foreign otherwise. As in the earlier tests, we perform subsample analysis to facilitate interpretation.

We first ask whether there is a difference in liquidity support provided to domestic and foreign subsidiaries within a banking group that has experienced security losses. Table 4 columns 1-3 present the results for borrowing subsidiary losses. Only domestic subsidiaries receive more loans from another part of the banking group when they experience considerable security losses while we do not observe an analogous effect for foreign subsidiaries. This is the case whether we consider foreign subsidiaries located in a different country from the lending subsidiary (column 2) or subsidiaries located in a different country from the group headquarters (column 3).

Interestingly, columns 4 and 5 highlight the importance of border effects for the functioning of internal capital markets. In column 4, we consider the subsample of foreign subsidiaries. It appears that foreign subsidiaries support other subsidiaries that are not located in the same country as the headquarters and have experienced losses to their pledgeable securities, while in column 5, domestic subsidiaries lend to other subsidiaries located in the same country as the headquarters. So puzzlingly, the internal capital markets seem to remain segmented arguably because of local liquidity pools and firewalls arising from the lack of a common deposit insurance.

Columns 6 to 8 consider how subsidiaries of the banking group extend liquidity when they experience security losses. On average, subsidiaries of a banking group do not extend less credit when they experience security losses (column 6). However, it appears that subsidiaries based in a different country than the headquarters extend less credit (column 8), suggesting that local liquidity

pools and firewalls limit their ability to provide insurance within the banking group.

5.2 Between-Group Lending to Domestic and Foreign Subsidiaries

Importantly, the evidence of segmentation along national borders appears to be specific to banking groups. Table 5 considers intergroup lending and how this depends on the security losses experienced by borrowing and lending banks. In columns and 2, banks that experience larger security losses obtain less credit from other banks outside the business group, irrespective of whether they are domestic or foreign. If anything, the effect of security losses appear smaller for foreign banks.

Columns 4 shows that subsidiaries that experience security losses lend less. Even though the effect appears to be statistically different from zero only for the foreign subsidiaries of a banking group, the lack of statistical significance for loans to domestic banks is largely due to lack of power. Overall, there is no evidence that banks outside the group provide liquidity support to other banks experiencing security losses, whether these are domestic or foreign. Thus, border effects appear to only emerge within banking groups.

5.3 Robustness — Other Subsidiary Characteristics

One reason banking groups tend to shield domestic subsidiaries from losses to a greater extent could be that the domestic subsidiaries are larger and more central to the group's business. If this is the case, the border could play a minor role in explaining the segmentations in liquidity provision that we observe within the group.

Columns 1 of Table 6 indeed shows that large subsidiaries tend to receive more credit from other subsidiaries of the group when they experience more extensive losses. However, column 2 shows that only large domestic subsidiaries of banking groups obtain liquidity support. The double interaction term $SecurityLosses_{b,t} \times LargeSubsidiary_b$ is negative and significant, indicating that not only large foreign subsidiaries do not benefit from the intra-group liquidity support, but also obtain less liquidity than other foreign subsidiaries.

Thus, large domestic subsidiaries, and domestic subsidiaries in general, benefit from the intra-group liquidity provision. This finding resonates with (Cetorelli and Goldberg, 2012a) that US banks obtain liquidity from their foreign subsidiary when funding conditions at home deteriorate. However, we also show that foreign subsidiaries subject to shocks do not experience similar benefits. We also observe that foreign subsidiaries experiencing losses tend to provide less credit to other domestic subsidiaries of the group.

6 Monetary Transmission to Corporate Lending

This section explores whether banks that are more exposed to the monetary tightening through their security holdings lend less to firms and whether subsidiaries of banking groups that benefit from liquidity provision from other subsidiaries of the group insulate their borrowers from the shock. These tests are important to evaluate to what extent stand-alone banks and domestic and foreign subsidiaries of banking groups transmit the monetary tightening to the corporate sector. They also allow us to evaluate to what extent the decrease in liquidity distribution through the interbank market and within banking groups may depend on differences in banks' lending opportunities.

We estimate the following equation for the outstanding credit issued by bank (subsidiary) b belonging to group g to firm f during month t:

$$\text{Loan Amount}_{b,g,f,t} = \alpha + \beta(times\text{Security Losses}_{b,t}) + \gamma X_{b,t} + \delta_{f,t} + \mu_{g,t} + \theta_{b,f} + \epsilon_{b,g,f,t} \qquad (4)$$

Following (**?**), we include throughout the analysis interactions of firm and time fixed effects ($\delta_{f,t}$) to control for demand shocks. We also control for the strength of the relationship between a bank and a firm including interactions of bank and firm fixed effects ($\theta_{b,f}$). Finally, in some specifications, we include subsidiary level controls ($\mathbf{X_{b,t}}$), namely share of deposits to total assets, equity to total assets, and the logarithm of total assets, to capture group and subsidiary level financial conditions, and interactions of banking group and time fixed effects ($\mu_{g,t}$), which allow us to compare domestic and foreign subsidiaries of the same banking group.

Table **??** shows that banks that experience larger security losses because lend less to a given firm relative to other banks. The effect is both statistically and economically significant. A one-standard-deviation increase in banks' losses is associated with a 5.48% decline in lending to firms (column 3). This seems to be the case whether the losses are in securities that are market-to-market or at historical cost accounting in columns 4 to 6.

Supporting the collateral channel column 7 shows that the effect of security losses is larger for banks with high collateral utilization rate. Thus, collateral scarcity leads to a sharper contraction in bank lending following a monetary tightening.

Importantly, the estimated parameter on the variable of interest is similar in columns 2 and 3 when we include interactions of group and time fixed effects. This suggests that subsidiaries of a banking group experiencing losses contract lending, notwithstanding the liquidity they receive from other subsidiaries of the group. However, as we will show in Table 7, the average effect conceals

important differences between domestic and foreign subsidiaries of the same banking group,

Table 7, column 1 distinguishes between standalone banks and subsidiaries of banking groups. It appears that one euro of security losses translates into a larger contraction in lending for standalone banks rather than for subsidiaries of banking groups. In column 2, we focus on standalone banks and domestic subsidiaries to compare banks within the same country. The coefficient estimates in column 2 are consistent with column 1 and confirm that domestic subsidiaries are partially shielded from security losses by intra-group loans.

Columns 3 restricts the sample to group banks and considers differences between domestic subsidiaries and foreign subsidiaries, defined as subsidiaries located in a different country from the headquarters. Consistent with the finding that foreign subsidiaries of banking groups do not benefit from liquidity redistribution, they appear to contract credit much more for a euro amount of losses.

7 Conclusions

We document that collateral constraint affect bank lending. Monetary policy tightenings affect the valuations of securities that banks can pledge in the interbank market. As a result, banks experience reduced access to liquidity through the interbank market and cut lending.

We show that the internal capital market within banking groups tends to mitigate the adverse effects of security losses at their domestic subsidiaries, which, consequently, can extend more credit than similarly affected stand-alone banks. However, foreign subsidiaries of banking groups do not appear to appear to benefit as much from the internal capital market when they experience security losses and cut credit as much as stand-alone banks.

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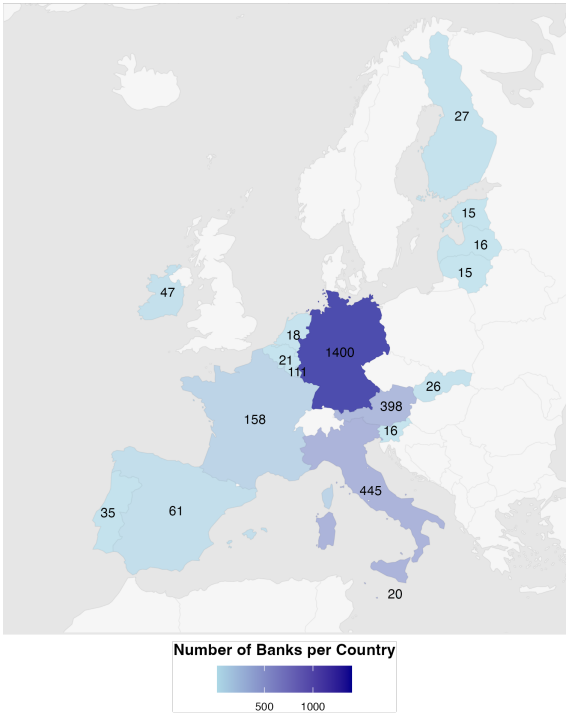
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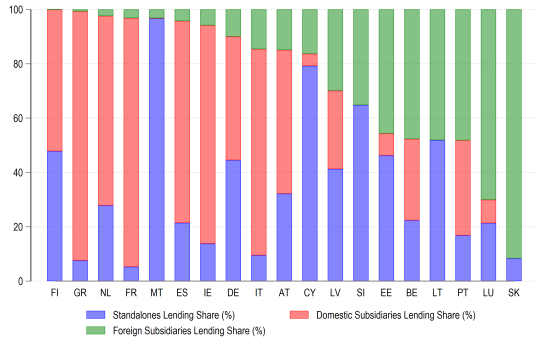
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Figure 1: Distribution of Banks within the Euro Area

(a) Geographical Distribution of Banks

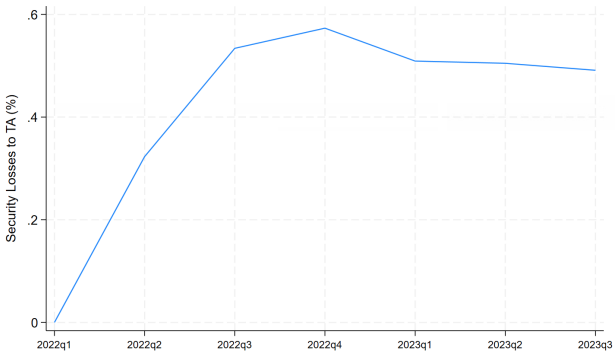


(b) Lending Share of Standalone Banks and Banking Groups



The figure plots the country-level distribution of banks and their lending shares across the Euro Area. Panel A shows the number of banks per country. Panel B decomposes the lending shares of standalone banks, domestic and foreign subsidiaries of banking groups in each Euro Area country. A standalone bank refers to a bank that is not part of a larger banking group. A bank (subsidiary) is classified as domestic if it is located in the same country as its banking group's headquarters, and as foreign otherwise.

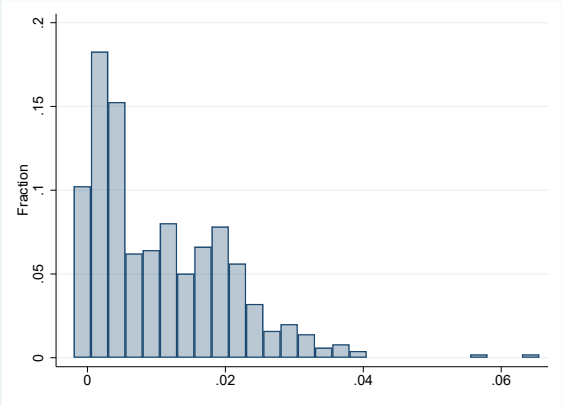
Figure 2: Security losses over time



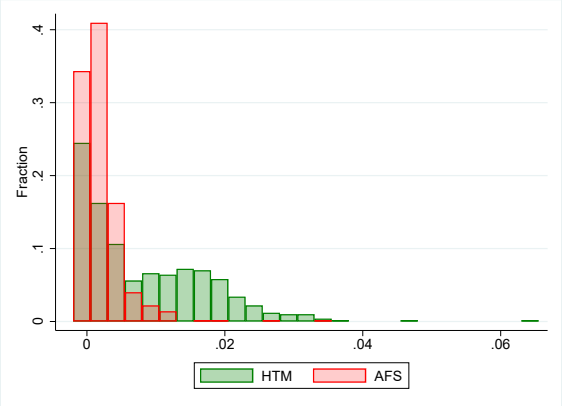
The figure presents the time-series evolution of aggregate security losses as a share of total assets, as defined in Equation (1). Aggregate security losses are calculated as the weighted average of individual bank losses.

Figure 3: Distribution of Security losses

(a) Total Security Losses



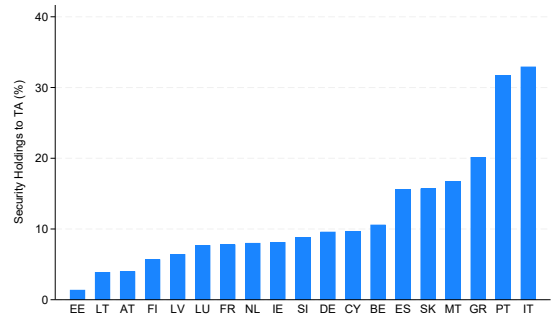
(b) HTM vs. AFS Security Losses



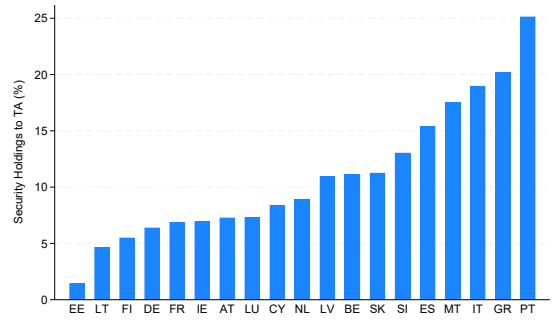
The figure shows the distribution of security losses as a share of total assets as of 2023q3, as described by Equation (1). Panel A presents the distribution of total security losses. Panel B plots the distribution of HTM vs. AFS portfolio losses, respectively.

Figure 4: Security Holdings by Country

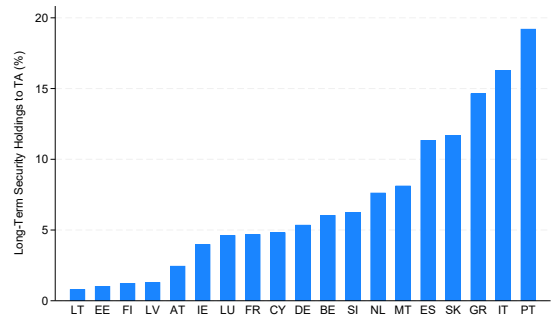
(a) All Securities (Median Bank)



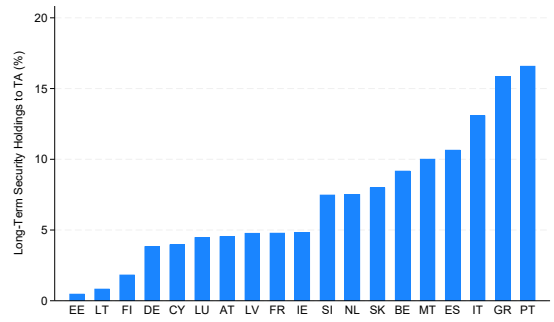
(b) All Securities (Weighted Average)



(c) Long-Term Securities (Median Bank)



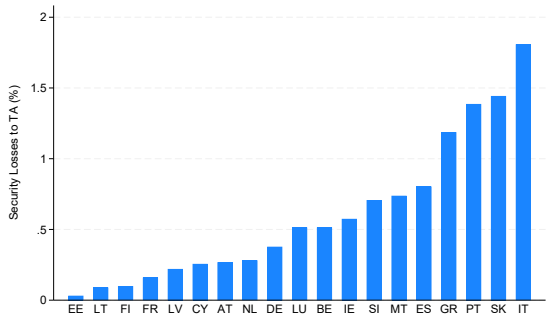
(d) Long-Term Securities (Weighted Average)



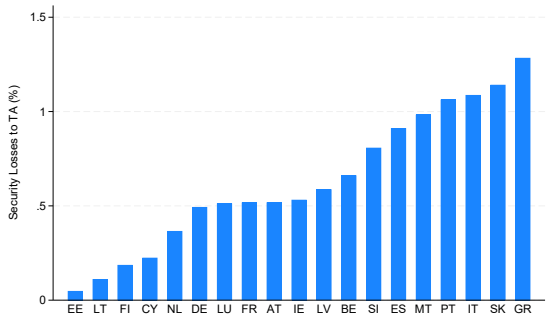
The figure plots security holdings across Euro Area countries as of 2022q1. Panels A and B present the country-level security holdings of all reported securities for a median bank and as a weighted average, respectively. Panels C and D focus on long-term securities with a residual maturity of more than three years, showing the country-level distribution for a median bank and as a weighted average, respectively. All values are reported as a percentage of total assets.

Figure 5: Security Losses by Country

(a) Median Bank



(b) Weighted Average



The figure plots security losses across Euro Area countries as of 2023q3. Panel A presents the country-level security losses of all reported securities for a median bank. Panel B plots the security losses as a weighted average of banks withing the country. All values are reported as a percentage of total assets.

Table 1: Summary Statistics

Panel A: Country-level summary statistics of stand-alone banks and banking groups in the Euro Area						
Variable	N	Mean	SD	P10	P50	P90
Number of Banks and Banking Groups per Country						
Total Number of Banks	19	151	328	15	26	445
Number of Standalone Banks	19	96	285	5	10	293
Number of Domestic Subsidiaries	19	34	64	1	6	124
Number of Foreign Subsidiaries	19	20	24	3	9	78
Number of Banking Groups Present in the Country	19	105	294	9	13	314
Composition of Banks per Country (in %)						
Standalone Banks / All Banks	19	43.29	22.97	12.77	44.26	80.00
Domestic Subsidiaries Banks / All Banks	19	25.75	22.02	5.00	21.05	66.67
Foreign Subsidiaries Banks / All Banks	19	30.96	19.54	5.03	27.78	63.83
Composition of Key Balance Sheet Variables per Country (in %)						
Share of NFC Lending by Standalone Banks	19	33.25	25.52	7.58	24.38	79.21
Share of NFC Lending by Domestic Subsidiaries	19	40.83	34.72	0.00	34.99	91.52
Share of NFC Lending by Foreign Subsidiaries	19	25.92	26.43	0.74	14.97	70.07
Share of Total Assets of Standalone Banks	19	30.55	25.08	10.81	18.35	76.23
Share of Total Assets of Domestic Subsidiaries	19	44.24	34.56	0.27	46.06	87.04
Share of Total Assets of Foreign Subsidiaries	19	25.20	25.48	1.15	14.58	70.55
Share of Security Holdings by Standalone Banks	19	30.93	30.14	4.14	18.76	95.88
Share of Security Holdings by Domestic Subsidiaries	19	45.55	35.69	0.00	44.70	93.21
Share of Security Holdings by Foreign Subsidiaries	19	23.52	28.26	0.00	8.30	79.87
Number of Subsidiaries and Key Characteristics per Banking Group						
Number of Subsidiaries	108	6.08	10.96	2	2.5	10
Number of Domestic Subsidiaries	108	3.94	10.08	1	1	5
Number of Foreign Subsidiaries	108	2.14	3.42	0	1	6
Number of Countries Banking Group Operates in	108	2.68	1.98	1	2	6
Share of Group NFC Lending Held Domestically	108	83.29	24.94	49.98	95.35	100.00
Share of Group Total Assets Held Domestically	108	86.25	20.87	64.15	94.67	100.00

Panel B: Bank-level security holdings, security losses and other balance sheet variables						
Variable	N	Mean	SD	P10	P50	P90
Security Holdings (as of 2022q1)						
Total Security Holdings (mil EUR)	498	3,164	8,657	38	386	9,592
Security Holdings to Total Assets (in %)	498	18.37	14.45	1.64	14.26	36.96
Security Holdings to Total Equity (in %)	498	216.82	200.86	18.48	183.88	444.18
HTM Securities / Total Security Holdings (in %)	498	64.19	33.26	0.00	71.76	99.98
AFS Securities / Total Security Holdings (in %)	498	35.81	33.26	0.02	28.24	100.00
(ECB + Interbank Borrowing) / Total Security Holdings (in %)	498	90.92	90.08	27.77	55.55	202.89
Other Balance Sheet Variables (as of 2022q1)						
Total Assets (log)	498	8.48	2.21	5.81	8.02	11.47
Interbank Borrowing (% of Total Assets)	498	13.82	16.05	0.32	13.55	23.73

Variable	N	Mean	SD	P10	P50	P90
Security Losses						
Security Losses (% of Total Assets)	3486	0.87	1.02	0.00	0.51	2.19
Collateral Security Losses (% of Total Assets)	3486	0.86	1.00	0.00	0.49	2.17
Non-Collateral Security Losses (% of Total Assets)	3486	0.01	0.20	0.00	0.00	0.05
HTM Security Losses (% of Total Assets)	3486	0.68	0.91	0.00	0.29	1.91
AFS Security Losses (% of Total Assets)	3486	0.18	0.29	0.00	0.08	0.48
Security Losses (% of Total Equity)	3486	10.26	14.42	0.00	6.37	24.79
Collateral Security Losses (% of Total Equity)	3486	10.09	13.97	0.00	6.09	24.47
Non-Collateral Security Losses (% of Total Equity)	3486	0.17	3.36	0.00	0.00	0.61
HTM Security Losses (% of Total Equity)	3486	8.02	13.46	0.00	3.31	21.18
AFS Security Losses (% of Total Equity)	3486	2.07	3.29	0.00	0.90	5.48

Panel C: Loan-Level Summary Statistics

Variable	N	Mean	SD	P10	P50	P90
Interbank Lending						
Loan Amount (log)	67,845	16.27	3.48	11.75	16.62	20.39
Security Losses of Borrowing Banks (% of Total Assets)	67,609	0.66	0.62	0.08	0.45	1.59
Security Losses of Lending Banks (% of Total Assets)	67,341	0.65	0.60	0.08	0.45	1.59
Repo Amount (log)	14,820	18.04	2.32	14.92	18.42	21.00
Repo Rates (in %)	14,820	1.03	1.53	-0.35	0.01	3.60
Corporate Lending						
Loan Amount (log)	19,005,930	12.23	1.76	10.31	12.07	14.48
Number of Bank Relationships	19,005,930	3.40	4.25	2	3	6
Security Losses (% of Total Assets)	19,005,930	0.79	0.57	0.08	0.81	1.34

Table 2: Types of security losses and Interbank Market

	Loan Amount						
	All Instruments					Repo	Non-Repo
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
All Security Losses$_{b,t-1}$	-3.691***						
	(1.403)						
Collateral Security Losses$_{b,t-1}$		-9.006***			-6.226*	-25.22***	2.480
		(3.211)			(3.325)	(5.602)	(4.592)
Non-Collateral Security Losses$_{b,t-1}$			-1.236				
			(1.014)				
AFS Security Losses$_{b,t-1}$				-13.24**			
				(5.441)			
HTM Security Losses$_{b,t-1}$				-6.930**			
				(3.325)			
Collateral Security Losses$_{b,t-1}$					-4.939***		
×Collateral Util. Rate$_{b,2022q1}$					(1.251)		
Bank Lender-Bank Borrower FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Lender-Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Borrower-Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	120799	120005	120005	120005	99344	13258	85280
R^2	0.899	0.898	0.898	0.898	0.896	0.809	0.888

The table reports the results of the relationship between banks' behavior in the interbank market and security losses. We examine the effect of borrowing banks' losses, where the dependent variable is the natural logarithm of the outstanding interbank credit amount issued by bank l to bank b during month t. Security losses are calculated based on Equation (1). Collateral utilization rate is defined as the ratio of ECB + interbank borrowing to total security holdings. OLS regressions are used to estimate the models. Standard errors are two-way clustered at the borrowing bank-time and lending bank-time level. ***, **, and * denote significance at the 1%, 5%, and 10% (two-sided) levels, respectively.

Table 3: Security Losses and Interbank Market

	Loan Amount						
	Borrowing Banks' Losses		Lending Banks' Losses			Borrowing and Lending Banks' Losses	
	Between Groups	Within Group	All	Between Groups	Within Group	Between Groups	Within Group
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Collateral Security Losses$_{b,t-1}$	-16.73***	13.61***				-15.56***	9.269**
	(3.778)	(3.971)				(5.839)	(3.839)
Collateral Security Losses$_{l,t-1}$			-8.896**	-10.26**	0.273	-9.900**	-1.017
			(3.467)	(4.840)	(4.280)	(4.936)	(4.203)
Bank Lender-Bank Borrower FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Lender-Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Borrower-Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	99134	20855	51879	35330	16518	35151	15968
R^2	0.881	0.907	0.882	0.841	0.916	0.841	0.910

The table reports the results of the relationship between banks' behavior in the interbank market and security losses for the subsamples of between groups and within group loans, as described by Equations (2) and (3). The dependent variable is the natural logarithm of the outstanding interbank credit amount issued by a lending bank l to a borrowing bank b during month t. Security losses are calculated based on Equation (1). Standard errors are two-way clustered at the borrowing bank-time and lending bank-time level. ***, **, and * denote significance at the 1%, 5%, and 10% (two-sided) levels, respectively.

Table 4: Within-Group Lending to Domestic and Foreign Subsidiaries

	Loan amount					
	Borrowing Subsidiary's Losses				Lending Subsidiary's Losses	
Definition of domestic/foreign	Dom.†	Dom.‡	Dom.‡	Dom.‡	Dom.†	Dom.‡
Lending by:	All	All	Foreign. subs.	Dom. subs.	All	All
	(2)	(3)	(4)	(5)	(7)	(8)
Collateral Security Losses$_{b,t-1}$	-8.960	3.573	71.22*	-4.625		
×Foreign$_b$	(13.30)	(12.72)	(39.40)	(13.57)		
Collateral Security Losses$_{b,t-1}$	10.82***	9.948***	8.796	5.346*		
×Domestic$_b$	(3.690)	(3.834)	(7.820)	(2.956)		
Collateral Security Losses$_{l,t-1}$					-6.681	-62.79***
×Foreign$_b$					(12.82)	(13.24)
Collateral Security Losses$_{l,t-1}$					1.003	5.021
×Domestic$_b$					(4.487)	(4.689)
Bank Lender-Bank Borrower FE	Yes	Yes	Yes	Yes	Yes	Yes
Country Lender-Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Country Borrower-Time FE	Yes	Yes	Yes	Yes	Yes	Yes
N	16132	16132	1420	15214	16423	16423
R^2	0.910	0.910	0.867	0.922	0.916	0.916

The table presents the results of the effects of banks' security losses on within-group lending to domestic and foreign subsidiaries, as described by Equations (2) and (3). The dependent variable is the natural logarithm of the outstanding intra-bank credit amount issued by a lending bank l to a borrowing bank b during month t. Security losses are calculated based on Equation (1). Two different definitions of domestic versus foreign borrowing (lending) subsidiaries are used. Domestic† is based on the location of the lending and borrowing bank: the borrowing subsidiary is classified as domestic if it is located in the same country as the lending subsidiary, and as foreign otherwise. Domestic‡ is based on the subsidiary's location relative to its headquarters: the subsidiary is classified as domestic if it is located in the same country as its banking group's headquarters, and foreign otherwise. Standard errors are two-way clustered at the borrowing bank-time and lending bank-time level. ***, **, and * denote significance at the 1%, 5%, and 10% (two-sided) levels, respectively.

Table 5: Between-Group Lending to Domestic and Foreign Subsidiaries

	Loan amount	
	Borrowing Subsidiary's Losses	Lending Subsidiary's Losses
Definition of domestic/foreign	Dom.†	Dom.†
	(2)	(4)
Collateral Security Losses$_{b,t-1}$	-4.119*	
×Foreign$_b$	(-1.71)	
Collateral Security Losses$_{b,t-1}$	-22.92***	
×Domestic$_b$	(5.939)	
Collateral Security Losses$_{l,t-1}$		-6.699
×Foreign$_l$		(6.421)
Collateral Security Losses$_{l,t-1}$		-13.57**
×Domestic$_l$		(5.590)
Bank Lender-Bank Borrower FE	Yes	Yes
Country Lender-Time FE	Yes	Yes
Country Borrower-Time FE	Yes	Yes
N	35271	35243
R^2	0.842	0.841

The table presents the results of the effects of banks' security losses on between-group lending to domestic and foreign subsidiaries, as described by Equations (2) and (3). The dependent variable is the natural logarithm of the outstanding interbank credit amount issued by a lending bank l to a borrowing bank b during month t. Security losses are calculated based on Equation (1). Domestic† is based on the location of the lending and borrowing bank: the borrowing subsidiary is classified as domestic if it is located in the same country as the lending subsidiary, and as foreign otherwise. Standard errors are two-way clustered at the borrowing bank-time and lending bank-time level. ***, **, and * denote significance at the 1%, 5%, and 10% (two-sided) levels, respectively.

Table 6: Large Subsidiaries and Intra-Group Domestic and Foreign Lending

	Loan Amount	
	(1)	(2)
Collateral Security Losses$_{b,t-1}$	8.025**	26.48*
	(3.857)	(14.56)
Collateral Security Losses$_{b,t-1}$× Large Subsidiary$_b$	11.22**	-58.02***
	(5.245)	(20.95)
Collateral Security Losses$_{b,t-1}$× Domestic$_b$		-22.56
		(14.89)
Collateral Security Losses$_{b,t-1}$× Large Subsidiary$_b$× Domestic$_b$		67.87***
		(21.48)
Bank Lender-Bank Borrower FE	Yes	Yes
Country Borrower-Time FE	Yes	Yes
Country Lender-Time FE	Yes	Yes
N	19267	16091
r2	0.906	0.909

The table presents the results of the effects of banks' security losses on intra-group lending to domestic and foreign subsidiaries, differentiated by subsidiary size. The dependent variable is the natural logarithm of the outstanding interbank credit amount issued by a lending bank l to a borrowing bank b during month t. Security losses are calculated based on Equation (1). Large Subsidiary is a dummy variable, which takes the value of one if the subsidiary's total assets rank above the median of total assets within its banking group, and zero otherwise. Domestic is an indicator variable that takes the value of one if the subsidiary is located in the same country as its banking group's headquarters, and zero otherwise. Standard errors are two-way clustered at the borrowing bank-time and lending bank-time level. ***, **, and * denote significance at the 1%, 5%, and 10% (two-sided) levels, respectively.

Table 7: Security Losses and Bank Lending to Firms

	Loan Amount						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Collateral Security Losses$_{b,t-1}$	-2.910***	-2.542***	-5.476***				-5.204***
	(0.572)	(0.541)	(0.576)				(0.945)
Collateral HTM Security Losses$_{b,t-1}$				-7.120***		-6.489***	
				(0.838)		(0.872)	
Collateral AFS Security Losses$_{b,t-1}$					-5.727***	-3.868***	
					(1.069)	(1.048)	
Collateral Security Losses$_{b,t-1}$							-2.588***
×Collateral Util. Rate$_{b,2022q1}$							(0.354)
Bank Controls	No	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Banking Group-Time FE	No	No	Yes	Yes	Yes	Yes	Yes
N	16290844	16290840	16290839	16290839	16290839	16290839	12536511
R^2	0.972	0.972	0.972	0.972	0.972	0.972	0.968

The table presents the results of the effects of banks' security losses on bank lending to firms, as described by Equation (4). The dependent variable is the natural logarithm of the outstanding credit issued by a bank (subsidiary) b to a firm f during month t. Security losses are calculated based on Equation (1). Collateral utilization rate is defined as the ratio of ECB + interbank borrowing to total security holdings. Standard errors are two-way clustered at the bank and time level. ***, **, and * denote significance at the 1%, 5%, and 10% (two-sided) levels, respectively.

Table 8: Security Losses, Banking Group Structure and Lending

	Loan Amount		
	All Banks	Domestic Banks	Banking Groups
	(1)	(2)	(3)
Collateral Security Losses$_{b,t-1}$× Standalone Bank$_b$	-6.761***	-7.368***	
	(2.052)	(2.064)	
Collateral Security Losses$_{b,t-1}$× Subsidiary$_b$	-1.951***	-1.985***	
	(0.8181)	(0.855)	
Collateral Security Losses$_{b,t-1}$× Foreign Subsidiary$_b$			-4.125***
			(1.093)
Collateral Security Losses$_{b,t-1}$× Domestic Subsidiary$_b$			-1.446***
			(0.556)
Bank Controls	No	No	No
Bank-Firm FE	Yes	Yes	Yes
Firm-Time FE	Yes	Yes	Yes
Banking Group-Time FE	No	No	Yes
N	16290844	13748918	10611217
R^2	0.972	0.972	0.974

The table presents the results of the effects of banks' security losses on bank lending to firms, by differentiating different types of banks. The dependent variable is the natural logarithm of the outstanding credit issued by a bank (subsidiary) b to a firm f during month t. Security losses are calculated based on Equation (1). Column 1 contrasts the lending behavior of standalone banks with subsidiaries of the banking groups. Column 2 repeats the analysis from Column 1 but restricts the sample to standalone banks and domestic subsidiaries within the same country. Column 3 restricts the sample to banking group subsidiaries and examines differences between domestic and foreign subsidiaries. A subsidiary is classified as domestic if it is located in the same country as its banking group's headquarters, and as foreign otherwise. Standard errors are two-way clustered at the bank and time level. ***, **, and * denote significance at the 1%, 5%, and 10% (two-sided) levels, respectively.

Internet Appendix

Figure 6: Importance of AFS Portfolio over Time

(a) Share of Securities in AFS Portfolio



(b) Reclassification



The figure examines changes in the importance of the AFS (Available for Sale) portfolio. Panel A plots the distribution of the share of all securities held in the AFS portfolio as a percentage of total security holdings in 2022 Q1 versus 2023 Q3. Panel B uses observations at the bank-ISIN level and focuses on the subset of securities that a specific bank b has reported in both AFS and HTM portfolios in different periods. It plots the share of securities from this restricted sample that are reported as part of the AFS portfolio in 2022 Q1 versus 2023 Q3.