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MARKET RISK OF SECURITIES HELD BY ITALIAN BANKS AND INSURANCE COMPANIES

by Michele Leonardo Bianchi* and Federica Pallante**

Abstract

In this paper, we study the market risk of the securities portfolios of Italian banks and insurance companies. We use granular information on securities holdings extracted from the statistical data collected by Banca d'Italia and IVASS in the years 2016 to 2023 from each Italian bank or insurer. We consider value-at-risk and expected shortfall as market risk measures. These risk measures are calculated using a historical simulation approach. For all institutions located in Italy, whether or not they have validated internal models for market risk or not, portfolio profits and losses are computed through simple operations and without the need for complex calibration algorithms. After analysing the differences in the composition of the securities portfolios of Italian banks and insurers, our findings show that despite insurers exhibiting higher exposure to equities and funds, the market risk of banks and insurers remains comparable.

JEL Classification: G21, G22, G32.

Keywords: value-at-risk, expected shortfall, granular data, banks, insurance companies.

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Introduction[1]

From a risk management perspective, market risk can be defined as the risk of losses of a financial assets portfolio caused by adverse price movements. From a regulatory perspective, under Basel Accords for banks, market risk stems from the behavior of all the positions included in trading book as well as from commodity and foreign exchange risk positions in the whole balance sheet and, under Solvency II for insurances, this risk depends on both assets and liabilities. In the following analysis only assets are taken into account, including those assets related to unit-linked products whose risk is borne by policyholders. This implies that the estimates presented in this study cannot be directly compared to those computed by banks and insurances for regulatory purposes.

A considerable share of the assets of Italian banks and insurances consists of debt securities, equity securities and fund units. These portfolios are usually referred to as securities holdings. In this work we explore the market risk of these holdings (i.e., by looking only at the assets) from a portfolio perspective, that is we analyze and compare the risk of the whole securities portfolio of these institutions, irrespective of any accounting or prudential rule. It is important to highlight that our approach provides a partial view of the overall risk. This limitation arises from our exclusive focus on assets. We do not analyze liabilities, where a significant part of the market risk for insurances lies.

The market risk of banks and insurances portfolios is analyzed on the basis of a methodology that uses the granular information of the securities (taken from the statistical and supervisory reports) and market data obtained from Datastream (LSEG). The risk indicators analyzed in this study are the value-at-risk (VaR) and the expected shortfall (ES) calculated for each individual institution. The riskiness of the securities portfolios of insurance companies is compared with that of the securities portfolios of Italian banks. The empirical analysis takes into consideration each trading day from March 31, 2016 to October 31, 2023.

From a methodological point of view, portfolio profits and losses are estimated on the basis of historical distributions of a set of representative risk factors (see Alexander [2009], Bianchi [2023] and Bianchi et al. [2023]). This historical approach is used by most euro area banks in internal models for market risk (see EBA [March 2021]), albeit with a higher granularity of their risk factors.

Our approach relies only on statistical and supervisory reports, and this emphasizes the importance of having reliable granular data to conduct advanced financial stability analyses (see Glasser [2013]).

The rest of the paper is organized as follows. In Section 1, we describe the granular data on securities on which our risk estimates are based. Then in Section 2, we present our non-parametric modeling framework, we define the risk factors, we show the pricing functions and how the risk measures can be evaluated. In Section 3 we describe the main findings of the empirical analysis by focusing on the differences between institutions and by analyzing the contribution of each asset

[1]The authors are grateful to Pierluigi Bologna, Giovanni Guazzarotti, Stefano Pasqualini and Agostino Tripodi for their helpful suggestions. This publication should not be reported as representing the views of the Bank of Italy and the IVASS. The views expressed are those of the authors and do not necessarily reflect those of the Bank of Italy and the IVASS.

class to the overall risk. Section 4 concludes.

1 Securities holdings data

The Banca d'Italia (IVASS) collects granular data on banks and insurances securities portfolios. Starting from 2008 (2016), monthly (quarterly) security-by-security holding data at an individual level are collected to the Banca d'Italia (IVASS) for each bank (insurance) located in Italy. The data are collected on the basis of the internationally recognized code for the identification of financial instruments (International Securities Identification Number, ISIN). The information provided includes fair values and nominal amounts. It should be noted that all securities are evaluated at fair value, irrespectively of the accounting portfolio.

The Banca d'Italia maintains also an electronic archive, named Securities Database, containing the details of each ISIN that banking and financial institutions and other companies report. The attributes crucial for determining risk factors can be directly derived from this database, such as security type, issuer sector, issuer country or region, residual maturity, coupon type, and currency. This enables us to efficiently and automatically explore and analyze the portfolio allocation.

After eliminating possible infra-group exposures, we consider the holdings of all Italian entities aggregated at a group level. On the basis of end-of-month, for banks, and end-of-quarter, for insurances, securities portfolios we estimate our risk measures on a daily basis. The dataset on which our empirical study is based has over nine million data points ranging from March 2016 to October 2023.

In Figure 1 we show the portfolio composition and the residual maturities of the assets in the portfolios. On the left (right) side we focus on all Italian banks (insurances). While infragroup transactions are excluded, here participations are included.

From March 2016 to October 2023, the securities portfolio of Italian insurances increased from 704 to 808 billion, with a peak of 957 in December 2021. In the same period, the securities portfolio of Italian banks (including Poste Italiane and Cassa Depositi e Prestiti), increased from 647 to 760 billion, with a peak of 818 in February 2022, due to the increase in purchases of government securities (Italian government securities and bonds issued by foreign sovereign or international bodies). Italian sovereign bonds represent, in the analyzed period, a large portion of the investments of both Italian banks (62%) and insurances (38%). Bonds issued by foreign sovereign or international bodies represents around 11% (8%) of the total exposures of Italian banks (insurances). The exposure to corporate and financial bonds, excluding securitizations and covered bonds, is also remarkable: slightly less than 10% for banks and 20% for insurances. Securitizations and covered bonds are the 4% of the overall holdings of banks and only 1% of the overall holdings of insurances. While the amount of investment funds in the insurances portfolios is material, on average around 28% of the total exposure, this is only a small portion of banks portfolios (less than 2%). Finally, equities, including participations, represent slightly more than 9% (5%) of the total portfolio of banks (insurances).

As expected, in the analyzed period, the overall duration of insurances portfolios

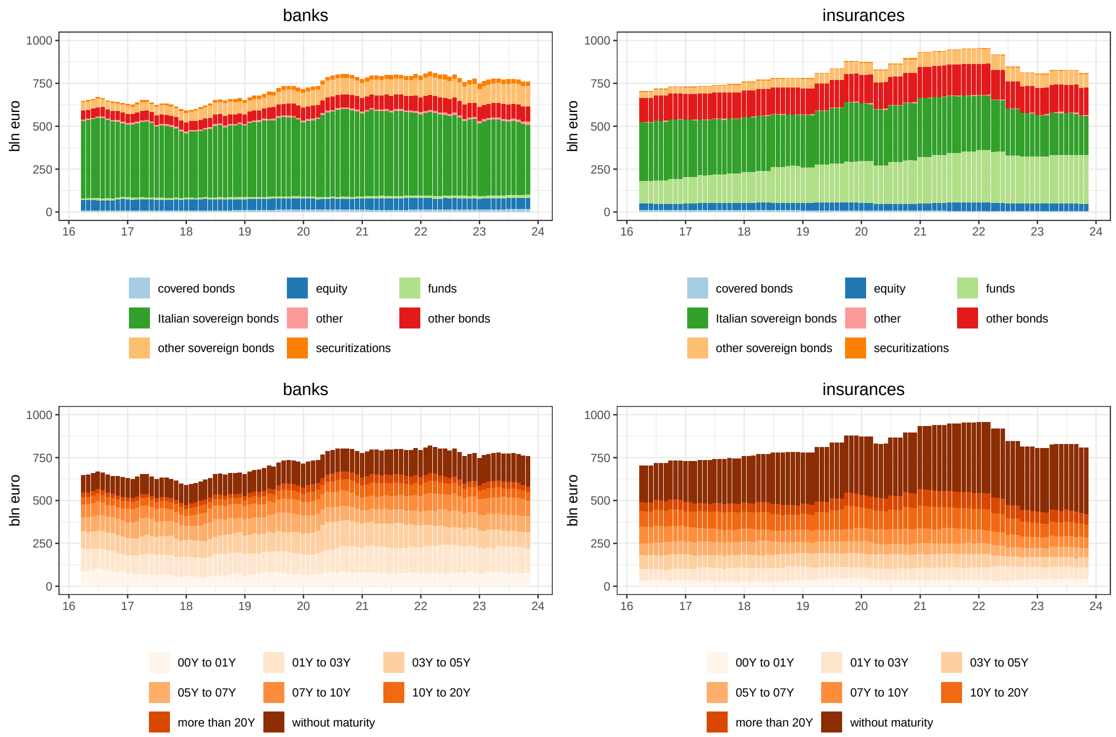

Figure 1: Italian banks and insurances securities holdings from March 2016 to October 2023. Portfolio composition and residual maturities are shown.

is higher than that of bank portfolios: 30% (23%) of the assets in the insurances (banks) portfolio have a residual maturity above five years and 40% (19%) are without maturity.

Given our primary objective of assessing the overall risk of securities portfolios held by both banks and insurance companies, we take into account all accounting portfolios, excluding participations. In the case of banks, this is roughly equivalent to considering both the banking and trading books. It is worth noting that larger banks often calculate the value-at-risk (VaR) for their entire securities portfolio in their day-to-day risk management practices, even though, for regulatory purposes, VaR is typically required only for positions in the trading book.

In the context of insurance companies, the regulatory VaR is evaluated by looking at both assets and liabilities. However, based on the information available, the work primary objective is to study the market risk of the securities portfolios of both insurers and banks. Moreover, our assessment has a financial stability perspective rather than a prudential one. This suggests a focus on broader and different implications and considerations beyond regulatory compliance.

2 Methodology

In our modeling approach, we strive for simplicity by adopting the historical simulation method, which is a non-parametric method. The historical simulation approach holds widespread popularity in the banking industry, as discussed in

Laurent and Omidi Firouzi [2017]. This preference is primarily attributed to its ability to reduce computational complexity compared to parametric models. Notably, it eliminates the need for a parameter estimation phase, making it adaptable across various asset classes such as bonds, equity, and derivatives.

According to the market risk benchmarking exercise detailed in EBA [March 2021], nearly three-quarters of European banks compute market risk requirements by means of historical simulation models. These models are often not only employed for prudential purposes but also integrated into risk management practices. It is important to highlight a scale difference in data processing between large investment banks and the Datastream (LSEG) data considered in this study. While risk management units in major banks typically handle thousands of risk factors, this study focuses on approximately 250 risk factors, emphasizing a more lean and streamlined approach.

Given the heterogeneity of securities in the portfolios of the institutions, we identify a set of risk factors and mapping each security to these factors. This approximation method simplifies the complexity of the problem, sparing us from the intricate task of handling daily prices for the numerous securities involved. It is crucial to acknowledge that mark-to-market values may not always be readily available for every security in the portfolios investigated in this study. As a result, an approximation approach is needed (see Bianchi [2023] for a discussion on approximations in this context).

Historical simulations draw from the past movements of the selected risk factors. The unweighted historical variations of these risk factors directly influence the valuation of the portfolio profit and loss (PnL).

Regarding the historical lookback period, we opt for a 250 trading-day period to calibrate our risk models. While this choice may be less conservative during periods of market calm, it enhances the responsiveness of the risk measures during stress periods. This modeling assumption significantly impacts the estimates. As noted in the benchmarking exercise conducted by EBA [March 2021] on a sample of European banks from 14 jurisdictions, the choice of lookback period varies among institutions. More than half of the banks in the sample use the minimum period of one year. Interestingly, only a minority (5 out of 53) of the banks opt for a lookback period greater than two years. This diversity in practice emphasizes the importance of considering different time horizons and reflects the range of approaches employed in the industry.

2.1 Risk factors

To ensure the relevance of risk factors and avoid defining them for exposures that are not material, our approach involves selecting risk factors associated with securities that, across the entire system of banks and insurances, exceed, on average over the observation period, 50 million euros. The chosen risk factors are then linked to market reference indexes, and this association represents the only manual step in the entire procedure. For each risk factor, we conduct a search for an appropriate market reference index, taking into account features such as data availability and quality. Importantly, the selection of risk factors is influenced by the availability of data throughout the entire observation window, spanning from 2015[2] to 2023. This ensures that the chosen risk factors are supported by robust and comprehensive data for the whole time period.

Limitations in data quality hinder our ability to consider the maturity of covered bonds, securitizations, and non-material exposures. Consequently, within our framework, risks associated with covered bonds and securitizations are exclusively captured through their credit spreads. As observed in Section 1, these bonds represent a small fraction of the total exposure.

Given that a substantial share of insurances exposures comprises investment funds (to which we refer as *funds* hereafter), we perform a look-through analysis to gain insights into each fund geographic focus, underlying asset classes, and fund type. This detailed examination enables us to define risk factors specific to funds. These factors are subsequently included in a distinct class, recognizing the diverse nature of risks associated with different funds. By incorporating this look-through approach, we enhance the granularity of our risk assessment, acknowledging the unique characteristics and exposures embedded within each investment fund. This enhancement ensures that our risk factors within this ad-hoc class effectively capture the complexities associated with fund investments, contributing to a more focused risk modeling framework. It should be noted that the available information allows us to define only a proxy for the dynamics of these funds. Given that we are dealing with around 14,000 funds, we are not able to assess to which extend our approximation affects the goodness of the risk estimates. It is evident that the approximation error is low for some securities, such as for example major sovereign bonds having a liquid secondary market for which market data are reliable. Conversely, the approximation error could be high if the risk factor on which a given security is mapped does not exactly represent the risk of that security.

In our risk factor selection, we identify a total of 257 risk factors across five categories: interest rate (81), credit (109), equity (29), funds (15), and foreign exchange rate (23). We consider interest rate (IR), asset swap spread (ASWPS), price index (PI), and middle exchange rate (ER) fields obtained from Datastream (LSEG) to capture interest rate, credit, equity and funds, and foreign exchange rate risk, respectively. Since the asset swap spread is the difference between the yield of a bonds and the swap rate with the same maturity, the category credit represents the credit spread with respect to the interest rate. It is important to highlight that our model does not incorporate inflation risk. Our approach allows one to work around data limitations while still effectively capturing and modeling risks associated with various asset classes, ensuring a comprehensive assessment within the constraints of available data quality.

2.2 Risk measures

The historical simulation are obtained by looking at the dynamics of risk factors and by defining two types of shifts s_t, at day t, that is *absolute returns* for interest rate and credit risk factors and *simple returns* for equity, funds or foreign exchange

[2]The estimates are obtained on the basis of the time series of the preceding 250 trading days. For example, the estimates for March 31, 2016 are obtained from the 250 trading days leading up to that specific date.

risk factors. The former returns are defined as the difference between the current value of the risk factor and its value on the previous day, the latter returns are defined as the ratio between the absolute returns and the value of the risk factor on the previous day.

As observed in Section 2.1, there are five risk factor categories: interest rates (IR), credit (CR), equity (EQ), funds (IF) and foreign exchange risk (FX), eventually with weight equal to zero in the case a given risk does not affect the dynamics of the value of the security.

The PnL of a security j with fair value FV_t^j at day t under the scenario k is computed by taking into account the risk factors affecting the value of the security j,

$$\mathrm{PnL}(t,k,j) = \mathrm{FV}_t^j \left(r_{IR}^i(t,k,j) + r_{CR}^c(t,k,j) + r_{EQ}^e(t,k) + r_{IF}^f(t,k) + r_{FX}^x(t,k) \right), \tag{2.1}$$

where r represents the return corresponding to each risk. Additionally, we have

$$r^\alpha(t,k,j) = -D_t^j s^\alpha(t,k) + \frac{1}{2} C_t^j (s^\alpha(t,k))^2,$$

where $\alpha \in \{(i,IR),(c,CR)\}$, D_t^j and C_t^j are the modified duration and the convexity of the security j at a given reporting date t, s^α is the shift of the i-th interest rate or c-th credit risk factor at date t under the k-th scenario. For the other risks, we have

$$r^\beta(t,k) = s^\beta(t,k),$$

where $\beta \in \{(e,EQ),(f,IF),(x,FX)\}$, s^β is the shift of the e-th equity, f-th investment fund, or x-th foreign exchange risk factor at date t under the k-th scenario. It appears clear that while the returns related to interest rate and credit risk depend also on the characteristic of the securities (i.e. duration and convexity), the returns related to equity, funds, and foreign exchange risk do not depend on the characteristics of the single security, but only on the associated risk factor. We are assuming a delta-gamma approach for interest rates and credit risk factors and a delta approach for the other risk factor categories.

The random variable $\mathrm{L}^€$ representing the portfolio PnL, is given by

$$\mathrm{L}^€(t,k) = \sum_j \mathrm{PnL}(t,k,j), \tag{2.2}$$

and the portfolio fair value is

$$\mathrm{FV}(t) = \sum_j \mathrm{FV}_t^j. \tag{2.3}$$

The index k point out a possible realization of the random variable $L^€(t)$ and the reference to t is useful since in the empirical study we estimate the risk measures for each trading day t. If L is the continuous random variable with finite mean defined as the ratio of $\mathrm{L}^€$ over FV, the VaR of L at tail level δ is

$$\mathrm{VaR}_\delta(\mathrm{L}) = -\inf\{q | P(\mathrm{L} \le q) > \delta\} = -F_{\mathrm{L}}^{-1}(\delta)$$

and the ES of L at tail level δ, that is the average of the VaR that are greater than $\text{VaR}_\delta(\text{L})$, is

$$\text{ES}_\delta(\text{L}) = \frac{1}{\delta}\int_0^\delta \text{VaR}_p(\text{L})dp = -E\big[\text{L}\big|\text{L} < -\text{VaR}_\delta(\text{L})\big].$$

Consequently, both VaR and ES are represented as percentages.

Under the historical simulation approach the estimate of the VaR is given by the δ-quantile of L and that of the ES is given by

$$\text{ES}_\delta^M(\text{L}) = \frac{1}{M\delta}\left(\sum_{i=1}^{[M\delta]} \hat{\text{L}}_i + (M\delta - [M\delta])\hat{\text{L}}_{[M\delta]}\right), \tag{2.4}$$

where M is the number of historical scenarios, $\hat{\text{L}}$ is the order vector of realizations, and the symbol $[\cdot]$ represents the integer part.

3 Empirical analysis

In this section, before describing the main empirical results, we summarize the essential steps of our risk measurement framework. The main steps of our approach are as follows: (1) we select all n factors F that account, across the whole system, for an average value of at least 50 million euros (for exchange rate risk we consider also factors greater than 50 million euros for a single reference date); (2) we simulate historical scenarios for each risk factor; (3) given the simulations of the previous step, map the risk factors into the PnL variable by considering the values of the exposures, duration and convexity data; (4) given the simulations of the PnL variable, compute the VaR and the ES for each tail level (0.01, 0.025 and 0.05).

Except for the initial step, all subsequent stages from 2 to 4 are executed daily for each trading day t, spanning from March 31, 2016, to October 31, 2023. By equation (2.1), the PnL is a function of risk factors, the values of the exposures, and appropriately selected modified durations and convexities. Daily data for bond sensitivities (fields DM and CX) are extracted from Datastream (LSEG) for the period between March 31, 2016, and October 31, 2023. In cases where modified duration and convexity are not available for a specific debt security at a given point in time, we compute weighted average durations and convexities. These averages are evaluated across all institutions on each trading date, for each maturity bucket and debt security type (ordinary bonds, securitizations, and covered bonds). Datastream (LSEG) provides duration and convexity information for a substantial number of bonds: we deal with around 25 million observations.

The algorithm is implemented in R, a statistical programming language (refer to R Core Team [2023]). While parallelization of the code is not strictly necessary, the execution is carried out on a multi-core platform capable of utilizing up to 40 cores concurrently. The estimates of the risk measures are evaluated by parallelizing the loop over trading days. The system is based on Linux and is equipped with Intel Xeon E5-2665 2.40GHz processors, along with a substantial amount of RAM

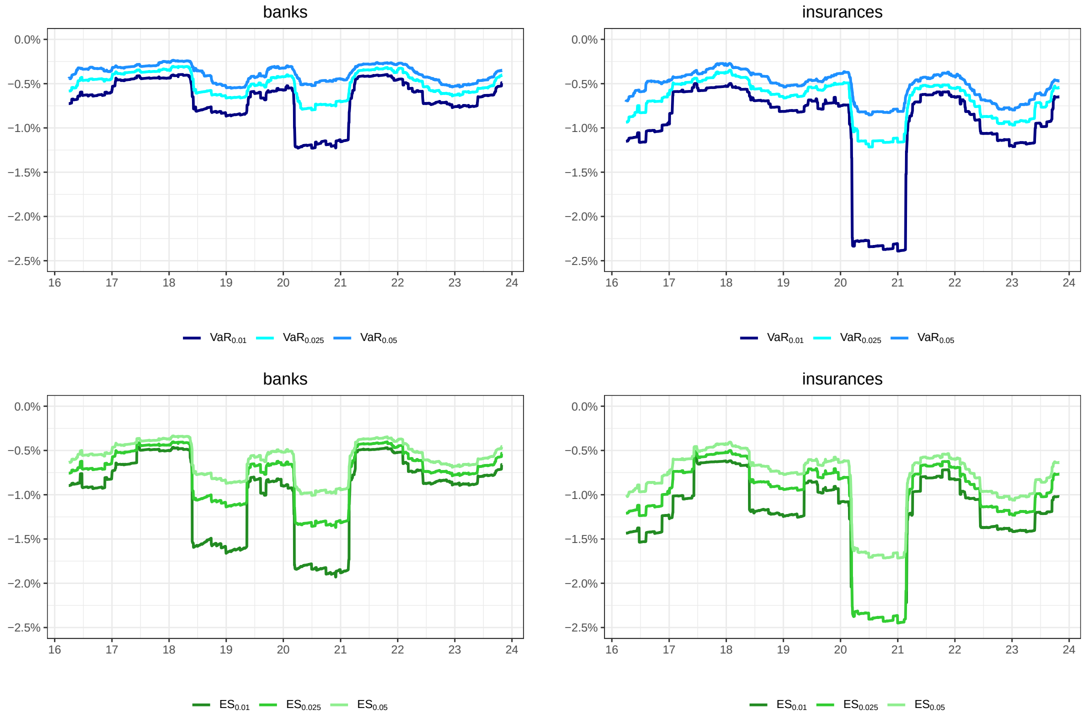

Figure 2: Italian banks and insurances risk estimates from March 2016 to October 2023. VaR and ES are shown. For both risk measures we consider the ratio between estimates expressed in euro and the fair value of the portfolio.

needed for the processing of the data. Surprisingly, the most time-consuming step of the algorithm is the download of the CX field from Datastream (LSEG).

The estimation of the risk measures is conducted for three tail levels (0.01, 0.025 and 0.05) and for each bank (insurance) having securities exposures in the period from March 2016 and October 2023 (i.e. 1,979 trading days). Since banks (insurances) report their holdings at the end of each month (quarter), we assume that the portfolio composition does not change during the month (quarter). This assumption is not too strong mainly because large institutions usually do not modify suddenly the allocation of their portfolio.

In Figure 2 we show the risk measure estimates for the three tail levels. Even if VaR and ES are evaluated at an institution level, we show the risk measures aggregated for all banks and all insurances. In aggregating risk measures, the weights are the fair values of the portfolios of each institution. For both risk measures we consider the ratio between estimates expressed in euro and the fair value of the portfolio. Then in Table 1 for the two risk measures, the three tail levels, and by distinguish between banks and insurances, we report some summary statistics computed over time. We evaluate various statistics of these time series over all trading days considered in this study. This allow us to evaluate the differences between Italian banks and insurances.

The risk of banks and insurances is comparable. Insurances are more exposed to equities and funds.[3] For this reason their risk estimates are more volatile (see

[3] A significant part of the risk of these exposures is not borne by the insurances but by the

		tail level	min	max	mean	median	σ
VaR	banks	0.01	-1.23	-0.40	-0.67	-0.63	0.24
		0.025	-0.80	-0.30	-0.50	-0.47	0.14
		0.05	-0.55	-0.24	-0.38	-0.36	0.09
	insurances	0.01	-2.39	-0.50	-0.99	-0.80	0.54
		0.025	-1.22	-0.35	-0.69	-0.62	0.23
		0.05	-0.85	-0.27	-0.53	-0.48	0.16
ES	banks	0.01	-1.93	-0.46	-0.97	-0.85	0.46
		0.025	-1.37	-0.40	-0.75	-0.68	0.29
		0.05	-1.01	-0.34	-0.60	-0.55	0.20
	insurances	0.01	-3.63	-0.56	-1.38	-1.19	0.84
		0.025	-2.45	-0.50	-1.06	-0.91	0.54
		0.05	-1.71	-0.41	-0.84	-0.73	0.36

Table 1: Summary statistics of the estimated risk measures between March 2016 and October 2023. We evaluate various statistics of these risk measures time series: minimum (min), maximum (max), mean, median, and standard deviation (σ).

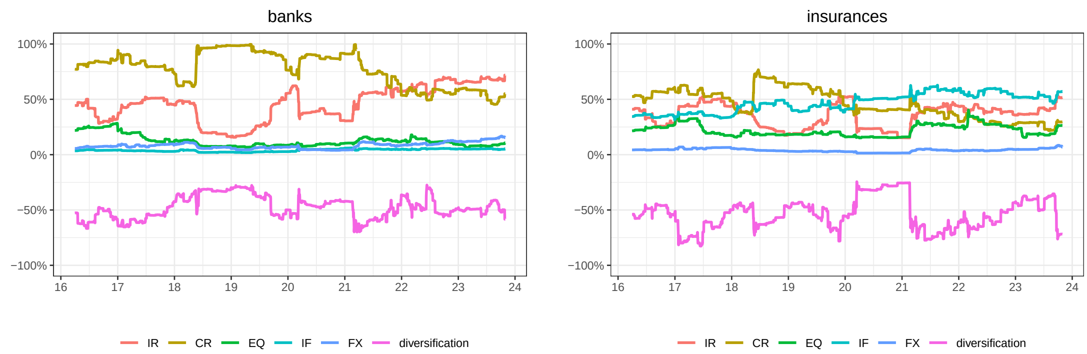

Figure 3: Italian banks and insurances risk estimates from March 2016 to October 2023. Risk contribution of each risk factor category to the VaR with tail level 0.01 is shown.

Table 1) and affected by market crashes as occurred at the end of the first quarter of 2020. However, the risk of banks strictly depends on their exposure to credit risk, as observed during the turmoil after the Italian political elections in 2018, due to the high weight of Italian sovereign bonds on their security holdings. The mean (median) value of VaR with tail level 0.01 was -0.67% (-0.63%) for banks and -0.99% (-0.80%) for insurances. The mean (median) value of ES with tail level 0.01 was -0.97% (-0.85%) for banks and -1.38% (-1.19%) for insurances. Similar differences are observed for other tail levels.

Given the pricing framework in equation (2.1), it is not difficult to evaluate the risk contribution of each risk factor category (IR, CR, EQ, IF and FX) and to obtain the diversification benefit, that is the reduction of total risk given by the

policyholders. According to Solvency II reports, as of September 2023, 28 percent of insurance securities holdings was related to unit-linked contracts. This percentage increased to around 70 percent when considering only investment funds. A similar portfolio composition was observed in the first quarter of 2020.

		risk category	min	max	mean	median	σ
$\mathrm{VaR}_{0.01}$	banks	IR	15.65	71.90	45.72	46.58	15.70
		CR	45.40	100.27	77.40	81.49	15.44
		EQ	6.28	28.34	12.36	10.98	5.30
		IF	1.82	6.10	4.06	4.39	1.16
		FX	3.89	16.76	8.19	7.62	2.83
		diversification	-69.86	-27.44	-47.73	-49.04	10.07
	insurances	IR	15.15	54.16	35.42	38.31	10.24
		CR	21.72	76.74	45.62	41.31	13.30
		EQ	15.16	40.37	21.91	20.01	5.21
		IF	31.42	62.75	46.85	48.36	8.41
		FX	1.33	8.49	4.04	4.06	1.46
		diversification	-82.59	-24.44	-53.84	-54.23	13.97

Table 2: Summary statistics of the risk contribution of each risk factor category to the VaR with tail level 0.01 estimated between March 2016 and October 2023. We evaluate various statistics of these risk measures time series: minimum (min), maximum (max), mean, median, and standard deviation (σ).

aggregation of the five categories. Diversification obtains because the uncertainties comprising the five risk factor categories typically have outcomes with different size and sign. In Figure 3 we show the risk contribution of each category to the VaR with tail level 0.01. We also show in Table 2 some statistics to assess how the five risk categories affect the risk of the two type of institutions. The risk diversification benefit is material for both type of institutions, on average around -54% for insurances and -49% for banks (i.e. there is a greater benefit for insurances).

There are differences between banks and insurances. While the risk contribution of funds in negligible for banks (4%, on average), it is significant for insurances (47%). It should be highlighted that a significant part of this risk is not borne by the insurances but by the policyholders. Equity risk accounts for around 12% (22%) of banks (insurances) overall risk. The impact on the overall risk of interest rate and credit factors is material for both type of institutions. Additionally, among the five risk categories, these are the most volatile risk factors over time (see the σ values in Table 2). The contribution of interest rate risk to the VaR with tail level 0.01 is, on average, equal to 46% for banks and 35% for insurances. For both type of institutions the contribution of credit risk is even higher. It is, on average, equal to 77% for banks and 45% for insurances. However, since most of the banks investments are on bonds, for this type of institutions the risk contribution of interest rate and credit risk factors is larger. It is interesting to notice that from 2021 for both banks and insurances the contribution of interest rate and foreign exchange risks increased and it was partially compensated by the decrease of credit risk.

4 Conclusions

Banks compute risk measures for regulatory purposes solely for positions in the trading book, while insurance companies take into account both assets and liabilities. In this paper, after having analyzed the differences in the composition of Italian banks and insurances security portfolios, we measure the market risk of the whole securities portfolio of these institutions, irrespective of any accounting or prudential rule.

Our methodology relies on granular security holdings data and market data sourced from Datastream (LSEG) to estimate both VaR and ES. We consider three tail levels and we explore the risk contribution of five risk factor categories, that is interest rate, credit, equity, investments funds and foreign exchange rate.

Our analysis shows that the market risk related to the portfolios of banks and insurance companies is comparable, although the latter have a higher risk: during the analyzed period, the median VaR with tail level 1% (i.e. expressed as the ratio between the monetary VaR with tail level 1% and the portfolio fair value) was -0.63 percent for banks and -0.80 percent for insurances. However, a portion of the risk related to insurances is not borne by the insurances but by the policyholders. Both for banks and insurance companies, interest rate risk and credit risk are the factors that contribute significantly and predominantly to the overall risk. Insurance companies have greater exposure to equities and funds, resulting in more volatile risk estimates. A significant portion of these funds are related to unit-linked contracts. Insurance portfolios benefit more from portfolio diversification.

Finally, even if our approach is built on a huge amount of granular data, it prioritizes simplicity, requiring no model calibration and relying solely on straightforward matrix operations. This practical and scalable methodology serves as a transparent tool for assessing market risk in securities portfolios.

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