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A Risk Dashboard for the Italian insurance sector

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Abstract

The paper presents the general features of the Risk Dashboard as an instrument for macroprudential supervision of the financial sector and motivates why it could also be useful in monitoring the specific risks of insurance. After a synthetic description of two EU-level Risk Dashboards, one by the European Systemic Risk Board (ESRB) covering the whole financial sector, the other by the European Insurance and Occupational Pensions Authority (EIOPA) for the specific risks of the European insurance, we illustrate how IVASS implemented its own Risk Dashboard in order to monitor the risks of the Italian insurance companies. We deal extensively with the definition of the risk macro-categories, the description of the indicators, the construction of their scores and the graphical tools displaying the main results, also presented by historical series starting from the coming into force of Solvency II regulatory framework in 2016.

JEL codes: G22, G28.
Keywords: macroprudential supervision, financial stability, financial risks, insurance sector, risk scoring, heatmap, Risk Dashboard.

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Introduction

This paper aims to provide a general framework of the role of a Risk Dashboard (RDb) as a tool of macroprudential supervision for the financial sector and to analyse IVASS RDb within this framework.

Following the 2012 International Monetary Fund Financial Sector Assessment Program (FSAP) of the Insurance Core Principle 24 (Macroprudential Surveillance and Insurance Supervision), IVASS developed an early warning system specifically calibrated to represent the insurance Italian market, based on the same structure of Rdb used by the European Insurance and Occupational Pension Authority (EIOPA) and the European Systemic Risk Board (ESRB). As a consequence, IVASS has been maintaining an RDb since the end of 2013 for internal use and, since 2016, for the integration of the insurance section within the Bank of Italy's RDb covering the financial risks of the Italian economy.[1] In 2016 the RDb has been entirely restructured to take into account the data from the new Solvency II supervisory framework. The tool is continuously refined with the two main aims of: 1) guaranteeing a high degree of comparability with the RDb developed by EIOPA for the insurance sector of the whole European Union; 2) focusing on the specific risks of the Italian insurers.

The results of IVASS RDb are publicly available in the IVASS Annual Report in full accordance with the recommendation of transparency within the Insurance Core Principle n. 24 (IAIS, 2019, 1). In accordance with the principle, this paper provides a detailed discussion of IVASS RDb's methodology, a practice also followed by the Bank of Italy for its own RDb.[2]

IVASS RDb can be regarded as a comprehensive map of the insurance sector's systemic risk. It also provides useful indicators both to the supervised insurers, who can get a synthetic picture of risk they collectively face, and to the general public interested in understanding the motivations for the supervisory measures taken by IVASS.

The text is structured as follows. The first section describes the structure of a typical RDb and the second highlights the main steps of the measurement process, which produces the risk indicators. The third section provides the rationales for an RDb focused on the insurance sector, the fourth contains a short description of two RDbs monitoring the risks of the insurance sector and of the whole financial sector for all the European Union. The fifth section is dedicated to an extensive description of IVASS RBb and includes sub-sections covering: 1) the description of the main risk categories, 2) the aggregation of the indicators in each of them, 3) the graphical presentation of the evidence. The sixth and last section concludes. An appendix displays IVASS RDb's main indicators from the year 2016, when Solvency II regulatory framework came into force, to the latest period available.

1. The main features of a Risk Dashboard

An RDb is a tool for macroprudential supervision that provides quantitative indicators on the degree of distress within the supervised sector. As such, it can be regarded as a support system for supervisory decisions according to a top-down approach: the sector-wide risks identified may suggest how best to focus supervisory resources towards the entities with the highest contributions to the risk.

[1] The Bank of Italy's RDb is mainly for internal use, with some results occasionally appearing on its Financial Stability Report (Bank of Italy, 2020).
[2] See Venditti *et al.* (2018) and Bonato *et al.* (2020).

The validity of an RDb depends on its capability of early detection of two kinds of risks. The risks of the first kind are called inward risks and are those that threaten the sector stability. One of the primary goals of the supervisor should be the early detection of these risks and the implementation of all the measures required to safeguard the sector's stability. The second type of risks, defined as outward or systemic risks[3], are those arising when the services offered by the sector can no longer be provided, with potentially disruptive effects to the whole economy. The supervisor should pay attention to these latter too.[4]

An RDb also considers the main trends of the external factors (typically macroeconomic variables) which could influence the development of the sector and hence play an effect on its risk profile. These trends are measured together with a set of sector-specific indicators, which require reliable databases for their correct measurement. These databases should be highly granular and well-structured in order to enable a fast information retrieval. These features also make possible the previously mentioned top-down approach.

An RDb measures both the magnitude and the direction of the risks and it should capture the trend inversions that could anticipate the build-up of sector-wide weaknesses.

The typical field of implementation of the RDbs is the financial sector, whose size also justifies the creation of specialized RDbs for critical sub-sectors such as banking and insurance. The instrument supports the supervision of activities which are intensely regulated for the complexity of their inward risks and for their high propensity to become a source of systemic risks for the rest of the economy.[5]

2. Measuring risks in a Risk Dashboard

The measurement process of an RDb takes in various steps (IAIS, 2021, 1). The first classifies the risks into homogeneous macro-categories. This taxonomy needs to be constantly updated to take into account of emerging risks not previously considered. The next step is the identification of the specific risk indicators falling into each macro-category. These first two phases produce therefore a two-level list.

The admissible range of each indicator is then divided into intervals by thresholds corresponding to increasing levels of risk. This process is mainly based on the analysis of historical patterns, whenever a long historical series is available.[6] For some indicators this information can be integrated by "objective" thresholds (often defined by the regulator) and judgmental evaluations.

[3] We rely on the definition of Systemic risk introduced by the International Monetary Fund (IMF), the Bank for International Settlements (BIS) and the Financial Stability Board (FSB) in 2009 at the peak of the financial crisis. It refers to a risk of disruption to financial services caused by a distress of the financial system with potential negative consequences (negative externalities) for the real economy (IAIS, 2019, 2).

[4] We refer to the difficulty for other participants in the financial system to keep on supplying their service after a failure or distress of an individual participant. However, it can also refer to a crisis affecting groups of participants with a highly specialized function or a high market power.

[5] Whereas the economic literature on the systemic risks of the banking sector is vast, the research focusing on the relevance of this risk also for the insurance sector is relatively more recent (Eling and Pankoke, 2012). It acknowledges the much weaker risks posed by the insurance sector to financial stability and highlights that they might mainly derive from non-traditional insurance underwriting (such as excessive underwriting of credit derivatives and financial guarantees) and excessive reliance on short-term funding in order to increase leverage. These risky behaviours are not material for Italian insurers. These findings are partially confirmed by Bierth *et al.* (2015), who carried out a panel analysis on a sample of 253 life and non-life European insurers, showing that their contribution to systemic risks is essentially driven by insurers' relative size and leverage. A generalized consensus has emerged that the insurance sector is a stabilizing factor for the economy rather than a potential source of disruption (Bobtcheff *et al.*, 2016).

[6] Cross-sectoral data might replace time series either if they are not essential or if they are not available or not complete.

Each indicator is accordingly measured by a continuous measure and by a discrete score, obtained by applying the previously mentioned thresholds.

This process is to be synthetized at the macro-category level by a suitable average of the scores of all the indicators falling into it. A weighted average might be necessary if the indicators are not of the same importance and, in such a case, different weights are attached to each of them. In this way, a final score is produced for each macro-category.

The next step is the application of a color-coded risk assessment scale to these scores, typically showing red for the highest alert level, amber for medium-high risk, yellow for intermediate scenarios and green for a low-risk assessment. This step ends the computation of the RDb relative to the latest reference period (typically the last quarter). Finally, these results should be compared with those coming from the latest past periods (in most cases only the previous one is considered), in order to provide a perspective of the risk trends. Arrows are commonly used to indicate the direction of the risk that emerges from this comparison.

An optional refinement of the RDb's results is the addition of forward-looking indicators for risk trends. They are derived from data sources different from those previously used and they may even be based on surveys of experts' forecasts. The analysts who incorporate them in their models should be aware of the uncertainties implied by using subjective expectations to extrapolate risks measured by micro-level financial data.

3. The importance of a specific Risk Dashboard for the insurance sector

A specific RDb for the insurance sector has three main motivations:

1) looking at the financial macro-sector, the size of insurance activity is relevant. For the whole EU, in 2020 its value added was 18% of the total value added generated by the financial sector (Eurostat[7]), without taking into account the sizeable contribution of independent product distributors such as agencies and brokers;

2) the specific features of the insurance business call for specialized risk indicators, different from those traditionally used to assess banks' riskiness;

3) systemic risks may arise in insurance by generalized difficulties for all the companies, generating significant disruptions to the broader financial system and to real economy, even if no insurers is systemically relevant.

An RDb for the insurance sector should look closely at the interconnections with the banking sector, due to the importance of bank-insurance relationships in Italy and in other European countries as well–. These latter ones take many forms, from simple agreements to distribute insurance products through bank branches to the creation of new insurance companies, in most cases controlled by a financial group headed by a bank (Fiordelisi and Ricci, 2011). The relevance of these interconnections for the activity and the profitability of both sectors increases the risk of crises, initially localized within banking or insurance, spilling over the whole financial sector.

[7] https://ec.europa.eu/eurostat/web/main/data/database.

4. Implementations of EU-level Risk Dashboards

The European legislation mandates that the ESRB and the European Supervisory Authorities (ESAs) join their efforts for developing an RDb for the systemic risk of the EU financial sector. Each ESA contributes to this RDb by providing specific risk indicators, which may also be structured as sectoral RDbs. A set of common features, to be shared by all the RDbs, has been agreed upon, in order to manage this two-tiered process.[8]

4.1 The EIOPA Risk Dashboard

In accordance with the flexibility principle, EIOPA's quarterly RDb has always used two additional macro-categories, respectively covering the underwriting risks and the risks derived by the financial markets' perceptions of the insurance sector. At the end of 2021 EIOPA added two further categories for the new risks emerging from: 1) environmental, social and governance factors (ESG) and 2) digitalization and cyber factors. Data are taken from Solvency II templates collected at company or group level, integrated by various financial or external data.

Each indicator is discretized into a ten-value score ranging from 1 (lowest risk) to 10 (highest risk). A set of internal guidelines indicates how to use historical, cross-sectoral data and pre-defined thresholds for this discretization, as well as how to aggregate the individual scores by a weighted average to get a final score for each risk macro-category. Another discretization transforms these final scores into a four-level factor, with each level associated to a colour. Arrows pointing in different directions represent the quarter-on-quarter change of these levels, which ranges from 1 (substantial decrease) to 5 (large increase).

Starting from the edition relative to the second quarter of 2020, an outlook for the following 12 months has been added, based on an opinion survey carried out among the National Competent Authorities (NCAs). Figure 1 shows the graphic representation of the EIOPA RDb for the third quarter of 2022 (EIOPA, 2023), published in January 2023.

Figure 1

Risk Dashboard January
2023 (Q3-2022 Solvency II Data)

Risks	Level	Trend (Past 3 months)	Outlook (Next 12 months)
1. Macro risks	high	→	↗
2. Credit risks	medium	↓	↗
3. Market risks	high	→	↗
4. Liquidity and funding risks	medium	→	↗
5. Profitability and solvency	medium	→	↗
6. Interlinkages and imbalances	medium	→	→
7. Insurance (underwriting) risks	medium	↑	↗
8. Market perceptions	medium	→	→
9. ESG related risks	medium	→	↗
10. Digitalisation & Cyber risks	medium	→	↗

Source: EIOPA.

[8] The two most relevant features are: 1) the utilization of a common set of six risk categories (macro, credit, market, funding and liquidity, profitability, interlinkages and imbalances); 2) a flexibility principle enabling every ESA to add additional risk categories and new indicators to follow new emerging risks, either within an already existing macro-category or inside new ones.

4.2 The ESRB Risk Dashboard

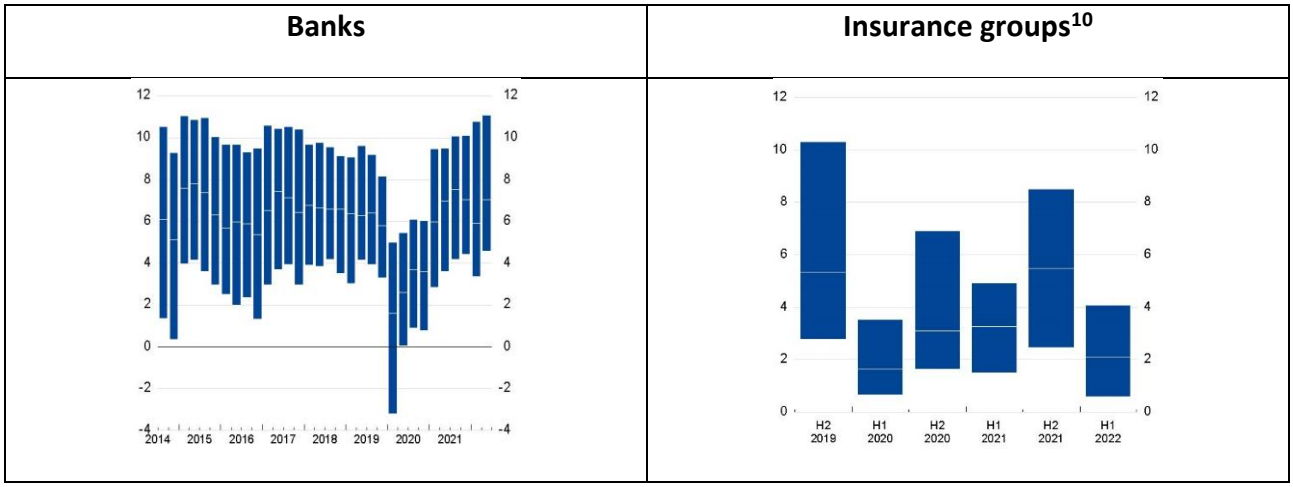
The RDb produced by ESRB contains a detailed set of indicators on all the risk factors of the EU financial sector using a plurality of data sources. Differently from other similar tools, the ESRB RDb does not provide any graphical representations of the intensity and trends of the main risks[9] but it displays the time series of all the indicators, classified into eight macro-categories (the six common ones listed in footnote 8, together with two additional categories for the structural risks and those derived from central counterparties). For almost all categories, where relevant, indicators specific for the banking and the insurance sectors are included, given their relevance in determining the total risk of the financial sector as a whole.

In figure 2 we show, as an example, the historical series of the Return on Equity[10] of the two sectors (ESRB, 2022).

Figure 2

ESRB Risk Dashboard, Return on Equity of the banking and the insurance sectors in the EU
November 2022

(inter-quartile range and median of Roe for two representative samples of banks and insurance groups, %)



Source: ESRB.

5. IVASS Risk Dashboard

The selection of the risk macro-categories for IVASS RDb has been inspired by the choice made by EIOPA for its own RDb and it is currently based on ten groups (tab. 1).

The last two macro-categories 9) and 10) have been recently introduced to capture these emerging risks (in line with IVASS 2021-2023 Strategic Plan[11] and with recent EIOPA's updates).

[9] The initial disclaimer of the report with the RDb's results states that the document is conceived as a statistical report and not as an early warning system.

[10] Since data on equity are not available in the Solvency II reporting, for the insurance groups the return on equity is approximated with the cumulated profit (loss) after tax and before dividends divided by the excess of assets over the liabilities for the current quarter.

[11] One of the plan's strategic requirements is the governance of the technological evolution of the insurance sector, by strengthening the controls of technological development, data governance and cyber risk. Moreover, a strategic objective is the contribution to national and international regulatory developments also with a view to increasing the insurance industry's contribution to the resilience of the national system and sustainable economic development. See: https://www.ivass.it/chi-siamo/organizzazione/Struttura-organizzativa/Strategic_Plan_2021-2023.pdf?language_id=3.

The selection of the indicators within each risk category builds largely on the literature on systemic risk and on the experience of other institutions that ensure financial stability.[12]

IVASS uses the EIOPA Risk Dashboard as a reference benchmark and, where possible, complemented it with indicators developed and used internally at IVASS. For instance, the liquidity indicators include a lapse ratio based on an IVASS monthly monitoring of investments and life sector's liquidity. Another example is the co-movements pattern of insurance and bank stock indexes included among the interlinkages risks. Moreover, compared to EIOPA, the macroeconomic area uses a wider set of forward-looking indicators as a partial replacement of EIOPA's outlook for the following 12 months (see subsection 4.1), not considered in IVASS RDb.

Table 1

Risks considered for IVASS Risk Dashboard

Macro-category of risk	Type of indicators included in the macro-category
1. Macroeconomic	trends of Gross Domestic Product, national output, unemployment, state indebtedness, inflation, interest rates, saving rates
2. Credit	creditworthiness of investments held into the most relevant bond categories (government, private financial and non-financial) and other indicators of investment quality
3. Market	measures of market risk (in terms of volatility, return, duration mismatch and concentration)
4. Liquidity	lapses, liquidity, sustainability of cash-flows
5. Solvency and profitability	solvency ratios, assets over liabilities, measures of own fund's quality, returns (in terms of premiums, equity, assets and investments), non-life combined ratio
6. Interlinkages	indebtedness, reinsurance utilization, investments in domestic sovereign debt, derivatives exposure, participations in other financial institutions, correlation of insurance and bank stock indexes
7. Underwriting	trends of premiums and non-life loss ratio
8. Market perceptions	market expectations for insurers' profits, stock evaluation of listed insurers
9. ESG[(a)]	exposure to physical risks, insurers' ESG ratings, investments in green bonds, climate index
10. Cyber	cyber-attacks, stakeholders' perception of digitalisation and cyber-risks

(a) Environmental, social and governance.

Moreover, some indicators used by EIOPA have been left out because the risks they cover are not relevant for the moment in the supervision of the Italian insurance market.

Data for the Italian economy are obviously used whenever macroeconomic risks are measured. Likewise, all the indicators based on balance-sheet data are derived from Solvency II reporting data on the individual Italian companies[13] and the physical and cyber risks covered in categories 9 and 10 are those localized in Italy.

Lastly, some calibrations used by EIOPA have also been tailored to the Italian specificities.

The following subsections analyse all the macro-categories listed in table 1.

[12] The great financial crisis of the years 2008-12 stimulated the debate among empirical economists working in supervisory bodies about the set of indicators to track in order to anticipate the build-up of systemic risks. See Mencìa and Saurina (2016) for one of the first attempts in Europe to provide a taxonomy of the macroprudential indicators for global financial risk.

[13] IVASS RDb considers data at the level of individual undertakings, differently from EIOPA RDb, which uses data for insurance groups.

5.1 Macroeconomic risks

This macro-category includes the standard macroeconomic variables for Italy that affect the whole economy and could then signal the build-up of risks stemming from macroeconomic developments that would threaten the insurance sector and the financial stability.

The area includes eight indicators, which can be split up into two sub-groups (tab. 2):

- historical indicators such as government debt, 10-year EURO swap rate and the unemployment rate;
- forward-looking indicators forecasting year-on-year real GDP growth, output gap, consumer price index, fiscal balance, change in gross saving rate.

Table 2

Indicators in the macro-category of macroeconomic risks

Historical indicators			Forward-looking indicators				
Government Debt	10-year Euro Swap Rates	Unemployment Rate	GDP Consensus Forecasts	Output Gap	Consumer Price Index	Fiscal Balance	Change in Gross Saving Rate

The forward-looking indicators generally consider four-quarter ahead or four-year ahead expectations. Whenever the indicators combine forecasts covering the next four years, decreasing weights are considered.

A low or negative GDP growth or a large output gap might affect the insurance sector through a lower growth in premiums, a negative impact on investment prices and higher claims in some Line of Business (for example credit insurance). A high unemployment rate could lower the demand of insurance products and trigger higher lapses in life insurance, while higher consumer price indices would increase the cost of claims. Given the crucial role of the government sector in ensuring financial stability, the dashboard also includes forecasts on the fiscal balance and the government debt.

The Gross Saving rate is a two-edged risk. While declining saving rates could depress the demand for life insurance products, even sharp increases could predict uncertainty about future economic outlook and therefore lower the demand for insurance products. For these reasons, this indicator is included in the dashboard as a two-directional risk driver.

The 10-year Euro swap rate is finally included to account for the relevance of the regulatory risk-free rate curve used to discount the companies' technical reserves. More specifically, a prolonged period of low interest rates puts strain on the business model of insurance companies by increasing the market value of their liabilities and by depressing their returns.

5.2 Credit risks

Credit risk can be defined as the risk of losses for the insurance sector due to the inability of counterparties to meet their obligations. This section of the dashboard accordingly measures the vulnerability of the Italian insurers to credit risk, with a focus on their credit exposures to relevant asset classes (government and corporate bonds) combined with relevant financial risk metrics applicable to such classes, together with balance-sheet indicators measuring the credit quality of these assets.

The five indicators for this macro-category are split up into two sets (tab. 3):

- mixed indicators (Solvency II and market data) based on Credit Default Swap (CDS) metrics applied to the investments in government bonds and in financial and non-financial corporate bonds;
- credit quality indicators based on Solvency II data, such as the average rating of investments and the share of "below investment-grade" assets.

Table 3

Indicators in the macro-category of credit risks

Mixed indicators			Credit quality indicators	
Sovereign bonds	Financial corporate bonds	Non-financial corporate bonds	Average rating of investments	Share of low rated investments

Traditionally, bonds are the main asset class for insurers due to their being more liquid and less risky compared to investments such as equities, property and derivatives. However, they would become riskier without a proper diversification or when the CDS spreads of these bonds increases to excessive levels. Therefore, as a first step, the CDSs of the Italian sovereign bonds and of the main financial and non-financial corporate bonds in which Italian insurers invest are measured. In the second step, the risk arising from those financial metrics is weighted with the company's exposures to these asset classes.

The search for yield on the asset sides is a common theme for insurers. On the other hand, a higher return is often associated with a lower credit quality. Credit quality indicates the likelihood of a default, which might have a direct impact on the insurer's profitability, solvency and liquidity positions. To measure this risk, the dashboard includes two credit quality indicators. The first computes the average credit quality of insurers' investments measured by internal and external ratings. A similar indicator integrates the previous one by measuring the share of the worst credit quality assets (corresponding to ratings below the investment grade). [14]

5.3 Market risks

This macro-category encompasses the risks of losses arising from movements in financial market prices. Like the previous area, some indicators use both Solvency II data and financial data in order to combine the exposures to different asset classes with an underlying measure of the relevant market volatility. The exposures give a picture of the vulnerability of the sector to adverse developments while the risk metric, usually the volatility of the yields of the associated indices, is a proxy for the current level of riskiness. Other indicators use balance-sheet data to represent the characteristics of the insurers' asset portfolio.

The area includes five indicators, which can be divided into the following two sub-groups (tab. 4):

- mixed indicators (based on Solvency II and market data) relying on volatility metrics applied to the investments in bonds and equity;
- investment-related indicators such as asset concentration, duration gap and spread of investment return over the guaranteed interest rate.

The main asset classes for Italian insurers are bonds and equities. Fluctuations of these asset prices due to market turbulence could generate economic losses or reduce insurers' own funds and hence affect their Solvency position. Therefore, the first step collects data on the realised volatility of a benchmark government-bond index (the 10-year German Bund) and on the FTSEMIB volatility and Price-to-Book Ratio.

[14] It considers only the investments with Credit Quality Step (CQS) greater than 3. The Credit Rating Scale CQS is a simplified and standardised scale of credit quality, mapped onto the ratings of the main credit rating agencies. It ranges from 0 to 6, with 0 being the highest quality and 6 being the lowest quality (for example, CQS = 4 represents the BB-rated bonds).

In the second step, the risk arising from those financial metric is weighted with the Italian companies' exposures to these asset classes.

Life insurers are also more exposed to market movements whenever there is a material mismatch between their assets and liabilities or in case of a large spread between the investment return of their assets over the guaranteed interest rates of their traditional products. Therefore, the duration gap as an Asset Liability Management (ALM) indicator is included, together with the spread between the investment return over the guaranteed rates to account for additional risks for life insurance stemming from market movements.[15]

Finally, this area contains an indicator of asset concentration through the Herfindahl-Hirschman Index (HHI), since high concentrations on specific asset classes can make a company vulnerable to sector-specific shocks.

Table 4

Indicators in the macro-category of market risks

Mixed indicators		Investment-related indicators		
Investments in bonds	Investments in equity	Spread of investment return over guaranteed interest rate	Duration mismatch[(a)]	Concentration of Assets

(a) Indicator included in Bank of Italy's RDb.

5.4 Liquidity risks

The indicators of this section measure the liquidity conditions in the insurance sector. The required data cover both the liquidity of the assets "*per se*" and the vulnerability to liquidity shocks stemming from a broader picture, encompassing both assets and liability sides of the balance sheet, jointly with the cash-flows.

The six indicators for this macro-category are split up into two sets (tab. 5):

- indicators measuring asset liquidity;
- liquidity indicators from the total balance-sheet, such as the lapse ratio, the ratio of surrenders over premiums and the sustainability of cash-flow positions.

Table 5

Indicators in the macro-category of liquidity risks

Asset liquidity indicators		Total balance-sheet liquidity indicators			
Cash and Deposits	Liquid assets ratio[(a)]	Lapse ratio	Ratio of surrenders to premium income[(a)]	Ratio of surrenders to premium income (Year-on-year change)	Sustainability of cash-flow positions

(a) Indicator included in Bank of Italy's RDb.

Since a low level of highly liquid assets might indicate the inability to pay the liabilities at short notice, the holding of cash and deposit is a gauge of the available liquidity buffer. Moreover, the liquid assets ratio,

[15] This indicator is based on local GAAP data. GAAP is the acronym of Generally Accepted Accounting Practices and indicates the accounting practices valid at the national level, as opposed to those internationally used.

based on assets classification and weighting according to their liquidity[16], provides a quarterly view of the liquidity obtained by assets holding.

Risks can also emerge whenever market movements or policyholders' behaviours force undertakings to sell assets to alleviate liquidity shortages. Hence, it calls for a joint exam of both assets and liabilities. The sustainability of cash-flow positions is a yearly assessment of whether the undertakings hold enough liquid assets to cover the cash-flow position at a given time. It considers the net cash flows stemming from the life and the non-life businesses, as well as those from investments (in the form of income gains/losses over the period).[17]

Furthermore, three indicators specific of the life business aim at measuring the lapse risk. High lapse ratios (in terms both of technical provisions and of written premiums) signal a liquidity risk. As information on surrenders in the Solvency II reporting is available only at the end of every year, the lapse ratio is integrated by two quarterly indicators: the mismatch between life premiums and surrenders and its year-over-year change. These two indicators are based on local GAAP data collected by the IVASS monitoring of investments and life sector's liquidity.

5.5 Profitability and Solvency risks

This section comprises a set of indicators focusing on the profitability and solvency of the insurance sector, based on supervisory reporting (both Solvency II and local GAAP), with a breakdown for life and non-life companies.

The area includes eleven indicators grouped into two subsets (tab. 6):

- profitability indicators, such as standard profitability measures for the whole sector complemented by the combined ratio and the return on investment, applied to the non-life and life businesses respectively;
- solvency indicators, using solvency ratios, asset over liabilities index and quality of own funds. This latter includes a measure of the expected profit in future premiums (EPIFP) used to cover the regulatory capital requirement.

Table 6

Indicators in the macro-category of profitability and solvency risks

Profitability indicators					Solvency indicators					
Return on Equity (ROE)[(a)]	Return on Assets (ROA)	Return on Premiums (ROP)	Combined Ratio - Non Life[(a)]	Return on invest-ment - Life	Solvency Ratio – Total[(a)]	Solvency Ratio - Life	Solvency Ratio - Non-Life	Assets over Liabilities	Quality of Own Funds	EPIFP/Eli-gible Own Funds

(a) Indicator included in Bank of Italy's RDb.

ROE, ROA and ROP are based on the yearly income statement drawn up according to local GAAP, but they should be monitored more frequently. For this reason, IVASS RDb computes them also at half year with data collected through the quarterly survey on potential vulnerability covering an extended sample of insurance entities relevant for the sector's financial stability. Two specialized profitability measures for the

[16] The index is based on the Basel III Liquidity Coverage Ratio. Liquid assets are calculated by applying haircuts to the different asset categories, in line with the banking sector rules set by Commission Implementing Regulation (EU) 2016/322 of 10 February 2016. For more details, see EIOPA 2021 (1) and EIOPA 2021 (2).

[17] We refer to footnote 16 for the methodology.

life and the non-life sectors are respectively: 1) the ratio between investment income[18] over total investments, 2) the combined ratio.[19]

The solvency score is based on the ratio of eligible capital to required solvency capital (in accordance with the Solvency II regulatory framework). It is computed for the total sector and, separately, for life and non-life companies to capture the specific vulnerabilities of the two types of business. Composite undertakings[20] are only included in the total indicator. Three indicators integrate the risk signals of the solvency ratios:

1) the assets over liabilities indicator, which helps to understand any solvency issue;

2) two quality measures of the eligible own funds (EOF) to meet the Solvency capital requirement:

- the share of Tier 1 EOF over the total EOF;
- the proportion of expected profit in future premiums over the total EOF.

While the first indicator of EOF quality assesses the own funds' loss-absorption capacity, the latter aims at highlighting the share of own funds subject to uncertainty.

5.6 Interlinkages risks

Under this section various kinds of national and international interlinkages are assessed: within the insurance sector itself, between the insurance sector and other financial sectors, as well as interlinkages created via derivative holdings. The exposure towards domestic sovereign debt is included as well.

Eight indicators belong to this macro-category, grouped into two sub-categories (tab. 7):

- interlinkages within the insurance sector, measured by investments in insurances and the reinsurance rate;
- interlinkages towards other financial intermediaries and government measured by non-insurance liabilities, investments in financial institutions other than insurances, exposures in derivatives and domestic sovereigns and a market indicator of the correlation between the stock indexes for banks and insurances.

Table 7

Indicators in the macro-category of interlinkages risks

Within the insurance sector		Towards other financial intermediaries and counterparties					
Investments in insurances	Reinsurance part of premiums	Insurers' non insurance liabilities	Investments in domestic sovereign bonds	Investments in banks[(a)]	Investments in other financial institutions	Derivative holdings	Comovement analysis (market indicator)

(a) Indicator included in Bank of Italy's RDb.

The first indicator aims at capturing the direct interconnectedness stemming from the asset side of the insurers within the insurance industry (excluding pension funds), while the second measures the degree of interconnection from the liability side stemming from the reinsurance treaties in force. By strongly relying on reinsurance, the insurers increase the systemic risk within the insurance sector caused by reinsurers'

[18] The assets held for index-linked and unit-linked contracts are not considered, due to the peculiar features of these contracts.

[19] The latter indicator measures net costs (sum of operating expenses and insurance-related claims) in proportion to net premiums. High combined ratios can hamper the generation of sufficient profits from the insurance business and therefore decrease the volume of own funds.

[20] Undertakings pursuing simultaneously both life and non-life insurance activities according to article 73(5) of the Solvency II Directive.

potential insolvency. The ratio of the amount of premiums ceded to reinsurers on total premiums measures this risk. The indicator is more relevant for the non-life business, due to its structurally higher use of reinsurance covers compared to the life business.

The second sub-category keeps track of Italian insurances' national and international interlinkages by computing the ratios of investments in banks and other financial institutions on total investments. Two other indicators of the subset measure:

1) the exposure to the Italian sovereigns, which has proven to be important in the past financial crises;

2) the indebtedness towards non-insurance related debt, associated with high levels of interconnectedness across markets and sectors.[21]

As for derivatives, they certainly play a central role in hedging risks, especially life insurers' interest rate risk. However, since they can also create risk by increasing the interlinkages within the financial system, IVASS RDb considers a measure of derivative holdings on both sides of the balance sheet.

A final indicator of interlinkage risks derives from the market and assesses the 3-month correlation between the (daily) variation of the indexes of insurance market and of the banking one. Since tensions in the banking sector can reverberate on the insurance market too, albeit at a different pace depending on the trigger events, an increase of this correlation might be an early warning for a transmission channel of systemic risk.

5.7 Underwriting risks

This RDb section includes three indicators (tab. 8) that are more specific of the insurance business: two relative to technical in-flows (premiums) and another to technical out-flows (claims and reserving).

Table 8

Indicators in the macro-category of underwriting risks

Premiums		Claims
Change in life premiums[(a)]	Change in non-life premiums[(a)]	Non-life loss ratio

(a) Indicator included in Bank of Italy's RDb.

Measuring the yearly change in gross written premiums of life and non-life businesses is relevant for insurance oversight, since significant expansions and contractions of premiums might indicate the build-up of risks within the sector: the former by raising concerns over the sustainability of the business and the underpricing of risks, the latter by disclosing profitability problems.

The last indicator considered is the non-life loss ratio, calculated as the ratio of total losses incurred (paid and reserved) during the year, divided by the total premiums earned in the same period. The indicator is a component of the non-life combined ratio, which measures profitability by also including the general expenses, whereas the loss ratio focuses only on technical aspects such as the underwriting and claims-handling processes.

5.8 Market perceptions

This macro category encompasses two quite separate sub-categories of indicators based only on market data, both aiming at assessing the financial markets' perception of the healthiness and profitability

[21] More precisely, we consider the amounts of (i) subordinated liabilities, (ii) debts owed to credit institutions and (iii) other financial liabilities.

of the Italian insurance sector (tab. 9). The indicators included are the quarterly change in 12-month forward expected earnings for listed insurance companies as well as the relative stock market performances of Italian insurance index against the FTSEMIB. The former is also used to assess the expected performance of the Italian insurances compared with that of the other EU insurances.

Table 9

Indicators in the macro-category of market perceptions

Future profits		Stock performance
Expected change in future profits (a)	Expected change in future profits of Italian insurances versus other EU insurances	Over/under performance of the Italian insurance market index versus FTSEMIB

(a) Indicator included in Bank of Italy's RDb.

5.9 Environmental, Social and Governance (ESG) risks

Monitoring climate-related risks is an important requirement in an insurance-specific RDb (IAIS, 2021, 2), since the global threats posed by climate change may foster an increase of the companies' underwriting activity for the related natural perils (such as floods, wildfires, etc.). Even if this new demand of insurance protection is positive from a macroeconomic perspective, the supervisor should make sure that it develops without endangering the financial stability of the sector. Another source of financial risks from climate change comes from the introduction of sustainable investments (such as green bonds) in the companies' assets and from the path of disinvestment of their non-sustainable components. Whereas the replacement of non-sustainable assets by sustainable ones is a long-term desirable aim, the process should be closely monitored to minimise the risks for the insurers caused by assets downgrading.

This recently introduced macro-category evaluates the crucial issues of the insurance industry's vulnerability to Environmental, Social and Governance (ESG) risks and of its exposition to physical and transition risks. This area is subject to further developments, as new and more granular data will become available also thanks to the Solvency II review.

The six indicators for this macro-category are split up into three subsets (tab. 10):

- market indicators based on the ESG ratings of the Italian listed insurers;
- transition risks indicators based on Solvency II and market data, such as the share of green bond and of brown assets in the insurance portfolios;
- physical indicators of the risks from climate change through: 1) an extreme climate index and 2) the Italian insurance sector's exposure to flood risk (the only significant peril in Italy affected by climate change).[22]

Table 10

Indicators in the macro-category of ESG risks

Market indicators		Transition risks indicators		Physical risks indicators	
Insurers´ ESG rating	Change of insurers' ESG ratings	Insurers' investments in green bonds	Climate relevant assets share based on their greenhouse gas emissions	Italian extreme climate index	Exposure at flood risk

[22] So far, there is no evidence of any impact of climate change on the intensity and frequency of earthquakes.

For the listed Italian insurers, the first two indicators capture the level and the change of ESG ratings over time.[23] Low or decreasing ratings may signal insufficient insurers' attention to ESG factors, which could worsen both their reputational and operational risks.

The green bond indicator combines Solvency II data on the insurers' corporate bond portfolio with market data on green-bond labelling. Low shares of green bonds may signal transition risks in the adaptation to a more carbon-neutral economy. These risks are also measured by the share of so-called "brown assets", computed by the methodology developed by Battiston *et al.* (2017), which maps insurers' exposures to six climate-relevant sectors (agriculture, fossil fuel, utilities, energy-intensive, transport and housing) on the basis of the NACE Industry Code Classification.

With regard to physical risks, an indicator similar to the one included by EIOPA in its Pilot Dashboard on Insurance Protection Gap for Natural Catastrophes (EIOPA, 2022) has been adapted to Italy's natural risks. It evaluates Italian insurers' exposure to flood, the most significant natural peril influenced by climate change for Italy, along with the potential hazard and the vulnerability score computed by EIOPA. An index for the frequency of extreme weather events (high and low temperatures, heavy rainfall, drought and high wind) based on the Actuaries Climate Index[24] integrates the information of this insurance-based indicator.

5.10 Cyber risks

The recent introduction of Cyber risks in IVASS RDb is due to their potential impact on financial stability caused by the fast-paced digitalisation which exposes the insurance sector to risks both from an operational resilience perspective (as insurers themselves can be targets of cyber-attacks) and from an underwriting perspective (related to the provision of cyber insurance products). So far, only two indicators have been included: the first one relative only to cyber security risk, the second one proxying both cyber security risk and cyber underwriting (tab. 11). No specific indicators on the cyber underwriting business are considered, since no specific data on cyber insurance products are currently available in the regular Solvency II reporting. The section will be subject to further developments as new data becomes available following the Solvency II review project.

Table 11

Indicator	**Risk measured by the indicator**	
	Cyber security risk (operational risk)	Cyber underwriting risk
Stakeholders' assessment of digitalisation & cyber risks	*yes*	*no*
Change in the frequency of cyber incidents	*yes*	*yes*

The stakeholders' assessment of digitalisation & cyber risks combines a qualitative assessment of the materiality of different aspects such as cyber security risks, cyber underwriting risks and Insurtech competition. Data are provided by the IVASS quarterly survey of the insurance sector's vulnerabilities.

The second indicator aims to proxy both cyber security and cyber underwriting risks for the Italian insurance sector. An increase of the cyber incidents can affect insurers directly (if targeted by the attack) or indirectly (through higher cyber underwriting losses). Therefore, the yearly change of the total number of cyber incidents included in publicly available database is considered.

[23] The indicators are based on a 10-category score applied by the data provider.

[24] The index is computed for the Italian territory by IFAB (International Foundation Big Data and Artificial Intelligence for Human Development) and it can be found here https://e3ci.dataclime.com/

5.11 Aggregation

A set of aggregate indicators represent synthetically the riskiness of the Italian insurance industry from a financial-stability perspective. They capture the main trends within each risk category by applying the same 3-step process used by EIOPA (see section 4.1).

The first step measures for each indicator the relative importance of the different insurers (in terms of assets, investments, technical provisions, premiums or other suitable variables depending on the indicator) by applying specific weighting parameters that define the cross-sectional distributions and the relevant quantiles.

Then, a linear transformation of the median and the riskier quantile(s) produces a normalized score ranging from 1 (low risk) to 10 (high risk).

The final step aggregates all the normalized scores within each macro-category by applying a set of weights, which account for the correlation between some indicators within the same macro-category as well as for the different relevance of some indicators compared to others.

For areas consisting of two or more subgroups of indicators, their scores were first aggregated within them and then at macro-category level. Theoretically, when all the indicators are deemed equally relevant to explain the riskiness of the area and are not correlated, no weights are applied and a simple average is used to get the final score of the area. Whenever the need arises, weights are computed either considering the correlation coefficient between the indicators or through expert judgement.

5.12 Heat map, radar chart and historical series

The final scores of each area stemming from the aggregation of the indicators' scores described in the previous section are organized into different visual tools. They help communicate the results and compare the riskiness of the Italian insurance sector with that signalled by similar tools either for other geographical areas or for other financial sectors. The most closely watched comparison is that with the EIOPA RDb covering the EU insurance industry.

In order to make these comparisons easier, IVASS RDb's scores are structured into a set of visual tools:

- a synthetic **heat map** that allows geographical comparison (Italian vs European insurance riskiness) for the main qualitative results (tab. 12);
- a **radar chart** for a quick snapshot of the Italian insurance riskiness (current quarter vs previous one; fig. 3);
- **historical series** of the synthetic heat maps, for a long-term analysis of the specific risks (see appendix).

Table 12

Heat maps of IVASS and EIOPA Risk Dashboards[25]

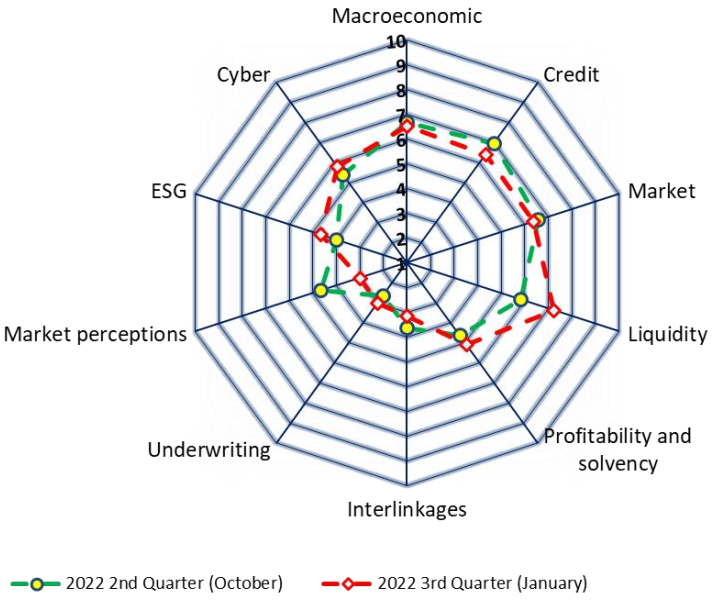
	IVASS		EIOPA	
Macro-category of risk	**Level**	**Trend[26]**	**Level**	**Trend[26]**
1. Macroeconomic	medium-high	→	medium-high	→
2. Credit	medium	↘	medium	↓
3. Market	medium	→	high	→
4. Liquidity	medium	→	medium	→
5. Profitability and Solvency	medium	→	medium	→
6. Interlinkages	low	→	medium	→
7. Underwriting	low	→	medium	↑
8. Market perceptions	low	↓	medium	→
9. ESG	medium	↗	medium	→
10. Cyber	medium	→	medium	→

Source: IVASS and elaboration on EIOPA data.

Figure 3

Radar chart for financial stability risks of the Italian insurance sector

(scores from 1 to 10)



The table and the historical series match a colour to each risk level associated to a macro-category, whereas the radar chart gives an indication of the quantitative level of the risks (by a scale from 1 to 10). The utilization of the same colour palette as EIOPA (green, yellow, orange and red) grants comparability with EIOPA RDb, even if IVASS's apply a more granular risk scale with six levels (with the two additional ones for

[25] The reference date for Solvency II based indicators is Q3-2022 for the quarterly indicators and end-of-2021 for the annual indicators. The cut-off date for most market indicators is the beginning of January 2023, while the data from IVASS' monthly monitoring refer to the latest month available (December 2022).

[26] The arrows indicate the change from the previous quarter. For further information, see tab. 13.

low-medium and medium-high risks; tab. 13). The additional levels enhance the capability of spotting sudden risk upturns or downturns.

Table 13

Risk levels and trends[(a)]

Levels		Very high (8,5;10]
		High (7;8,5]
		Medium-high (6,5;7]
		Medium (4;6,5]
		Low-medium (3,5;4]
		Low [1;3,5]
Trends[(b)]	↑	Signicant increase (>1)
	↗	Increase (>0,5)
	→	Stable (-0,5 <x<0,5)
	↘	Decrease (<-0,5)
	↓	Significant decrease(<-1)

(a) The numeric intervals refer to the synthetic score for each macro-category. – (b) Trends measured by the difference between the scores of two consecutive quarters.

6. Conclusions

This paper describes a risk dashboard for the Italian insurance sector composed of 57 indicators grouped into 10 different risk categories. Using thresholds selected on the basis of either expert judgment or historical distributions, the indicators are normalized in scores from 1 (lower risk) to 10 (higher risk). An aggregate indicator for each macro-category is also developed with the aim of providing a synthetic overview of the riskiness of the Italian insurance sector, represented by using a four-color scale and six risk levels (see tab.13 in section 5). Moreover, it also features a radar-chart and a set of historical graphs for each macro-category as a useful complementary visual tools for monitoring risks.

An RDb is a very useful instrument that collects a set of analysis aimed at providing the picture, on a quarterly basis, of the evolution of the risks and vulnerabilities of the insurance industry to supports the supervision and policy-making decision and to monitor the potential for a systemic risk stemming both from inward and outward risks. However, an RDb is not intended to be used as an automatic early-warning system or to carry out any inference analysis and it can't replace a subjective assessment of financial stability risks.

It should be rather meant as a living tool that needs to be updated on a regular basis to capture any emerging risk or macroeconomic evolutions requiring different calibrations or reviewed aggregations of the existing risks. It should also be considered that, over time, some indicators can lose their signalling potential while others can become more relevant and therefore an on-going review should be carried out to preserve its risk-detection ability.

IVASS is fully aware of some limitations of its RDb that needs to be addressed in the future. For example, the forward-looking perspective might be enhanced, to make it more reactive to the external changes and additional indicators or new macro categories might be added for emerging risks.

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Appendix

Historical series of the IVASS Risk Dashboard's synthetic heat maps (2016-2022)