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KEYWORDS

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Physical risk and natural catastrophes insurance: an analysis on Italian limited companies

Donatella Albano[*], Monica Billio[**], Gabriella De Bernardo[*], Dario Focarelli[*], Carlotta Gianni[**], Luigi Salvati[***]

([*]ANIA, [**]UNIVE, [***]UNIME)

Abstract

This paper examines the determinants of natural catastrophe (NatCat) insurance demand among Italian limited companies, combining a dedicated ANIA survey on insurance contracts with geographic risk indicators from ISPRA and GeoSafe and with firm-level information from AIDA. Despite Italy's significant exposure to floods, earthquakes and landslides, NatCat insurance penetration remains low. Descriptive statistics and spatial analysis reveal a clear mismatch between physical risk and insurance uptake.

Logistic regressions show that exposure to seismic risk and hydraulic risk is positively and significantly associated with the probability of holding coverage, but the marginal effects are small, indicating that insurance decisions respond only weakly to underlying hazard levels. No significant relationship emerges for landslides, reflecting both limited supply and low demand. Firm characteristics, sectoral affiliation and regional disparities play a stronger role than objective risk in explaining uptake.

Overall, the analysis points to a persistent protection gap among Italian limited companies. Reducing it will require both demand-side measures—such as awareness campaigns and targeted incentives—and supply-side interventions, including public–private reinsurance schemes and premium-stabilisation tools in high-risk areas. The introduction of mandatory NatCat insurance is a major institutional step; assessing its impact on firms' risk perception and on the insurance culture more broadly will be essential for future policy design.

Keywords: Natural Catastrophe; Insurance; Protection gap; Underinsurance.

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1. Introduction

Natural catastrophes pose a growing and persistent threat to businesses, particularly small and medium-sized enterprises (SMEs), which often lack the financial resilience to absorb or recover from their economic consequences (World Bank and European Commission, 2024; Fatica et al., 2024; Harries, 2021; Zodrow et al., 2020). Climate change is amplifying this risk, driving both the frequency and severity of such events (ECB and EIOPA, 2024; IPCC, 2022).

In 2024, natural disasters generated an estimated $320 billion in economic losses worldwide, of which less than half ($140 billion) was insured. In real terms, insurance claims were 32% above the five-year average and nearly 50% above the ten-year average (Munich Re, 2025).

Italy is particularly exposed, given its high seismic risk and growing vulnerability to climate-related extreme events such as floods and landslides. In late 2023, floods in Tuscany caused extensive damage to infrastructure and local economies (NASA, 2023). Similarly, the Emilia-Romagna floods of May 2023 led to 17 fatalities, the displacement of tens of thousands of people, and damages exceeding €9 billion (Valente et al., 2025). Other recent disasters – including the Ischia landslide and the Marche flash floods in 2022 – further illustrate the escalating scale of environmental risks (Copernicus Emergency Management Service, 2022a, 2022b). These events underscore the urgent need for robust risk-management strategies.

Despite this evidence, only a small share of Italian firms is insured against natural disaster risks – with even lower coverage among SMEs – and penetration levels remain far below those of comparable European countries. In Germany, about half of all firms are insured; in the UK, three-quarters; in Spain, an even higher share; and in France, coverage is nearly universal. These cross-country differences are likely to reflect variations in market and regulatory frameworks, highlighting the importance of tailored national strategies to increase NatCat insurance uptake, especially among SMEs.

In response, the Italian government introduced a mandatory insurance scheme through the 2024 Budget Law (Law No. 213/2023, Article 1, Paragraphs 101–112). The requirement applies both to companies with their registered office in Italy and to foreign companies with a permanent establishment in the country. Firms are obliged to insure their real estate, plants, and machinery against natural disasters such as earthquakes, floods, landslides, and river overflows. The obligation also extends to insurance undertakings, but only those operating in the fire and natural elements sector.

Traditionally, underinsurance has been assessed ex post through the so-called "insurance protection gap," defined as the difference between total economic losses from

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a catastrophic event and the insured portion (Jarzabkowski et al., 2019). While informative, this measure has limitations: it overlooks preventive and mitigation measures, focuses solely on post-event assessments, and often underestimates social and humanitarian costs. In other words, a purely ex-post approach to disaster recovery is suboptimal (Signorini, 2024).

An alternative ex-ante perspective compares firms' exposure to physical risks from natural disasters with their actual level of insurance coverage (Guiso and Schivardi, 2010; Frigo and Venturini, 2024). This approach allows for a more proactive understanding of risk protection and insurance demand.

Our study contributes to this ex-ante perspective by analysing NatCat insurance penetration among Italian firms – with a particular focus on SMEs – and by identifying the key drivers of demand for coverage against the specific events included in the new mandatory insurance scheme.

The analysis draws on a survey conducted by ANIA (the Italian Association of Insurance Companies) in February 2024 and January 2025, which collected information on the diffusion of mandatory NatCat contracts from 2018 to 2024. The survey involved twenty-five insurers (representing about 70% of the Italian fire insurance market by premiums). These data were combined with firm-level information from the AIDA database and geographic hazard data from ANIA's GeoSafe and ISPRA's Idrogeo datasets.

Section 2 reviews the literature, focusing on recent developments and the main determinants of underinsurance. Section 3 describes the dataset and its key features. Section 4 presents the results of a geospatial analysis and of a logistic regression applied to a subsample of micro and SMEs (limited liability companies), aimed at assessing the drivers of underinsurance and the potential presence of adverse selection. Section 5 concludes by highlighting the main insights and policy implications regarding the uptake – or lack – of NatCat insurance among Italian firms.

2. Literature Review

The importance of reducing the magnitude of the economic impact of natural catastrophe events on enterprises, particularly those of smaller size, is a key focus in literature and among international institutions, together with the one related to the assessment of the role of insurance in this context.

The Intergovernmental Panel on Climate Change (IPCC, 1990) recognizes the fundamental role of insurance against catastrophic events serving both as a financial safeguard against potential losses and as a mechanism for signalling risk, thereby discouraging hazardous behaviours. The OECD (2003) recognises the advantages of the insurance sector's technical expertise in risk assessment and underlines its role in managing

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climate and environmental impacts, addressing large-scale financial losses and supporting effective risk-sharing and loss-financing mechanisms. Several authors identify the insurance sector role as increasingly crucial as natural disasters continue to rise in frequency and intensity (Suk et al., 2020; Tasri et al., 2022; Nobanee and Nghiem, 2024), also driven by exacerbation of the climate change issue (Kalfin et al., 2022; Seneviratne et al., 2021) and resulting in significant and widespread economic and social damage (Kron et al., 2019; Di Marcoberardino and Cucculelli, 2024).

Besides the role in supporting post-disaster recovery, Kalfin et al. (2022) emphasize also that of mitigating future risks and promoting adaptation strategies to climate change. Botzen and van den Bergh (2008), focusing on hydraulic risk, state that insurance can motivate enterprises to take preventive actions, such as investing in resilient infrastructure, thus playing a crucial part in the broader effort to reduce total economic losses from natural disasters.

Despite this, the high levels of underinsurance observed worldwide, has opened the floor to a variety of studies focusing on the quantification of the issue and on the identification of the reasons behind the decision of firms not to purchase an insurance coverage against natural disasters.

According to the Global Federation of Insurance Associations (GFIA, 2023), underinsurance represents a significant global issue, particularly in regions vulnerable to natural disasters, with businesses lacking adequate coverage against catastrophic risks. Among European countries, the European Insurance and Occupational Pensions Authority (EIOPA, 2024) highlights income, high premiums, lack of clarity in terms of costs and coverage, previous (negative) experience, lack of risk awareness, supply-side mechanism limits, as well as limited understanding of how insurance works or high expectations about State intervention, as important barriers to uptake.

In the Italian framework, several studies have analysed the characteristics of insured firms and the factors influencing insurance demand, both for traditional contracts and for natural disasters.

Guiso and Schivardi (2011) examine the determinants of insurance demand among 2,295 Italian firms with up to 250 employees, based on an ANIA survey conducted in 2009. The survey gathered information on existing contracts, past claims, organizational features, and firm demographics.

Their analysis highlights how firm size influences insurance decisions: while larger companies, operating across multiple sites, are more likely to insure due to higher exposure, smaller firms—often family-owned—would in principle have strong incentives to insure, yet in practice they remain less insured, thus revealing a significant underinsurance problem.

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As for non-purchase decisions, the main reasons reported are a perceived low risk (over 70% of cases) and the cost of contracts.

Gallo et al. (2024) and Frigo and Venturini (2024), consistent with the approach adopted here, investigate the determinants of insurance demand through multivariate linear regression, following a descriptive analysis of insured firms' characteristics. Their studies, however, are limited to firms with at least 20 employees, thereby excluding the majority of Italian firms, and focus only on industry (in the narrow sense) and private non-financial services, omitting several NACE codes. Notably, firms in the construction sector are also excluded.

The ANIA survey underlying our analysis covers nearly 70% of the Italian fire insurance market and, unlike previous studies, also includes the construction sector, which proves particularly relevant in terms of insured firms. A key strength of our dataset is the availability of information on contracts covering specific natural catastrophe risks (earthquakes, floods, landslides), rather than relying on proxies such as fire or general damage insurance. This allows for a more accurate assessment of the link between coverage and firms' exposure to physical hazards.

3. Data

The Survey on Italian Companies non-life Insurance (ICON-I), conducted by ANIA in February 2024 and in January 2025, serves as the primary data source for insurance coverage among Italian firms. The survey targets insurance undertakings and covers all firms that are required to register in the Italian Business Registry, i.e. all types of companies (limited companies[1], partnerships and individual companies). Consequently, the dataset excludes individuals such as freelancers, as well as public institutions and authorities.

This extensive survey involved the participation of twenty-five insurance undertakings, collectively representing around 70% of the Italian insurance market in terms of Fire insurance premiums and provides a detailed snapshot of the diffusion of insurance coverage among a sample of Italian firms (around 2.3 million in 2024, Table 1, almost 50% of total Italian firms) [2].

The database covers the years from 2018 to 2024, offering a view of the trends in insurance demand levels within the Italian business sector. However, there are some important limitations to consider, including the absence of data on firms insured with the

[1] Limited companies are the Italian *Società di capitali*, i.e. forms of commercial companies in which the shareholders are liable for the debts of the company only to the extent of the capital invested.
[2] ISTAT: 4.8 billion in 2024.

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insurers not participating in the survey, on firms insured through foreign insurers or those firms relying on self-insurance mechanisms or on captive insurance companies.[3]

In addition to natural catastrophe risks - as defined in the recent application Decree of the previously mentioned Italian Budget Law[4] - the Survey gathers data on other types of non-life insurance, totalling twenty-five different insurance contracts. This expanded scope enables the collection of a more comprehensive dataset that captures the evolving landscape of insurance and risk management practices among Italian firms and some of them will be presented for comparison purposes.

The insurance contracts related to the risks mentioned in the Decree (from now on, NatCat contracts) are defined as follows:

- Floods and Inundations Insurance: covers material and direct damages to insured property caused by the overflow of rivers or water basins, including debris, even if triggered by an earthquake.
- Earthquake Insurance: covers material and direct damages caused by earthquakes, including secondary events such as fires, explosions or bursts.
- Landslides and Mudslides: covers material and direct damages to the insured property caused by landslides and mudslides, regardless of their origin.

NatCat contracts are examined alongside Fire, Third-Party Liability, Liability towards Employee, Theft and Business interruption insurance - the most diffused types of insurance coverages among Italian limited companies – and contracts covering damages resulting from atmospheric events (weather-related events), which, despite being related to physical risks, remains non-mandatory according to the 2024 Budget Law[5]. Figures on the

[3] Wholly owned subsidiaries established by a parent firm to provide insurance coverage for the risks of the parent company or its affiliates. They represent a common form of self-insurance, allowing firms to retain and manage their own risk while potentially benefiting from cost savings and tailored coverage.

[4] Decree No. 18 of 30 January 2025 states that "The events to be insured […] are understood to be earthquakes, floods, landslides, inundations and overflows".

[5] Fire Insurance covers material and direct damages caused by fire to the insured property. Third-Party Liability (RCT, Responsabilità civile verso terzi) compensates for damages legally owed by the insured to third parties, including personal injury and property damage, arising from accidents related to the insured's activities. Liability towards Employees (RCO, Responsabilità Civile verso i terzi per l'Operatore), to indemnify the employer for any amounts the latter is required to pay to an injured worker. Theft Insurance covers the for direct material losses resulting from the theft of insured property located at the risk address specified in the policy. Business Interruption Insurance covers financial losses resulting from the total or partial suspension of business activities due to material damage to the premises or equipment, orders by public authorities, workplace accidents leading to closure, environmental remediation, utility supply interruptions, or material damage suffered by key suppliers or customers. Weather-related events Insurance covers material and direct damages to property caused by atmospheric phenomena such as hurricanes, storms, hail, tornadoes, or structural collapses due to snow loads.

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percentage of firms which do not have any NatCat coverage are also provided in the table below.

Table 1: Number and % incidence of insurance coverage by type of risk - firms with at least one of the 25 non-life guarantees (year 2024)

Year	Number of firms insured (whole sample)	Fire	TPL	Employees TPL	Theft	Business Interruption	Weather-related events	Floods and Inundations	Earthquake	Landslides and Mudslides	No NatCat
2018	1,825,974	74.08	70.30	15.76	21.39	3.97	58.86	5.27	4.76	0.11	93.63
2019	2,014,391	71.85	65.12	15.29	19.73	3.84	56.59	4.94	4.53	0.10	94.04
2020	1,992,398	72.96	66.21	16.01	20.42	4.55	57.86	7.21	6.78	0.10	91.11
2021	2,048,512	72.28	65.30	16.60	20.14	4.72	57.86	7.32	6.96	0.10	91.00
2022	2,049,009	72.04	66.39	17.24	20.46	4.93	58.19	7.53	7.25	0.11	90.77
2023	2,092,885	72.86	66.44	17.51	21.15	6.25	58.81	8.12	7.79	0.12	90.15
2024	2,315,268	71.53	60.92	15.30	20.36	7.69	56.68	9.32	8.92	0.81	88.99

Note: The table refers to the sample of all types of firms included in the database (limited companies, partnerships and individual companies).

Survey data were cross-referenced with the AIDA database, available for limited companies, which provides economic, financial, biographical, and commercial information (including firm size, sector of activity, and branch locations beyond the registered office). Additional integration with Idrogeo and GeoSafe datasets enabled the construction of municipal-level indicators of seismic, hydraulic, and landslide risks. This combined framework allows for a detailed mapping of firms' characteristics and geographical distribution, offering a more comprehensive picture of the insured corporate landscape and facilitating analysis by size, sector, and exposure to physical risks.

Table 2 summarises the diffusion of insurance coverage among limited companies in the sample, comprising about 0.5 million firms (roughly 30% of all Italian limited companies). Panel A reports data for firms holding at least one of the 25 guarantees ("insured limited companies"), while Panel B focuses specifically on those with Fire insurance.

Using the evidence from Panel A, which includes only limited companies holding at least one non-life insurance policy, fire insurance emerges as the dominant coverage, protecting almost three-quarters of firms in 2024 (73.9%) and confirming its role as the baseline safeguard, often mandated by financial institutions and business partners. Third-party liability remains widespread, reflecting firms' persistent concern with exposure to external claims, although its recent decline to 63.9% suggests some weakening of demand. Employee liability (24.3%) and theft (31.8%) occupy intermediate positions, while business interruption, though still limited in absolute terms, has recorded steady growth (11.1% in 2024), indicating a gradual recognition of the costs associated with operational disruptions. Finally, insurance against weather-related events reaches 62.5% of firms but shows no further expansion,

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pointing to a plateau in voluntary demand despite the rising frequency of extreme climatic episodes. With regard to catastrophe-related contracts, penetration rates were 19.6% for flood insurance, 18.2% for earthquake coverage, and 1.5% for landslides and mudslides.

Table 2: Number and % incidence of insurance coverage by type of risk - limited companies (year 2024)

Panel A: With respect to the sample of limited companies with at least one of the 25 non-life guarantees

Year	Number of limited companies insured	Fire	TPL	Employees TPL	Theft	Business Interruption	Weather-related events	Floods and Inundations	Earthquake	Landslides and Mudslides	No NatCat
2018	461,958	75.56	66.76	23.29	31.06	7.85	62.33	12.36	10.99	0.23	85.75
2019	480,060	75.12	66.94	24.83	31.47	8.10	63.98	12.64	11.23	0.24	85.54
2020	487,368	75.00	66.84	25.14	31.83	8.76	64.38	17.06	15.51	0.23	80.34
2021	505,406	74.34	67.5	26.91	31.98	9.09	64.49	17.50	16.00	0.23	79.97
2022	525,790	73.63	68.07	27.91	32.00	9.25	63.94	17.53	16.20	0.23	79.99
2023	547,777	74.17	67.38	27.95	32.59	10.24	63.50	18.02	16.80	0.24	79.43
2024	531,228	73.93	63.92	24.27	31.83	11.08	62.48	19.62	18.20	1.52	77.84

Note: The table refers to the sample of limited companies included in the database.

Panel B: With respect to the sample of limited companies with Fire Insurance

Year	Number of limited companies insured	Fire	TPL	Employees TPL	Theft	Business Interruption	Weather-related events	Floods and Inundations	Earthquake	Landslides and Mudslides	No NatCat
2018	349,051	100	64.81	22.53	39.96	9.30	79.97	14.44	12.97	0.19	83.27
2019	360,612	100	65.51	24.16	40.75	9.74	82.17	14.86	13.34	0.19	82.92
2020	365,514	100	65.57	24.49	41.37	10.71	82.82	20.18	18.60	0.18	76.56
2021	375,725	100	66.22	26.27	42.04	11.30	83.48	20.81	19.25	0.18	75.99
2022	387,128	100	66.87	27.33	42.54	11.62	83.53	21.01	19.62	0.19	75.80
2023	406,304	100	66.04	27.29	43.08	12.74	82.56	21.76	20.42	0.23	74.96
2024	392,730	100	63.35	23.90	42.24	13.47	81.20	23.78	22.15	1.74	72.95

Note: The table refers to all limited companies included in the ANIA survey cross-referenced with AIDA database.

Using the evidence from Panel B, which considers only limited companies already covered by fire insurance, natural catastrophe (NatCat) policies show a gradual but still insufficient expansion. Within this subset of firms, flood insurance rises from 14.4% in 2018 to 23.8% in 2024, and earthquake coverage follows a similar pattern, increasing from 13.0% to 22.1%. This progression suggests that once firms recognise the need for baseline property protection, they are more inclined to add catastrophe extensions. Nevertheless, penetration remains modest when compared to Italy's structural exposure, and the persistence of high residual shares without coverage confirms the depth of the protection gap. Landslides and

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mudslides insurance remains almost absent, reaching only 1.7% of fire-insured companies in 2024, pointing either to a systematic underestimation of the peril or to limited supply. Overall, Panel B highlights that even among firms with established risk awareness, NatCat protection is far from universal, leaving nearly three-quarters still uninsured against catastrophic hazards.

The following section describes the main features of the sample and the distributions of the physical risks under analysis.

3.1 Description of the Sample: Breakdown by Firm-level Characteristics

The sample of limited companies insured obtained after the cross-reference with the AIDA database enabled the identification of firm-level characteristics, thereby facilitating a comprehensive evaluation of factors influencing insurance demand. The list of these variables is detailed in Appendix (Table A).

The first analysis undertaken compared the geographical distribution of insurance limited companies in the sample (Figure 1, approximately 0.5 million firms) with that of the overall population of limited companies recorded in the AIDA database (Figure 2, around 1.7 million firms). It can be quickly observed that maps indicate a broadly comparable regional distribution, with only minor deviations.

Figure 1 - Geographical distribution (quantiles) of insured limited companies – Sample

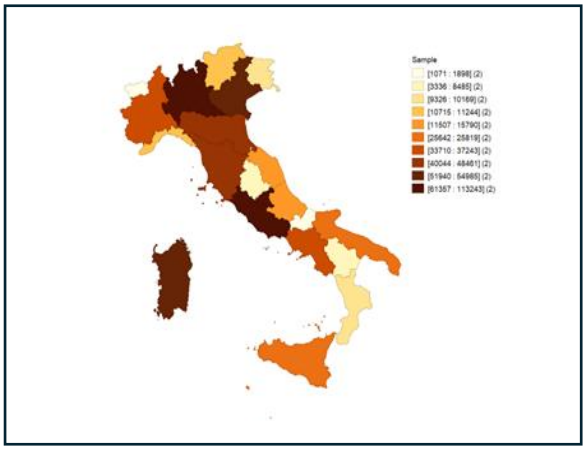
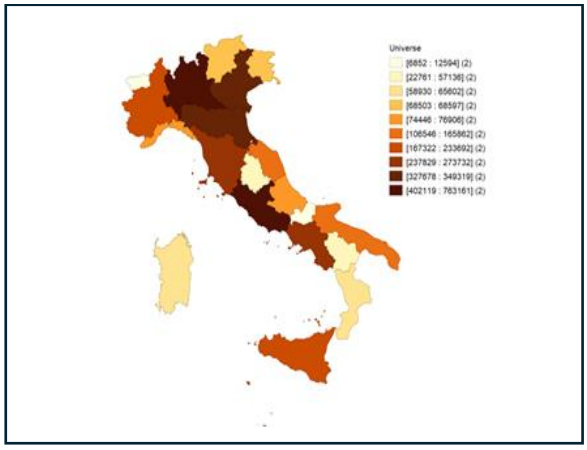


Figure 2 - Geographical distribution (quantiles) of limited companies – Universe



Note: fig. 1 refers to the sample of insured limited companies; fig. 2 refers to the whole AIDA database of limited companies.

Figures 3 and 4 show the distribution of business locations at the municipal level, measured by the number of company sites (including both registered offices and local units) in each municipality. The maps reveal a strong concentration of sites in industrialised and urban areas, particularly in Northern Italy and in specific central and southern regions. Conversely, some areas appear slightly underrepresented, suggesting potential regional disparities in firms' propensity to purchase insurance coverage.

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Figure 3 - Number of sites per municipality – Sample

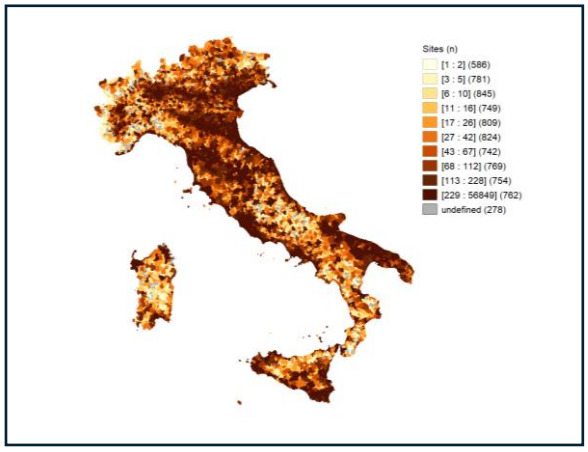
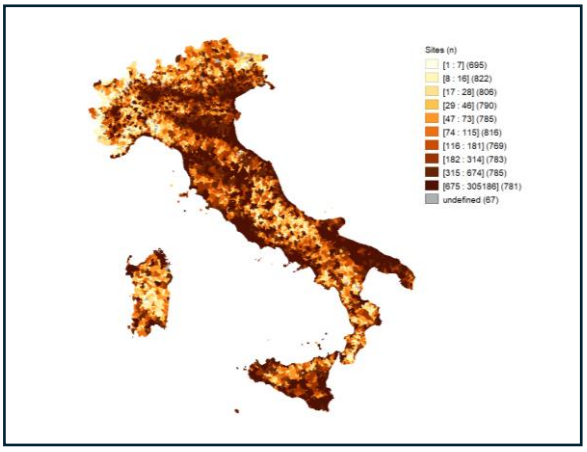


Figure 4 - Number of sites per municipality - Universe



Note: fig. 3 refers to the sample of insured limited companies; fig. 4 refers to the whole AIDA database of limited companies. In both cases, "undefined" denotes municipalities for which no company sites are reported.

Table 3 reports, for the year 2024, the incidence of natural catastrophe insurance coverage among Italian limited companies included in the sample. The table presents both the absolute number of firms and the percentage breakdown by main firm-level characteristics: size (large, medium, small, micro), sector of economic activity (e.g. trade, construction, manufacturing, energy, services), and legal form (e.g. S.r.l., simplified S.r.l., S.p.A.).

The sample tends to underrepresent micro-enterprises, which account for the vast majority of Italian companies (77.9%) but make up a smaller share of the analysed dataset (61.1%). By contrast, large firms are comparatively overrepresented, representing 20.7% of the sample against 12.6% in the overall population.

Although these imbalances—and the further limitation that the survey does not include all insurers operating in the market—introduce some bias, the dataset nonetheless provides a reliable picture of the main patterns of insurance diffusion among Italian limited companies. According to Table 3, only about 20% of firms in the sample hold NatCat coverage. In absolute terms, this corresponds to roughly 106,000 companies, equivalent to around 6% of the entire universe of limited firms. This finding aligns closely with ANIA estimates (see ANIA, 2025), which place NatCat insurance penetration for the total population of Italian companies at approximately 7%.

Unsurprisingly, NatCat coverage increases with firm size. A very large share of micro-enterprises remains completely uninsured against these risks (almost 85%), confirming their structural vulnerability, compared with around 66% of small firms and 42% of medium-sized firms. The same pattern holds for both flood and earthquake insurance, where coverage is significantly higher among medium and small firms than among micro firms. By contrast, landslide insurance remains negligible across all size classes, with penetration rates below

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3% for micro and SMEs and around 5% for large firms. An unexpected finding, however, is the relatively low coverage observed among large firms. This result stems from the fact that the survey does not include captive insurers or foreign insurance companies, which very often provide NatCat protection to Italian large firms.

Table 3 – Number and % incidence of insurance coverage by type of NatCat risk and firm-level characteristics – insured limited companies (year 2024)

	Universe		Total sample (insured companies)		Floods and Inundations	Earthquake	Landslides and Mudslides	no NatCat insurance
	Count	% (comp.)	Count	% (comp.)	% (incidence)	% (incidence)	% (incidence)	% (incidence)
Total	**1,740,864**	**100%**	**531.228**	**100%**	**18.02**	**16.80**	**0.24**	**79.44**
Size								
Large	10,084	0.58	6,630	1.25	62.23	61.24	5.43	34.72
Medium	40,747	2.34	28,185	5.31	53.95	52.05	2.43	42.55
Small	175,261	10.07	110,084	20.72	30.26	28.21	1.94	66.15
Micro	1,514,734	87.01	386,329	72.72	13.36	12.13	1.26	84.49
Sector								
Trade, Hotels and Restaurants	483,384	***27.77***	156,387	***29.48***	16.40	14.44	1.98	81.55
Construction	269,342	***15.47***	85,378	***16.10***	14.37	14.52	1.45	83.28
Energy, Water and Telecommunications	24,029	***1.38***	8,029	***1.51***	51.34	50.87	2.67	46.01
Extractive industry	126	***0.01***	46	***0.01***	41.30	39.13	6.52	54.35
Manufacturing	220,283	***12.65***	94,883	***17.89***	33.36	32.31	1.84	62.87
Transport	59,718	***3.43***	17,446	***3.29***	17.38	15.77	1.35	81.00
Other services	635,119	***36.48***	168,242	***31.72***	16.30	14.32	0.90	81.23
NA	48,863	***2.81***	817	***0.15***	9.55	9.06	1.59	88.74
Legal form								
S.R.L.	1,238,173	***71.12***	430,404	***81.02***	20.45	19.05	1.49	76.73
S.R.L. semplificata	382,906	***22***	61,150	***11.51***	6.36	5.08	1.50	92.81
S.P.A.	25,550	***1.47***	15,503	***2.92***	58.98	57.78	3.53	37.65
Other	94,235	***5.41***	24,171	***4.55***	13.12	10.83	0.76	85.57

Note: Data refers to all limited companies included in the ANIA survey cross-referenced with AIDA database (insured companies).

Moving to the analysis by economic sector, the Energy, Water and Telecommunications sector together with the Extractive industry display the highest incidence of flood and earthquake coverage, exceeding 50% in the former and 40% in the latter. By contrast, coverage levels are much lower in the Trade, Hotels and Restaurants, Construction, Other Services, and Transport sectors, where penetration ranges between 14% and 17% for both floods and earthquakes. The share of firms without any NatCat protection is particularly high

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in the services and trade sectors, reaching around 81%, thus highlighting a pronounced protection gap in these areas of economic activity.

Turning to the analysis by legal form, joint-stock companies (S.p.A.) record the highest levels of NatCat coverage and show a relatively low share of firms without protection. By contrast, limited liability companies (S.r.l.) and, even more markedly, simplified limited liability companies (S.r.l. semplificata) display much lower coverage rates and a significantly higher proportion of firms without any NatCat insurance.

An interesting feature of the sample emerges when comparing statistics based on companies considered as single entities (531,228 observations) with those derived from the analysis of all company sites (Table 4), which includes both registered offices and local units (955,466 in total). The frequency of insured sites within the overall sample rises markedly, particularly for NatCat contracts. This reflects the fact that considering insured sites gives greater weight to larger firms, which are typically more inclined to insure. For flood insurance, the penetration rate increases from 19.62% to 25.74%, for earthquake coverage from 18.20% to 23.87%, and for landslides from 1.52% to 1.98%.

Table 4 – Number and % incidence of insurance coverage by type of NatCat risk and firm-level characteristics – all sites of insured limited companies (year 2024)

Size	n	%	Fire	TPL	Employee TPL	Theft	Business Interruption	Weather-related Events	Floods and Inundations	Earthquake	Landslides and Mudslides	No NatCat
Large	75,018	7.85	80.77	64.08	22.81	47.61	24.83	75.75	61.18	60.30	5.94	35.77
Medium	100,227	10.49	85.15	64.11	26.52	49.98	23.74	79.86	53.32	49.99	2.51	43.65
Small	222,168	23.25	81.22	67.47	30.68	44.14	15.98	73.75	30.60	28.07	1.96	65.99
Micro	558,053	58.41	73.68	64.07	23.70	29.88	9.31	60.60	14.09	12.61	1.35	83.82
Total	**955,466**	**100.00**	**77.19**	**64.86**	**25.55**	**36.69**	**13.59**	**66.87**	**25.74**	**23.87**	**1.98**	**71.69**

Note: Data refers to all limited companies included in the ANIA survey cross-referenced with AIDA database (insured companies)

3.2 Physical Risks: Data Sources and Distributions

The physical risks considered in this analysis are hydraulic, landslide, and seismic risks. The information is sourced from two specialized platforms:

- IdroGeo: an Italian web platform developed by ISPRA, providing comprehensive data on landslide and hydraulic (flood) risks across the country, available at https://idrogeo.isprambiente.it/app/;
- GeoSafe: ANIA's proprietary service, which offers companies detailed territorial assessments to enhance their understanding of exposure to natural risks, available at https://www.geosafe.ania.it/. Data on seismic risk have been collected from this platform.

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3.2.1 Hydrogeological risk

To investigate the distribution of the two components of hydrogeological risk (i.e. hydraulic and landslide risk) and the exposure of Italian municipalities to those risks, IdroGeo indicators (defined in the ISPRA Report[6]) have been used. These indicators quantify the surface area (km²) exposed to each hazard level. The classification follows the national standard for hazard mapping, harmonized across basin authorities, and is expressed through the following classes.

Hydraulic risk indicators (flood hazard):

- P1: area exposed to moderate flood hazard, corresponding to events with relatively low frequency (long return period) and limited potential damage.
- P2: area exposed to medium flood hazard, representing intermediate-frequency flood events with potentially significant impacts.
- P3: area exposed to high flood hazard, corresponding to frequent events (short return period) with high potential for damage.

Each variable (P1, P2, P3) represents the extent (km²) of the municipal territory affected by that specific flood hazard level.

Landslide risk indicators:

- P1: area potentially affected by slope movements of limited extent or probability.
- P2: area with intermediate probability of landslide occurrence.
- P3: area with high probability or intensity of landslide phenomena.
- P4: area characterized by very high probability and/or severity of slope failure, often involving significant volumes of material or risk to infrastructure and settlements.

Each variable (P1, P2, P3, P4) indicates the surface area (km²) within the municipality that falls into each landslide hazard class. Note that, since areas of different hazard levels may overlap spatially, the sum of risk classes may exceed the total municipal area.

To account for non-exposed areas, an additional indicator has been defined as:

$$P0 = max\left(0, A_{total} - \sum_i A_{Pi}\right)$$

Where A_{total} is the total municipal surface, and $\sum_i A_{Pi}$ is the sum of the areas classified under all hazard levels. If this difference is negative, P0 is set to 0.

[6] ISPRA – Istituto Superiore per la Protezione e la Ricerca Ambientale. (2024). Dissesto idrogeologico in Italia: pericolosità e indicatori di rischio. Edizione 2024. Sistema Nazionale per la Protezione dell'Ambiente (SNPA).

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The analysis of these indicators highlights that 96% of Italian municipalities are exposed at least to the minimum level of hydraulic or landslide risk, P1 (85% and 75%, respectively, if considered separately).

To gather a better understanding of the exposure of hydraulic and landslides risk in terms of level of risk, the following composite indicators have been constructed:

- **Hydraulic (flood) risk indicator:** for each municipality, the areas (in km²) classified under hydraulic hazard levels P0, P1, P2 and P3 were considered. A composite indicator was computed as the weighted average of the hazard levels (0-3), using as weights the corresponding surface areas.
- **Landslide risk indicator:** for landslides, the areas assigned to hazard levels P0, P1, P2, P3, and P4 were used. Similarly, a composite indicator was derived as the weighted average of the risk levels (0-4), weighted by the extent of the area assigned to each level.

The so-called natural breaks were then calculated for the risk indicator using the Jenks (1967) optimization method, which defines four classes that minimize within-class variance and maximize between-class variance for each municipality's risk distribution.

Tables 5 and 6 report the summary statistics for the hydraulic and landslide composite risk indicators across Italian municipalities, together with the distribution of insurance coverage, measured as the percentage of insured sites per municipality. For both risks, the four classes were defined using the Jenks natural breaks method.

Table 5 – Descriptive Statistics – Hydraulic Risk and % incidence of insurance coverage

Hydraulic risk								
Risk/Incidence (%)	**N.**	**Mean**	**SD**	**Min**	**Max**	**Break 1**	**Break 2**	**Break 3**
Risk by Municip.	7,901	0.412	0.532	0	2	0.235	0.710	1.243
Risk by Sites	949,263	0.414	0.513	0	2	0.231	0.618	1.235
% incid. by Municip.	7,795	28.1	18.9	0	100	14.7	36.0	65.6

Note: The total number of observations differs from the value in Table 4 due to missing value in risk indicators related to some geographical location. Data refers to the geographical distribution of companies in 2024.

In particular, Table 5 shows that hydraulic risk is unevenly distributed across municipalities, with an average value of 0.41 and a relatively high standard deviation, confirming strong territorial heterogeneity. The distribution of firms' productive sites mirrors this pattern. However, insurance penetration varies widely even within similar risk classes, and the correlation between hydraulic hazard and municipal coverage is essentially zero (0.02 in the Spearman correlation across Jenks classes), indicating that uptake is not meaningfully related to underlying hydraulic risk.

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Table 6 shows that landslide risk also varies substantially, with a low average value but wide dispersion. The spatial distribution of firms' sites again broadly reflects the municipal risk pattern, but insurance coverage remains extremely limited across all classes, with no clear relationship between hazard levels and uptake.

Table 6– Descriptive Statistics – Landslide Risk and % incidence of insurance coverage

Landslide risk								
Risk/Incidence (%)	**N.**	**Mean**	**SD**	**Min**	**Max**	**Break 1**	**Break 2**	**Break 3**
Risk by Municip.	7,901	0.435	0.634	0	3.820	0.335	1.140	1.987
Risk by Sites	949,263	0.365	0.590	0	3.820	0.328	1.066	1.972
% incid. by Municip.	7,795	2.0	4.9	0	100	2.0	8.3	29.4

Note: The total number of observations differs from the value in Table 4 due to missing value in risk indicators related to some geographical location. Data refers to the geographical distribution of companies in 2024.

3.2.2 Seismic risk

Moving to seismic risk, physical risk indicators reported by GeoSafe platform have been used to perform the analysis. These parameters are computed for three partially overlapping period intervals, designed to represent the vibration periods of ordinary buildings with different heights. The resulting indicators (ASI1, ASI2, ASI3) therefore describe spectral accelerations corresponding to short-, medium- and long-period responses, which can be used to assess seismic risk in relation to the structural typology of the exposed assets.

Differently to IdroGeo's indicators, those values refer to seismic-intensity classes without providing the information on extension of the area exposed to each level of hazard. More precisely, they are defined as follows:

- **ASI1** (short-period spectral acceleration indicator): represents the seismic response of low-rise buildings, typically up to about 4 storeys, characterized by short fundamental vibration periods (0.1 – 0.5 s). This indicator captures the expected ground acceleration in the lower range of structural response, relevant for stiff or low buildings.
- **ASI2** (medium-period spectral acceleration indicator): corresponds to the seismic response of medium-rise buildings, generally between 4 and 8 storeys, with intermediate vibration periods (0.4 – 0.8 s). This indicator reflects the expected spectral acceleration for structures of moderate height, which are sensitive to ground motions within this period band.
- **ASI3** (long-period spectral acceleration indicator): represents the seismic response of high-rise buildings, typically taller than 8 storeys, associated with longer vibration periods (0.7 – 1.1 s). This parameter accounts for ground motion amplification effects relevant to flexible or tall structures.

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To get a synthetic indicator offering a similar picture with respect to that offered by the hydrogeological indicators defined in section 3.2.1, we define the following composite seismic indicator:

- **Seismic risk indicator:** obtained as the arithmetic mean of the three ASI values reported by GeoSafe, where ASI refers to seismic-intensity classes used in its seismic module. Averaging across classes produces a single synthetic measure of seismic hazard that captures different seismic scenarios and building-period categories, rather than relying on a single return period or indicator.

Table 7 reports the summary statistics for the composite seismic risk indicator. Seismic risk is relatively high on average and shows clear territorial stratification. Firms' productive sites follow a similar spatial pattern, meaning many businesses operate in areas with significant seismic exposure. However, the correlation between seismic hazard and municipal insurance coverage is negative (−0.05 in the Spearman correlation across Jenks classes), suggesting that higher risk does not translate into higher uptake. One reason may be that premiums in high-risk areas tend to be higher, which can discourage demand.

Table 7 – Descriptive Statistics - Seismic Risk and % Incidence of insurance coverage

	Seismic risk							
Risk/Incidence (%)	N.	Mean	SD	Min	Max	Break 1	Break 2	Break 3
Risk by Municip.	7,815	2.578	0.815	0	5	1.333	2.667	3.667
Risk by Sites	936,949	2.576	0.655	0	5	1.333	2.667	3.667
% Incid. by Municip.	7,795	28.0	18.9	0	100	14.1	32.5	60.0

Note: The total number of observations differs from the value in Table 4 due to missing value in risk indicators related to some geographical location. Data refers to the geographical distribution of companies in 2024.

4. Geospatial and Econometric Evidence

4.1 Geospatial Analysis

A geospatial analysis was conducted to integrate insurance coverage data with physical risk maps. Using the indicators defined in Section 3.2, risk levels for floods, earthquakes and landslides—corresponding to the natural hazards included in the 2024 Budget Law—were assigned to all company sites based on their municipality. The analysis, performed with GeoDa, enabled the creation of overlay maps comparing the geographical distribution of natural hazards with the uptake of corresponding insurance contracts.

The proposed analysis focuses on the diffusion of natural catastrophe insurance among Italian limited companies, and it is based on 2024 data collected by ANIA.

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Figure 5 shows a marked territorial heterogeneity in hydraulic risk, with higher exposure concentrated in specific river basins and in parts of the North-East and Centre. Figure 6 indicates that flood insurance uptake is generally low and highly uneven across municipalities. Taken together, the two maps suggest that insurance penetration does not systematically increase in the areas classified as higher risk, a result consistent with the near-zero correlation mentioned above.

Figure 5 - Hydraulic risk across municipalities

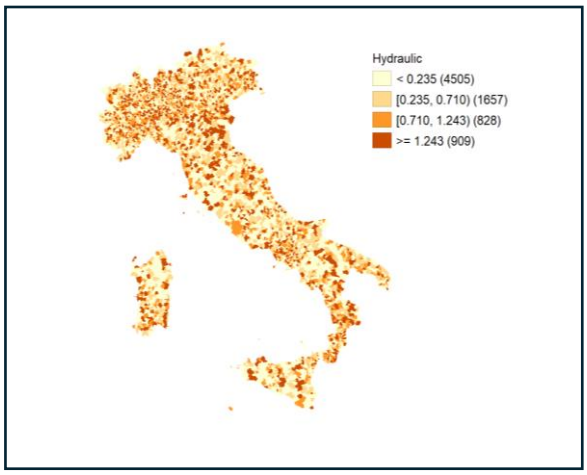
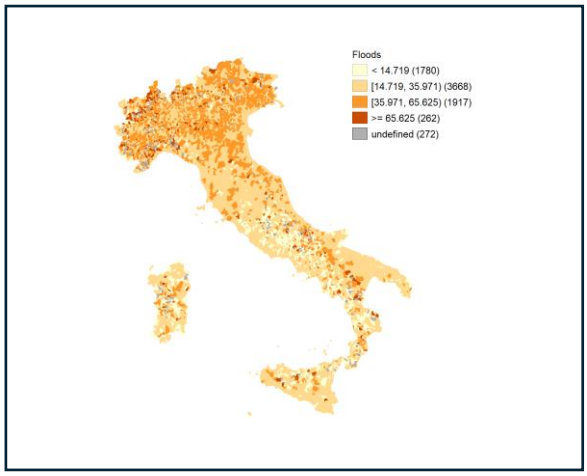


Figure 6 – Distribution of Floods and Inundations insurance (% of insured sites per municipality)



Note: fig. 5 refers to the distribution of the hydraulic risk indicator across municipalities; fig. 6 refers to the distribution of Flood and Inundation insurance uptake across municipalities. "undefined" denotes municipalities for which no company sites are reported.

Figure 7 - Landslide risk across municipalities

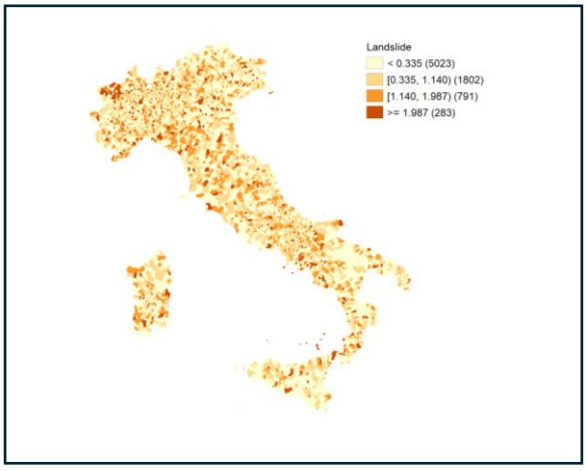
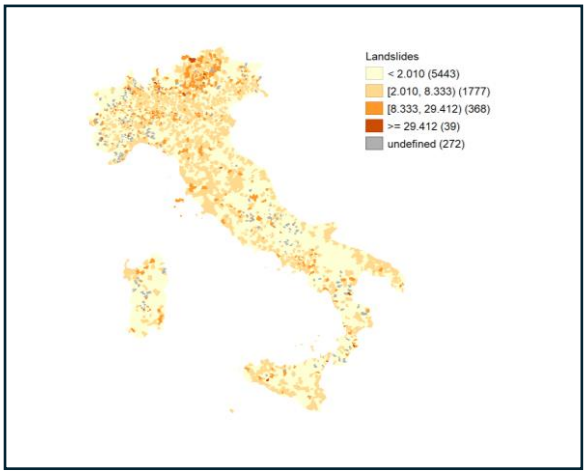


Figure 8 – Distribution of Landslides and Mudslides insurance (% of insured sites per municipality)



Note: fig. 7 refers to the distribution of the landslide risk indicator across municipalities; fig. 8 refers to the distribution of Landslides and Mudslides insurance uptake across municipalities. "undefined" denotes municipalities for which no company sites are reported.

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Figure 7 shows a highly uneven spatial distribution of landslide risk, with clusters of higher hazard concentrated in mountainous and hilly areas, particularly along the Apennines and in parts of the North. Figure 8 illustrates that insurance coverage for landslides remains extremely limited across municipalities and displays little variation even where risk levels are elevated.

Figure 9 - Seismic risk across Italian municipalities

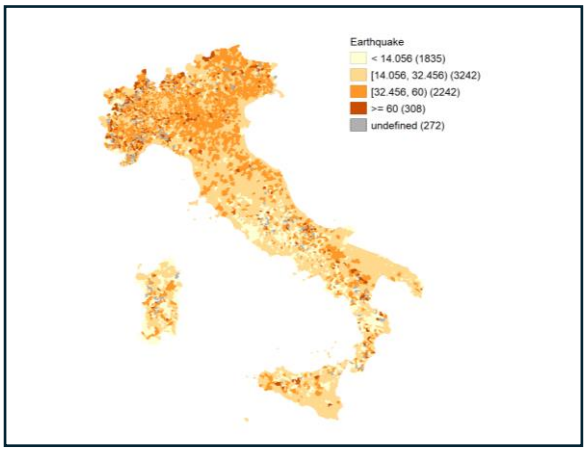
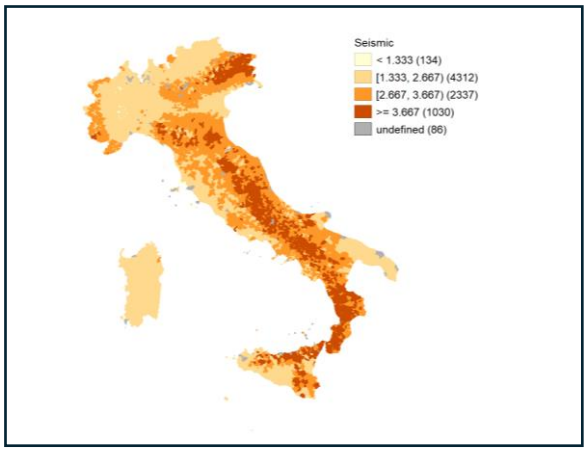


Figure 10 – Distribution of Earthquake insurance (% of insured sites per municipality)



Note: fig. 9 refers to the distribution of the seismic risk indicator across municipalities; fig. 10 refers to the distribution of Earthquake uptake across municipalities. "undefined" denotes municipalities for which no company sites are reported.

Figure 9 shows the territorial distribution of seismic risk across Italian municipalities, with higher hazard levels concentrated along the Apennine ridge and in parts of the South, confirming the well-known structural exposure of the country to earthquakes. Figure 10 depicts the corresponding distribution of earthquake insurance coverage, which remains modest and highly uneven. The comparison between the two maps suggests that insurance uptake increases only weakly—and not consistently—in the areas with higher seismic hazard, in line with the negative Spearman correlation.

Finally, an analysis based on the bivariate Local Moran's I (LISA) indicator is carried out (Anselin, 2003). LISA is a spatial analysis technique that measures how similar each municipality is to its neighbours and identifies local patterns of association. In our application, it compares the spatial distribution of the municipal risk indicators with that of insurance coverage, highlighting areas where high (or low) risk coincides with similar levels of uptake, as well as municipalities where the two variables diverge, thus revealing potential local mismatches between hazard and protection. Figures 11, 12 and 13 show the results for hydraulic, seismic and landslide risk, respectively, and indicate only limited spatial alignment between hazard and insurance coverage across all three perils.

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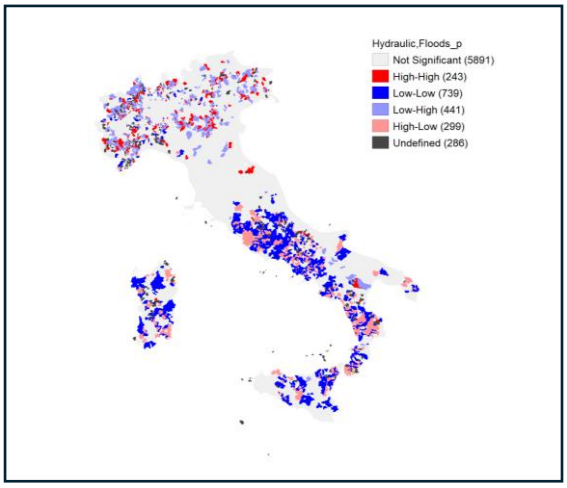
Figure 11 – LISA Cluster Map for Hydraulic Risk and Flood Insurance Uptake



For hydraulic risk (Figure 11), high-risk clusters emerge along major river basins, but only in a few northern areas do they coincide with high insurance uptake, while most municipalities in central Italy and the South fall into "high risk–low coverage" or "low risk–low coverage" configurations.

Figure 12 – LISA Cluster Map for Seismic Risk and Earthquake Insurance Uptake

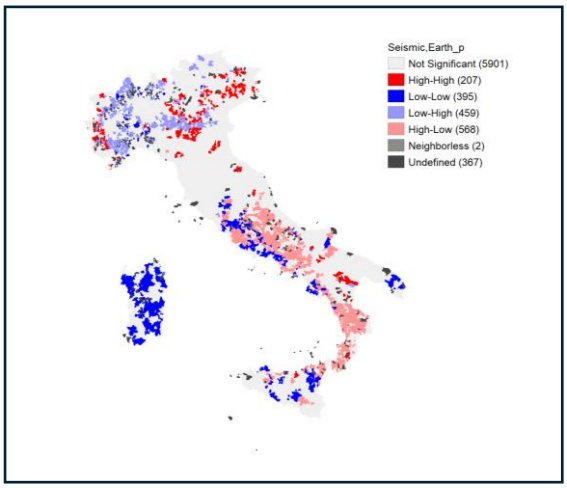


Figure 12 shows that seismic risk is highly clustered along the Apennines and in the South, but these areas seldom coincide with high insurance uptake. Most central and southern municipalities fall into the "high risk–low coverage" category, highlighting a clear spatial mismatch between seismic hazard and protection.

Figure 13 – LISA Cluster Map for Landslide Risk and Landslide Insurance Uptake

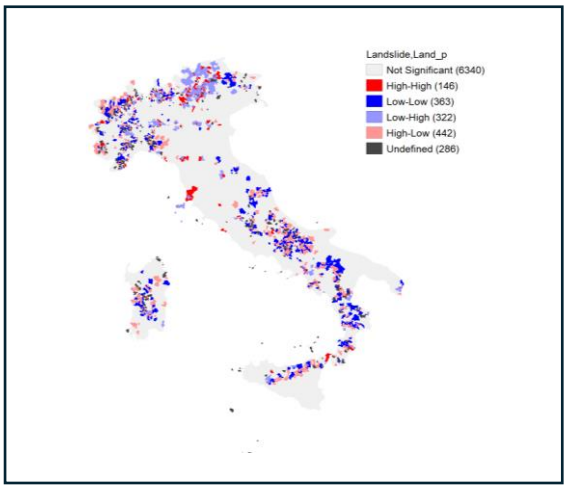


Figure 13 shows that landslide risk forms clear clusters in several mountainous and hilly areas, yet these patterns are not matched by insurance uptake. Coverage remains very low and spatially scattered, resulting in widespread "high risk–low coverage" configurations. Overall, the map confirms a pronounced spatial mismatch between landslide hazard and insurance protection.

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Overall, the LISA results confirm that local spatial mismatches between hazard and insurance are widespread. Particularly concerning is the concentration of pink areas—municipalities characterised by high risk and low insurance uptake—across central and southern Italy, a pattern especially pronounced for seismic risk.

4.2 Regression Analysis

To better understand the relationship between physical risk and NatCat insurance penetration among Italian companies—while controlling for the factors discussed above—a logistic regression model is implemented. This framework allows us to assess how exposure to natural hazards influences the decision to purchase coverage against floods, earthquakes or landslides, taking into account firm characteristics, sectoral differences and regional disparities. The aim is to provide a more precise identification of the determinants of NatCat insurance demand.

The analysis focuses on micro, small and medium-sized enterprises, which represent the segment most vulnerable to natural disasters and are therefore central in the related literature. Large firms are excluded from the analysis both because of their relatively limited presence in the sample and because they tend to rely on more diversified risk-management strategies—such as self-insurance, internal risk retention or insurance solutions purchased abroad in more developed markets. Their exclusion helps minimise potential biases and ensures more reliable estimates.

4.2.1 Model, Variables and Summary Statistics for the Regression Analysis

We estimate a binary logit model to analyse the determinants of *Y*, where the probability that the event occurs is specified as:

$$P(Y_i = 1 \mid X_i) = \frac{e^{X_i'\beta}}{1 + e^{X_i'\beta}}$$

where Y_i is binary dependent variable indicating the presence of insurance coverage (1 = present, 0 = absent). The primary explanatory variable is the firm's exposure to physical risk associated with the specific hazard type, measured through the Risk Indicators defined in Section 3.2.

The control variables are dummy variables included to account for heterogeneity across various dimensions:

- VAT number[7]: to account for intra-firm dependencies among branches.

[7] The VAT number is used to cluster standard errors in order to account for intra-firm dependencies among branches, without estimating a coefficient for this variable.

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- Firm size: given its influence on risk management and investment strategies due to more structured organisation and greater financial capacity.
- Sector: to capture industry-specific differences in risk perception and insurance behaviour.
- Region of the registered office: the degree of development of the insurance market in the region of the headquarter can significantly influence the decision to insure all the sites of a company.
- Year: to account for temporal trends in insurance demand (e.g., legislative changes, market conditions).

Summary statistics are reported in Table 8. For earthquakes, we have 5,636,964 observations referring to individual operating sites of the 611,113 insured companies over the period 2018-2024: the mean value of the risk indicator is 2.58, with a standard error of 0.66. For hydraulic and landslide risks, the mean values are 0.41 and 0.36, with standard errors of 0.51 and 0.59, respectively. The table also reports the values of the different indicators by firm size and sector.

Table 8 – Summary statistics

Variables	No. of Obs.	Mean	Std. Dev.	Min.	Max.
Panel A: Full sample					
Earthquake insurance	5,745,705	0.17	0.38	0	1
Seismic risk	5,636,964	2.58	0.66	0	5
Floods and inundations insurance	5,745,705	0.19	0.39	0	1
Hydraulic risk	5,711,653	0.41	0.51	0	2
Landslides and mudslides insurance	5,745,705	0.00	0.07	0	1
Landslide risk	5,711,653	0.36	0.59	0	3.82
Panel B: by Size					
Micro					
Earthquake insurance	3,549,292	0.10	0.30	0	1
Seismic risk	3,485,122	2.58	0.66	0	5
Floods and inundations insurance	3,549,292	0.11	0.32	0	1
Hydraulic risk	3,534,480	0.42	0.51	0	2
Landslides and mudslides insurance	3,549,292	0.00	0.06	0	1
Landslide risk	3,534,480	0.35	0.58	0	3.82
Small					
Earthquake insurance	1,496,003	0.23	0.42	0	1
Seismic risk	1,466,757	2.57	0.65	0	5
Floods and inundations insurance	1,496,003	0.25	0.43	0	1

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Hydraulic risk	1,484,627	0.41	0.51	0	2
Landslides and mudslides insurance	1,496,003	0.01	0.08	0	1
Landslide risk	1,484,627	0.37	0.59	0	3.82
Medium					
Earthquake	700,410	0.44	0.50	0	1
Seismic risk	685,085	2.57	0.65	0	5
Floods and inundations	700,410	0.47	0.50	0	1
Hydraulic risk	692,546	0.41	0.51	0	2
Landslides and mudslides insurance	700,410	0.01	0.08	0	1
Landslide risk	692,546	0.38	0.60	0	3.82
Panel C: by Sector					
Trade, hotel and restaurants					
Earthquake insurance	1,861,222	0.13	0.34	0	1
Seismic risk	1,816,392	2.59	0.66	0	5
Floods and inundations insurance	1,861,222	0.15	0.36	0	1
Hydraulic risk	1,849,825	0.43	0.52	0	2
Landslides and mudslides insurance	1,861,222	0.00	0.06	0	1
Landslide risk	1,849,825	0.35	0.58	0	3.82
Construction					
Earthquake insurance	750,961	0.14	0.34	0	1
Seismic risk	739,721	2.58	0.67	0	5
Floods and inundations insurance	750,961	0.14	0.35	0	1
Hydraulic risk	747,681	0.42	0.51	0	2
Landslides and mudslides insurance	750,961	0.01	0.10	0	1
Landslide risk	747,681	0.36	0.58	0	3.82
Energy, water and telecommunication					
Earthquake insurance	123,899	0.49	0.50	0	1
Seismic risk	121,415	2.59	0.71	0	5
Floods and inundations insurance	123,899	0.5	0.50	0	1
Hydraulic risk	122,850	0.39	0.50	0	2
Landslides and mudslides insurance	123,899	0.01	0.10	0	1
Landslide risk	122,850	0.4	0.60	0	3.72
Extractive industry					
Earthquake insurance	555	0.30	0.46	0	1
Seismic risk	518	2.47	0.71	2	5
Floods and inundations insurance	555	0.33	0.47	0	1
Hydraulic risk	555	0.39	0.55	0	2
Landslides and mudslides insurance	555	0.02	0.13	0	1
Landslide risk	555	0.44	0.70	0	2.38
Manufacturing					

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Earthquake insurance	1,056,798	0.32	0.47	0	1
Seismic risk	1,040,100	2.59	0.65	0	5
Floods and inundations insurance	1,056,798	0.33	0.47	0	1
Hydraulic risk	1,049,010	0.41	0.52	0	2
Landslides and mudslides insurance	1,056,798	0.00	0.06	0	1
Landslide risk	1,049,010	0.39	0.59	0	3.82
Transports					
Earthquake insurance	219,382	0.17	0.38	0	1
Seismic risk	215,127	2.54	0.65	0	5
Floods and inundations insurance	219,382	0.19	0.39	0	1
Hydraulic risk	218,237	0.40	0.51	0	2
Landslides and mudslides insurance	219,382	0.00	0.06	0	1
Landslide risk	218,237	0.37	0.60	0	3.82
Other services					
Earthquake insurance	700,410	0.44	0.50	0	1
Seismic risk	685,085	2.57	0.65	0	5
Floods and inundations insurance	700,410	0.47	0.50	0	1
Hydraulic risk	692,546	0.41	0.51	0	2
Landslides and mudslides insurance	700,410	0.01	0.08	0	1
Landslide risk	692,546	0.38	0.60	0	3.82

Note: The table reports variables statistics of the total sample (Panel A) and of the subsamples by firm size (Panel B) and by sector (Panel C). Data are drawn from the ANIA's ICON-I, from ISPRA database on hydrogeological risk (2025) and from GeoSafe. Statistics are computed using firm-level data including all company branches.

Descriptive statistics indicate that only 17% of sites are covered by earthquake insurance and 19% by flood insurance, while coverage against landslides is minimal. Coverage rates increase with firm size—particularly among medium-sized enterprises—but remain relatively low even in sectors exposed to higher risks, such as energy, water and telecommunications, and extractive industries. This pattern suggests a significant degree of underinsurance against natural hazards.

4.2.2 Results

In the first set of regressions (Table 9), we use the risk indicator as a continuous variable. This variable is positive and statistically significant both in the earthquake and in the flood regressions. In these two cases — characterized by a higher prevalence of insurance coverage — the positive sign suggests a form of adverse selection: firms operating in areas with higher risk levels tend to insure themselves more.

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Table 9 – Logit regression on whole sample

Variables	Earthquake	Floods	Landslides
Risk indicator	0.085***	0.014***	0.032
	(0.007)	*(0.006)*	*(0.022)*
Size: micro	-1.866***	-1.866***	-0.725***
	(0.019)	*(0.019)*	*(0.071)*
Size: small	-0.99***	-0.959***	-0.251***
	(0.019)	*(0.019)*	*(0.074)*
Trade, Hotels and Restaurants	-0.004	-0.122***	0.488***
	(0.017)	*(0.016)*	*(0.058)*
Construction	0.194***	-0.035*	1.396***
	(0.016)	*(0.015)*	*(0.056)*
Energy, Water and Telecommunications	1.888***	1.673***	1.025***
	(0.037)	*(0.036)*	*(0.133)*
Extractive industry	1.058**	0.868*	1.508
	(0.334)	*(0.299)*	*(0.811)*
Manufacturing	0.886***	0.676***	0.378***
	(0.015)	*(0.015)*	*(0.061)*
Transport	0.088**	-0.066*	*0.232*
	(0.033)	*(0.031)*	*(0.132)*
2019	0.045***	0.047***	*-0.024*
	(0.004)	*(0.004)*	*(0.027)*
2020	0.47***	0.459***	*-0.012*
	(0.006)	*(0.006)*	*(0.033)*
2021	0.523***	0.507***	*-0.050*
	(0.007)	*(0.007)*	*(0.049)*
2022	0.562***	0.532***	*-0.016*
	(0.007)	*(0.008)*	*(0.051)*
2023	0.636***	0.595***	*0.037*
	(0.008)	*(0.007)*	*(0.052)*
2024	0.761***	0.732***	*1.962****
	(0.008)	*(0.008)*	*(0.048)*
Constant	-1.448***	-0.901***	*-6.347****
	(0.0547)	*(0.0448)*	*(0.1706)*
N	**5,635,157**	**5,709,828**	**5,709,828**

Note: The table reports the coefficients from logit regressions from logit regressions for earthquake, floods, and landslides insurance coverage. Dependent variable: firm-level insurance coverage dummy (1 = insured, 0 = uninsured). Heteroskedasticity robust standard errors are reported in parentheses. The symbol *** indicates a significance level of 1 per cent or less; ** between 1 and 5 per cent; * between 5 and 10 per cent. Geographical region fixed effects are included in all regressions but not reported in the tables to save space. Standard errors are clustered at the firm level to account for within-group correlation.

To measure the impact of this phenomenon, we use the marginal effect (Table 9.1), which measures the change in the predicted probability of having insurance coverage associated with a one-unit increase in the risk indicator, holding all other variables constant. For

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earthquakes, the marginal effect is 0.0104, while for floods it is 0.0019. An increase of one standard deviation in the risk indicator (0.66 for seismic risk and 0.51 for hydraulic risk) raises the probability of being insured by approximately 0.7% and 0.1%, respectively. The effect is therefore statistically significant but rather limited in magnitude. It cannot be ruled out that the limited effect also depends on the supply policies of insurance companies, which tend to be more cautious in offering coverage in the highest-risk areas. For landslides, the risk indicator variable is not statistically significant, probably due to the limited diffusion of this type of coverage.

Table 9.1 - Average marginal effects (AMEs) from logit models for insurance coverage

Variable	Earthquake	Floods and inundations	Landslides and mudslides
Risk indicator	0.0104***	0.0019**	0.00014
	(0.00091)	*(0.00084)*	*(0.00005)*

Note: The table reports the average marginal effects (AMEs) estimated from logit regressions. Robust standard errors in parentheses. Robust standard errors clustered at the firm level. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. The dependent variable equals 1 if the firm has an active insurance and 0 otherwise.

As for the coefficients of the dummy variables, it should be noted that for both earthquakes and floods, the highest and statistically significant coefficients are observed in the energy sector, followed by manufacturing. Regarding the unreported regional coefficients, the largest values are found in northern regions, including Trentino, Veneto, Friuli, and Lombardy. In both regressions, insurance coverage also increases significantly and steadily over the years of observation.

Finally, as a robustness check, we re-estimated the model by dividing the risk indicators into the four risk classes derived in Section 3.2 using the Jenks natural breaks classification method, based on the 2024 risk distribution (Table 10).

Table 10 – Logit regression on whole sample (by Jenks natural risk classes)

Variables	Earthquake	Floods and inundations	Landslides and mudslides
Break 2	0.117***	0.012	-0.014
	(0.052)	*(0.007)*	*(0.038)*
Break 3	0.207***	-0.012	0.049
	(0.052)	*(0.01)*	*(0.044)*
Break 4	0.265***	0.037***	0.091
	(0.055)	*(0.011)*	*(0.073)*
N	**5,635,157**	**5,709,828**	**5,709,828**

Note: The table reports the marginal effects coefficients from logit regressions for the probability that a firm is insured against natural hazards. Heteroskedasticity robust standard errors are reported in parentheses. The symbol *** indicates a significance level of 1 per cent or less; ** between 1 and 5 per cent; * between 5 and 10 per cent. Size, Sector, Year and Geographical region fixed effects are included in all regressions but not reported in the tables to save space. Standard errors are clustered at the firm level to account for within-group correlation.

Aprile 2026 - Pubblicazione finanziata dal PNRR, Missione 4 (Infrastruttura e Ricerca), Componente 2 (Dalla Ricerca all'Impresa), Investimento 1.3 (Partnership Estese), Tematica 9 (Sostenibilità economica di sistemi e territori). Sito web: https://grins.it/.

In the earthquake regression, the marginal effect on the probability of being insured increases steadily from the first to the fourth risk class, and all these effects are strongly statistically significant when compared with the lowest-risk class. By contrast, in the case of floods, only the fourth—and highest—risk class shows a positive and strongly significant coefficient, while none of the lower classes exhibits a significant marginal effect.

Specifically, for earthquakes, firms located in the highest-risk class are 26.5 percentage points more likely to be insured than those in the lowest-risk class, while the difference decreases to 3.7 percentage points for floods. Hence, the marginal effect appears relatively stronger for seismic risk, possibly reflecting a higher and more established perception of earthquake risk and the more recent and still emerging awareness of climate-related hazards such as floods and landslides.

5. Conclusions

Climate change is set to profoundly affect economic systems, increasing the frequency and severity of extreme weather events, thereby exposing businesses to greater physical risks and threatening their productivity and continuity. This study analyses the relationship between firms' exposure to physical risks and the uptake of natural catastrophe (NatCat) insurance in Italy. Combining ANIA's firm-level survey data with the AIDA, GeoSafe and ISPRA databases, it provides a unique picture of how risk exposure, firm characteristics, and geographical factors jointly shape insurance demand. Despite Italy's high and growing exposure to natural hazards, the overall penetration of NatCat insurance remains limited, particularly among small and micro enterprises – the segments most vulnerable to physical and financial shocks.

Descriptive evidence shows a clear misalignment between risk and coverage. In several high-risk areas, particularly in central and southern Italy, insurance uptake remains very low, while coverage is higher in northern regions where industrial concentration, insurance awareness, and market development are greater. These results confirm that economic capacity, local market structure, and the degree of risk awareness play a stronger role than objective exposure in determining insurance demand.

Regression results indicate a positive and statistically significant relationship between risk exposure and the probability of holding NatCat insurance, particularly for earthquakes and floods. However, the estimated marginal effects are small, pointing to a limited sensitivity of insurance demand to physical risk. This pattern suggests mild adverse selection—firms in riskier areas insure more—but also highlights the persistent structural underinsurance of Italian enterprises. For landslides, the absence of significant effects confirms the very limited diffusion of this coverage and, possibly, a lack of tailored products in the market.

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Sectoral and territorial differences remain substantial. The energy and manufacturing sectors show higher coverage rates, while trade, services, and construction display the lowest. The most insured regions are in the North-East, where the insurance industry is more developed and risk management practices are more established. Over time, insurance diffusion has increased, particularly after 2020, suggesting a gradual improvement in awareness and possibly an anticipatory effect of the 2024 mandatory scheme.

These findings have relevant policy implications. A national strategy to close the protection gap should combine demand-side measures—such as education campaigns, fiscal incentives and risk-awareness initiatives—with supply-side actions, including the development of public–private reinsurance pools, shared data platforms and premium-stabilisation mechanisms in high-risk areas. It will also be essential to assess the full impact of the newly introduced insurance mandate on the development of risk awareness among Italian firms and, more broadly, within Italian civil society.

Future research will focus on refining the analysis through the imputation of missing information on firms not directly observed in the available datasets. By applying advanced imputation techniques, we aim to reconstruct a more comprehensive sample of the Italian limited companies' population, which will allow us to define an appropriate control group and to estimate the natural catastrophe insurance protection gap more accurately. This step will provide a fuller picture of underinsurance patterns across sectors and territories, and support more targeted policy recommendations.

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7. Appendix

Table A

Name	Description	Unit of measurement
Company name	Legal name of the company	-
Province	Province where the company is registered	-
Sales revenue	Total sales revenue in 2024	Million EUR
Employees	Total number of company employees in 2024	Number
Tax code	Tax identification code assigned to the company	-
Chamber of Commerce registration number	Company registration number at the Chamber of Commerce	-
Local unit - Municipality	Municipality where the company's local unit is located	-
Local unit - Address	Address of the company's local unit	-
Local unit - Postal code	ZIP code (Postcode) of the local unit	-
VAT number	Company VAT number	-
Profile/Local unit	Brief description of the company profile or local unit	-
Sales revenue (Last year)	Sales revenue for the most recent year available (2024)	Million EUR
Registered office - Municipality	Municipality where the registered office is located	-
Registered office - Postal code	ZIP code of the registered office	-
Registered office - Region	Region where the company's registered office is located	-
Registered office - Longitude	Longitude coordinate of the registered office	Decimal degrees
Registered office - Latitude	Latitude coordinate of the registered office	Decimal degrees
Legal form	Legal form of the company (e.g. LLC, JSC)	-
Date of last financial statement closing	Date when the last financial statement was closed	Date
Profile/Registered local unit	Brief description of the company profile or registered local unit	-
Employees (Last year)	Number of employees in the most recent year available (2024)	Number
ATECO 2007	ATECO 2007 code identifying the company's business sector	Code
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization in 2024	Million EUR
EBITDA Year - 6	EBITDA (2018)	Million EUR
EBITDA Year - 5	EBITDA (2019)	Million EUR
EBITDA Year - 4	EBITDA (2020)	Million EUR
EBITDA Year - 3	EBITDA (2021)	Million EUR
EBITDA Year - 2	EBITDA (2022)	Million EUR
EBITDA Year - 1	EBITDA (2023)	Million EUR
TOTAL ASSETS	Total value of assets recorded in the 2024 balance sheet	Million EUR
TOTAL ASSETS Year - 5	Total value of assets recorded (2019)	Million EUR
TOTAL ASSETS Year - 4	Total value of assets recorded (2020)	Million EUR
TOTAL ASSETS Year - 3	Total value of assets recorded (2021)	Million EUR
TOTAL ASSETS Year - 2	Total value of assets recorded (2022)	Million EUR
TOTAL ASSETS Year - 1	Total value of assets recorded (2023)	Million EUR
Local unit - Hamlet	Name of the hamlet where the local unit is located	-
Local unit - Province	Province where the local unit is located	-
Registered office - Hamlet	Name of the hamlet where the registered office is located	-
Legal status	Legal status of the company (active, in liquidation, etc.)	-

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