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Impact of EU-wide Insurance Stress Tests on Equity Prices and Systemic Risk

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Abstract:
Since the global financial crisis in 2007, stress tests have become standard tools for regulators and supervisors to assess the risks and vulnerabilities of financial sectors. To this end, the Insurance and Occupational Pensions Authority (EIOPA) regularly performs EU-wide insurance stress tests. This paper analyses the impact of the conducted exercises in 2014, 2016 and 2018 on the equity prices of insurance companies. Using an event study framework, we find a statistically significant impact only for the publication of the 2018 exercise results. Our empirical analysis further suggests that the final version of technical specifications for the 2014 exercise, the initiation of public consultation, and the published stress test scenario of the 2018 exercise contributed to the decline in systemic risk. To our best knowledge, this is the first paper that investigates this topic for the European insurance sector. Our empirical results could help improve the communication and design of future stress test exercises.

JEL: G23, G12, G14, G18
Keywords: European insurance sector; EU-wide insurance stress test, systemic risk, event study, equity prices

1. Introduction

Over the past decade, system-wide stress tests have been fully established as a key tool for financial stability risk assessment. Regulatory authorities aim to promote transparency in financial sectors, improve market discipline and foster financial institutions' own risk management capacity. Furthermore, they intend to help policymakers set up microprudential and macroprudential measures to ensure the adequate resilience of financial sectors.

How stress tests are implemented has evolved since the financial crisis. Supervisors, policy makers and academicians continue to discuss the long-term strategy for their use with market participants. While system-wide bottom-up banking stress tests were extensively used to determine the level of capital needed after the financial crisis in 2007, that changed in later years to using stress test exercises as a supervisory tool. In the case of EU-wide bottom-up insurance stress tests conducted by the European Insurance and Occupational Pensions Authority (EIOPA), it has never been considered a pass-or-fail or capital exercise. Instead, the exercises have been tailored to assess the resilience of the European insurance sector to specific adverse scenarios with potential negative implications for the stability of European financial markets and the real economy.

The first EU-wide insurance stress test was conducted in December 2009 by the Committee of European Insurance and Occupational Pensions Supervisors (CEIOPS) for large and important insurance groups in Europe as a response to the 2007 financial crisis.[1] The second EU-wide insurance stress was conducted by EIOPA and employed a market-based valuation framework. However, the first fully-fledged EU-wide insurance stress test exercise using the Solvency II framework was conducted only in 2014. Such exercises had been regularly performed every two years until 2018. Since then, EIOPA has moved to a three-year frequency in order to allow for sufficient follow-up with national supervisors on the identified vulnerabilities to utilise the full potential of the exercises.[2] In this respect, EIOPA has further worked on methodologies to be used according to objectives selected for the particular stress test exercise. Supervisory stress tests can have various objectives which drive the design, methodology and application of each stress test exercise. The most important distinction is between microprudential and macroprudential objectives (EIOPA, 2019).

[1] On 5 November 2003, the European Commission adopted the decision, to establish the Committee of European Insurance and Occupational Pensions Supervisors, which entered into force on 24 November 2003.

[2] EIOPA is not a direct supervisor of the European insurance sector. Hence, all contacts with participating insurance companies are hold via national supervisors.

Based on constructive dialogue and feedback received from stakeholders in the preparation of the first methodological paper (EIOPA, 2019), EIOPA has followed the same approach and has engaged with stakeholders to enrich the stress test toolbox with additional elements that may be applied in future exercises (EIOPA, 2020). Apart from the main aim of EU-wide stress test exercises to assess the resilience of financial institutions to adverse market developments, these exercises should also contribute to the overall assessment of systemic risk in the EU financial system.

The objective of this paper is thus twofold. In the first part, we assess the potential impact of the key issued EIOPA announcements related to EU-wide stress tests on the equity prices of participating insurers via an event study. In this respect, we follow an event study methodology described e.g. by Brown and Warner (1985), Thompson (1995), and MacKinlay (1997). The second part of the paper assesses the possible changes in systemic risk caused by the stress test-related announcements as consultation, scenario, launch, and follow-up recommendations of the exercises. For this purpose, we decompose the insurers' beta into a market correlation component and a volatility component partially following the approach of Nijskens and Wagner (2011). This helps us develop a model that estimates the relation between insurers' returns and their betas through the coefficients capturing the change in insurers' betas after the several types of events. In addition to the previous studies, we use a novel approach utilising company specific betas.

Our paper contributes to an emerging research on stress testing and the effectiveness of EU-wide stress tests conducted by EIOPA at the EU level. In particular, it contributes to the ongoing discussion on optimal stress test disclosures and their implications (Ellahie, 2012; Petrella and Resti, 2013; Morgan et al., 2014, Ahnert et al., 2018, Sahin et al. 2020). Our paper aims to answer whether an EIOPA EU-wide stress test produces new valuable information for the market and whether such exercises have any impact, either positive or negative, on the stock prices of involved institutions.

The paper is structured as follows. First, we review previous relevant studies. Second, we present the data and the methodology employed. Third, we provide empirical results and their discussion. The key conclusions are detailed in the last section.

2. Literature Review

This paper contributes to the recent research stream on regulatory stress tests as well as the more established literature on financial stability and regulation of financial institutions.

There is a small but emerging literature on stress test disclosures and their implications, offering both theoretical and empirical angles. Theoretical studies mainly cover the optimal level of disclosure. Following Bernanke (2013), the disclosure of information related to stress tests promotes transparency by providing investors and market participants with consistent and comparable information on financial institutions' (particularly banks') financial conditions. Other authors recognize the benefits of disclosure, but also shed light on potential related issues (Schuermann, 2014, Goldstei, et. al, 2012, Gick, et.al, 2012). Carboni et al. (2017) highlight the so-called Hirsh-Leifer effect related to the disclosure of too much information, which consequently destroys risk-sharing opportunities and reduces liquidity in the interbank market. During a crisis, when the risk-sharing arrangements are compromised by public perception that financial institutions are opaque and under-capitalized, the disclosure, at least partial, of regulatory stress tests can produce a stabilizing effect. To reinforce this effect, it is critical that regulators provide new and valuable information to market participants by increasing transparency on their financial conditions. Similarly, based on a game-theoretical framework, Gick and Pausch (2012) claim that macro stress tests can improve welfare if the methodology and results of the stress test are communicated effectively. In the case of the banking sector, Spargoli (2012) argues in favour of disclosing banks' capital shortfalls under the assumption that regulators are able to ensure banks' recapitalizations. Some theoretical papers investigate the trade-off implied by the disclosure of stress test results. Goldstein and Sapra (2012), for example, find that disclosure of regulatory information and stress test results can have an inimical effect on the ex-ante incentives of financial institutions. In this context, Georgescu et al. (2017) argue that in the absence of information frictions, more information always improves market discipline. In reality, financial institutions are opaque and their reactions are endogenous to the regulatory environment. Furthermore, the results of Morris and Shin (2002) suggest that if the precision of the disclosed information is not sufficiently high, market participants may place unnecessary weight on the public signal, causing market overreaction and coordination failures.

There is a limited but growing number of empirical papers assessing market reactions to stress tests or similar regulatory exercises. Some of these studies assess whether those exercises were able to increase transparency. The results of these empirical assessments have contributed greatly to the discussion of designing an optimal level of disclosures of stress tests. Financial institutions are generally considered to suffer from a degree of opaqueness, specifically the inaccessibility of financial data to outsiders (Carboni et al. 2017). Hence, the market reaction to the disclosure of stress test results is to some extent proof of the existence and the reduction of opaqueness. However, the scale and timing of stress test information provision are challenged by

scholars and regulators as a trade-off between restoring confidence in financial institutions and risk of destabilising the financial system by signalling-out institutions failing the exercise (Golstein, et. al, 2015). Studies that assess the impact of the released information related to stress tests can be used to modify stress test design and to improve stress test-related communication.

The literature that compares US and EU stress tests raises important issues regarding governance, which is essential for the effectiveness of stress tests (Schuerman, 2013, Candelo et al., 2015). The analysis suggests that a well-established institutional framework, a credible backstop and efficient communication of the scope, methodology, scenario design, the granularity of disclosed information, and the planned follow-up may play a greater role than the technical specifications of the stress test. The existing empirical evidence on stress tests conducted across the EU member states suggests that the mandatory disclosure of stress test-related information generally produces new information for investors. Breckenfelder et al. (2018) assess the reaction of equity and CDS markets to the publication of 2014 bank stress test results to measure the cross-border spill-overs from changes in banks' CDS and equity prices in stressed countries (Greece, Ireland, Portugal, Italy, and Spain) to the sovereign CDS in non-stressed countries (Austria, Belgium, France, Germany, and the Netherlands). The results of the paper offered evidence that non-stressed countries provide a second line of defence to financial institutions in stressed countries within the studied period. Similarly, Acharya et al, (2014) debate the trade-off faced by the ECB between maintaining its reputation as an independent regulator and disclosing financial institutions' shortfalls in the context of the absence of credible backstops.

There is an emerging literature that provides an empirically-oriented impact assessment of the effectiveness of the disclosure of European regulatory institutions, specifically, EU-wide stress test by the European banking Authority (EBA) (Georgescu, et al., 2017, Ahnert, et. al., 2018, Georgoutsos, et. al, 2020) and Comprehensive Assessment by the Single Supervisory Mechanism (SSM) (Sahin et al., 2016, Lazzari et al., 2017; Carboni et al., 2017). Our study takes a different perspective from the existing papers on the European cases, since we analyse the market reaction related to the EIOPA insurance wide stress tests covering not only the dates of results' disclosures, but also other intermediate steps of the exercises.

Moreover, the aforementioned literature concentrates on the financial sector or the banking industry, with minimal emphasis on the insurance sector. Traditionally, insurance sectors are not deemed to be of systemic relevance to destabilise the overall financial system. Insurers, in contrast to banks, are typically not subject to a "bank run" type of event and therefore do not face the potential of unexpected

liquidity risk.[3] Nonetheless, the seminal theoretical work of Arrow (1963), Akerlof (1970), and Rothschild, et al. (1976) shed light on the potential for market failures arising from asymmetric information in private insurance markets. Research in this direction has advanced, beginning with theoretically motivated attempts to test if asymmetric information exists in insurance markets, and in what form (Chinkelstein, et. al, 2004, Cohen 2005, Finkelstein, et. al, 2006, Einav et.al 2010). More recently, Bierth et al (2015) assess the exposure and contribution of 253 insurance companies operating worldwide to systemic risk between 2000 and 2012. The authors suggest that the rise of interconnectedness within the financial sector increases insurers' systemic risk exposure, and highly leveraged insurance entities contribute more to systemic risk. Garcia, et al. (2021) analyse the optimal information structure in competitive insurance markets with adverse selection from a regulatory perspective. They suggest that the optimal rating system minimises ex-ante risk subject to participation constraints, which proves the existence of a unique optimal system under which all individuals trade.

The main contribution of this paper is that, to the best of our knowledge, this is the first study providing empirical evidence of market reaction to the EIOPA EU-wide stress tests and their impact on systemic risk in the sector. By observing market reactions from the announcements of the EU-wide insurance stress tests, this is the first paper that investigates whether the insurance stress test increased transparency and confidence in the insurance sector. The results have important policy implications for regulators, since they shed some light on investors' perceptions on the use of this important supervisory tool applied to the European insurance sector.

3. Data description and methodology

We collect data for all listed insurance companies at the group level participating in the EIOPA EU-wide stress test in 2018 and 2014.[4] There are 42 (out of which 20 are listed) and 31 (out of which 19 are listed) insurance groups participating in the 2018 and 2014 exercise, respectively. Overall, 29 insurance groups are included in our sample for both the 2014 and the 2018 stress test.

Moreover, we collect data for all listed insurers at the solo level for both the 2014 and the 2016 exercise. However, only a few solo insurers are listed. Out of the 236 solos

[3] However, similar situation as bank run was experienced by several life-insurance companies steaming from mass lapse events. Hence, the need to monitor and assess liquidity risk is currently widely debate (EIOPA, 2020).

[4] Apart from the 2014 and 2018 exercise, there has not been any further stress test exercise that would be conducted at group level. The exercise in 2016 was performed on insurance solo basis and the 2021 exercise was ongoing at the time of writing this study.

which participated in the 2016 EIOPA insurance stress test, only 6 are listed, and 24 solos are listed out of the 327 that participated in the 2014 EIOPA stress test. However, some of those listed solos participating in the 2014 exercise were traded with only a few transactions. In fact, their market value changes were very limited. Hence, we also select a subsample of those solo insurers whose equity prices were changed at least in 85% of trading days included in the sample. In this respect, we ensure sufficient liquidity of those titles in stock exchange markets, but reduce the sample to 7 solo insurers only. The results for solos thus have to be interpreted very carefully due to their limited representativeness.

We measure market reaction around all announcements related to the mentioned EIOPA insurance EU-wide stress tests. Table 1 reports the list of the considered events related to the stress tests. Further details on the reported announcement days can be found in the Appendix.

Table 1: EIOPA Stress Test events

2014		2016		2018	
		Invitation to the workshop with stakeholders	14-Mar-16		
Consultation	13-Mar-14	Scenario	17-Mar-16	Scenario	09-Apr-18
Scenario	08-Apr-14	Consultation	13-Apr-16	Consultation	16-Apr-18
Launch	30-Apr-14	Launch	24-May-16	Launch & technical specifications	14-May-18
Technical specifications	28-May-14	Technical specifications	01-Jun-16	Results	14-Dec-18
Results and Recommendations	01-Dec-14	Results and Recommendations	15-Dec-16	Recommendations	26-Apr-19

Daily stock market data are obtained from Reuters. We estimate abnormal returns (ARs) as the difference between actual stock returns and expected returns. Following a common procedure to estimate (e.g. De Long and De Young, 2007), we use the market model (MacKinlay, 1997) in which expected returns for an insurer ($R_{i,t}$) are obtained as a function of the market portfolio returns (Rm_t), represented by the European equity index (i.e. STOXX 600). Market model parameters are obtained with daily logarithmic returns of insurance stock prices over a year period preceding 10 days before the announcement date. ARs are then cumulated over a time period around the announcement date. Following Morgan et al. (2014) and other articles measuring market reaction to policy announcements (e.g. Flannery et al, 2017, Sahin et. al, 2020) we have considered the following event windows: (-1;+1), (-1;+2), (-1;+5), (-1;+8), (-2;+1), (-2;+2), (-2;+5), (-2;+8) to ensure the consistency of our findings. We test the hypothesis of a market reaction significantly different from zero using a standard event study methodology. A recent study by Korali and Pynnonnen (2010) proposes a new test statistic that adjust t-statistics in order to consider possible cross-sectional correlation among abnormal returns. Furthermore, as a robustness check, we also use the non-parametric rank test proposed by Corrado (1989) for a single day and further elaborated by Campell and Wasley (1993) for a multiday event period.

Following Nijskens and Wagner (2011), we decompose the beta into a volatility component and a market correlation component to measure the possible changes in systemic risk related to stress test events using equation (1).

$$R_{i,t} = \alpha_i + \beta Rm_t + \sum_j \delta_j D^j + \sum_j \zeta_j D^j * Rm_t + \varepsilon_{i,t} \quad (1)$$

where α_i is the insurer's fixed effect, and D^j is a dummy variable with value of 1 after the event and up to 10 trading days of the following stress test event j that refer to all events listed in table 1. Furthermore, we introduce novelty into their methodology through the adjustment of the decomposed beta, following the methodology of Jakubik and Uguz (2021). In the first step, we estimate beta for each insurance company *i* in the sample. In the second step, we create a new variable as follows.

$$\widehat{Rm}_{i,t} = \hat{\beta}_i Rm_t \quad (2)$$

Then we substitute the original variable for market return in equation (1) by the newly created variable. Formally,

$$R_{i,t} = \alpha_i + \theta \widehat{Rm}_{i,t} + \sum_j \delta_j D^j + \sum_j \varphi_j D^j * Rm_t + \varepsilon_{i,t} \quad (3)$$

Systemic risk is represented by the interacted term between event date and market return. Negative coefficients of this term imply a reduction of systemic risk as a reaction to the specific stress test-related event, while positive coefficients suggest an increase in systemic risk.

4. Empirical results

Our study covers three EU-wide stress tests based on the market based Solvency II regime that were conducted so far, namely the exercises performed in 2014, 2016 and 2018. The 2021 exercise is in process at the time of conducting this study, therefore it could not be included in this research. The empirical results obtained should be assessed in the context of the different attributes and aims of past exercises. The stress test in 2014 that was performed for insurance groups was the first exercise that employed the Solvency II framework at a time when its main attributes were already agreed on, despite the regulatory regime still not being in place. Hence, it could be seen as the first exercise providing a vulnerability assessment under the Solvency II valuation regime. In contrast, the 2016 exercise was the first stress test when the new Solvency II regulatory regime was in place. Unlike in 2014 and 2018, the 2016 exercise was conducted for insurers' solos, having two modules. The first was a standard module assessing the impact of an adverse market scenario on insurance solvency position. The second one assessed the impact of low yields on European solo insurers. Finally, the 2018 exercise was again conducted for insurers' groups. It was

also the first time EIOPA asked groups for their consent to publish individual results, as EIOPA does not have the legal power to enforce it. However, only four groups agreed to publish their results. For the majority of stress test participants, therefore, only aggregate results were published, as in the previous two exercises investigated in our study.

Our analysis covers the launch of public consultation of the exercises, publication of stress test scenarios, launch of stress test exercises, publication of a revised version of technical specifications based on a question & answer process, publication of results and issuance of supervisory recommendations. Furthermore, for the 2016 exercise, we also test a public invitation to the workshop with stakeholders meant to initiate the process of public consultation. In some cases the two events took place on the same day, such as launching the exercise together with the final version of the technical specifications in 2018, and publishing the results together with supervisory recommendations in 2014 and 2016.

Results of the conducted event studies for the 2014 and 2018 exercises with event windows (-1, 2) and (-1, 8) are provided in table 2. Results for other different event windows' specifications bring no additional information to the market.

Overall, the results reveal no significant market reactions to the 2014 and 2018 stress tests that would be robust through different specifications and employed statistical tests. The significant negative impact of publishing the final version of technical specifications for the 2014 stress test only applied to some event windows when using the rank test. On the contrary, a statistically significant positive impact could be observed for the publication of the 2018 stress test for (-1, 8) event windows that is robust across different test statistics. We further investigated the results at individual group level. A significant market reaction was obtained only for a few insurers. However, no significant market reaction could be seen for those insurers that agreed to publish their individual results.

For the 2016 exercise, the sample is very limited. However, it seems to be in line with the results for the 2014 and 2018 exercise, as the analysis does not point to any significant impact that would be robust across all tests. For the 2016 exercise, some statistically significant negative effect could be seen for the announcement of the stress test scenario for the (-1, 2) and (-1, 5) event windows. The statistically negative effect for consultation could be seen only for one event window (-1, 1). Given that so few companies were used for this sample, we cannot draw any strong conclusion from this.

Table 2: Cumulative abnormal market returns (CAR) and their statistical significance

Stress Test	Events	CAR	t-test st.	Adjusted t-test st.	Rank test st.
Event window		(-1,2)			
2014	Consultation	0.7379%	0.7480	0.7303	0.1114
	Scenario	-0.4714%	-0.5040	-0.4920	-0.5173
	Launch	-0.7543%	-0.8298	-0.8097	-0.1706
	Technical Specifications	1.2231%	1.5622	1.5242	2.0895**
	Results and recommendations	-0.7506%	-0.9062	-0.8827	-0.0727
2018	Consultation	0.2848%	0.3035	0.2949	0.3321
	Scenario	0.5803%	0.6160	0.5985	0.6853
	Launch & technical specifications	-0.8248%	-0.8720	-0.8468	-0.9965
	Results	0.8379%	0.8248	0.8020	0.6818
	Recommendation	0.2969%	0.2836	0.2759	0.6791
Event window		(-1,8)			
2014	Consultation	0.8085%	0.4942	0.4826	0.3343
	Scenario	-1.0511%	-0.7108	-0.6938	-0.4876
	Launch	-2.3475%	-1.6332	-1.5936	-1.0167
	Technical Specifications	1.5926%	1.2456	1.2153	0.9201
	Results and recommendations	-0.0890%	-0.0648	-0.0631	0.2531
2018	Consultation	-0.0122%	-0.0082	-0.0080	0.5763
	Scenario	1.5644%	1.0504	1.0206	1.1932
	Launch & technical specifications	-1.9662%	-1.3859	-1.3458	-1.3064
	Results	2.5935%	1.7018*	1.6549*	1.6761*
	Recommendation	-0.4427%	-0.2674	-0.2601	0.0079

Note: *p<0.1; **p<0.05; ***p<0.01

Finally, we investigate whether the conducted stress tests based on insurance groups contributed to a decrease in systemic risk (2014 and 2018, Table 3 and 4). To this end, we estimate equation (1) with insurers' returns (column – "Normal"), standardised returns (column – "Standardised") and returns with adjusted beta (column – "Beta-adjusted") according to equation (3). The obtained results for insurers' groups suggest that some elements of the exercise could decrease systemic risk. In particular, publication of the final version of technical specifications for the Insurance Stress Test 2014 reduced systemic risk in in the insurance equity market.

Table 3: Systemic risk results for groups, EIOPA Stress Test 2014

2014	Normal	Standardized	Beta-adjusted
Stoxx	0.8913***	0.5783***	1.0211***
	-0.0206	-0.0129	-0.0225
Consultation	0.1876	0.1175	0.1907
	-0.1453	-0.0913	-0.1585
Scenario	0.0764	0.0616	0.0724
	-0.0844	-0.053	-0.0921
Launch	-0.2606	-0.2200**	-0.1301
	-0.1699	-0.1068	-0.1853
Technical	-0.0818**	-0.0562**	-0.0843**
specifications	-0.0352	-0.0221	-0.0384
Results and	0.0141	0.0136	-0.0061
Recommendations	-0.0486	-0.0306	-0.0531
Constant	-0.0002	-0.0123	-0.0001
	-0.0002	-0.0123	-0.0002
Observations	7,999	7,999	10,260
R^2	0.2942	0.3074	0.3150
Adjusted R^2	0.2932	0.3065	0.3140
F Statistics	302.6484***	322.2708***	333.8484***

Note: *p<0.1; **p<0.05; ***p<0.01

A similar positive effect is revealed for the initiation of consultation with stakeholders and the stress test scenario announcement of the 2018 exercise. On the contrary, the publication of the final version of technical specifications and recommendations in 2018 seems to increase systemic risk. However, the latter represents a market reaction to the follow-up supervisory actions at the national level rather than to the EU-wide stress test itself, as a recommendation is a legal tool of the EIOPA Regulation. It therefore might be the choice of tool driving the obtained results. It could also be related to the fact that apart from four insurers, the others did not grant their consent on publication of their individual results that might be expected by the market.[5] Unlike the EU banking stress tests, the European body does not have the legal power to enforce the disclosure of individual results. Furthermore, contrary to the 2014 exercise, our empirical results show that the launch of the stress test 2018 exercise, which was accompanied by publication of the final version of technical specifications, increased systemic risk—albeit to a lesser extent than other changes in systemic risk revealed. The significance of the coefficient further decreases when using the beta-adjusted model. All mentioned results are robust to different specifications: insurers' returns, standardised returns, and returns with adjusted beta. In addition, the launch of Insurance Stress Test 2014 seems to reduce systemic risk

[5] The consent was provided by Vienna Insurance Group, PFA Pension, Forsikringsselskabet Danica Skade-forsikringsab and MAPFRE S.A. However, only Vienna Insurance Group and MAPFRE S.A. are part of the employed data sample in this study.

when using standardised insurers' returns. This reduction appears to be insignificant for insurers' returns and returns with adjusted beta, however.

Table 4: Systemic risk results for groups, EIOPA Stress Test 2018

2018	Normal	Standardized	Beta-adjusted
Stoxx	0.9377***	0.5816***	0.9828***
	-0.0192	-0.0116	-0.0195
Consultation	-0.3298**	-0.2029**	-0.3551**
	-0.1616	-0.0976	-0.1635
Scenario	-0.3935***	-0.2479***	-0.4146***
	-0.0932	-0.0563	-0.0944
Launch & technical specifications	0.0772**	0.0496**	0.0669*
	-0.0337	-0.0204	-0.0342
Results	0.0064	0.0026	0.0112
	-0.0387	-0.0234	-0.0393
Recommendations	0.1124**	0.0686**	0.1241**
	-0.0519	-0.0313	-0.0526
Constant	-0.0001	-0.0044	-0.0001
	-0.0001	-0.0119	-0.0001
Observations	10,260	10,260	10,260
R^2	0.3331	0.3437	0.3465
Adjusted R^2	0.3324	0.344	0.3458
F Statistics	465.3435***	489.9953***	493.8766***

Note: *p<0.1; **p<0.05; ***p<0.01

The same analysis was also performed for solo insurers for both the 2014 and 2016 stress test. Due to the small number of listed companies participating in the exercise, however, we cannot draw a clear conclusion. In this case, only the empirical results for the 2014 exercise suggest some impact on systemic risk. In particular, consultation appears to reduce systemic risk for both the full and reduced sample when using insurers' returns and standardised insurers' returns. Nevertheless, these results are not very robust, as the coefficient for market return is insignificant in all cases. This is further confirmed by the estimates for the adjusted beta specification according to equation (3), as the coefficient for market returns turns significant, but the coefficient for systemic risk for consultation turns insignificant. This is driven by the fact that the sample is too small to make reliable estimates. Similarly, our empirical results for the 2016 exercise do not point to any conclusion due to the extremely limited sample.

Table 5: Systemic risk results for solos, EIOPA Stress Test 2014 and 2016

	Full-sample 2014	Full-sample standard. 2014	Reduced sample 2014	Reduced sample standard. 2014	Reduced sample beta adjusted 2014	2016
Stoxx	-0.0085	0.0063	0.0271	0.0206	1.2038***	-0.0537
	-0.0275	-0.0138	-0.0259	-0.0159	-0.4626	-0.1328
Consultation	-0.4553***	-0.1943**	-0.3888**	-0.2126**	-1.5026	0.2006
	-0.1755	-0.0881	-0.1653	-0.1017	-2.8224	-0.8068
Scenario	-0.2995***	-0.1325**	-0.1633	-0.0948	0.7488	-0.2064
	-0.1143	-0.0574	-0.1077	-0.0662	-1.934	-1.1118
Launch	0.4513*	0.2311*	0.2944	0.1931	1.5722	0.0362
	-0.2349	-0.1179	-0.2213	-0.1361	-3.9744	-2.0059
Technical specifications	0.0284	0.0068	0.0033	-0.0053	-1.0015	0.2432
	-0.0463	-0.0232	-0.0436	-0.0268	-0.7836	-0.2506
Results and recommend.	0.0052	-0.0023	-0.0115	-0.0038	0.1526	1.4382
	-0.0615	-0.0309	-0.0579	-0.0356	-1.0362	-2.9505
Constant	0.0008***	0.0550***	0.0009***	0.0654***	0.0009***	-0.0003
	-0.0002	-0.0129	-0.0002	-0.0148	-0.0002	-0.002
Observations	10,056	10,056	7,542	7,542	7,542	2,358
R^2	0.0029	0.0027	0.0036	0.0033	0.0038	0.0006
Adjusted R^2	0.0018	0.0016	0.0021	0.0018	0.0024	-0.0041
F Statistic	2.6537***	2.4626***	2.4629***	2.2436**	2.6366***	0.1356

Conclusion

EU-wide insurance stress tests have become a standard part of the supervisory risk assessment toolkit to identify key risks and vulnerabilities to follow up. This study contributes to the existing literature by investigating market reactions to the conducted EU-wide stress tests as well as the impact of exercises on systemic risk. To our best knowledge, this is the first paper dealing with this topic for the insurance sector.

Our empirical results suggest that the EU-wide insurance stress tests conducted in 2014, 2016 and 2018 have a rather limited impact on the market. This is in line with the aim of regulators, namely to avoid negatively affecting financial markets. At the same time, our study points out some positive market reactions, but these are quite limited and not robust to different test statistics and event windows. Our analysis also reveals that EU-wide insurance stress tests have the potential to reduce systemic risk. In particular, publication of technical specifications for the 2014 insurance stress test helped reduce systemic risk. Similarly, public consultation also has the potential to reduce systemic risk. This seems to be the case for the 2018 exercise, with closer interaction with stakeholders ensuring better feedback and being reflected in the design of the exercise. Our results suggest that this practice should be kept as a standard part of the exercise. Finally, the announcement of a stress test scenario could help reduce systemic risk, as suggested by our empirical results for the 2018 exercise.

This study shows the important role of communication and its potential to positively affect the sector. Further research would be needed to better understand under which conditions the publication of technical specifications could decrease systemic risk, as in 2014, and when it could increase risk, as in 2018. Likewise, a better understanding of the impact of the recommendations in the 2018 insurance stress test would need further investigation. However, the impact of recommendations is linked to the follow-up actions as a response to the identified vulnerabilities at the national level rather than the reaction to the stress tests themselves. One explanation of the market reaction to the recommendation related to the 2018 stress test could stem from the negative response of participating insurance companies to the EIOPA request to provide consent on the publication of individual results. Unlike the banking stress tests conducted at the EU level, EIOPA does not have the legal power to do so without such consent. Based on numerous research studies, enhanced transparency could contribute to the overall stability of financial sectors.

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Annex

Insurers participated in the 2014 and/or 2016 and/or 2018 stress tests included in the sample

Group level	2014	2018
Münchener Rückversicherungs-Gesellschaft AG	X	X
NN Group N.V.		X
RSA Insurance Group plc	X	X
Aegon N.V.	X	X
Ageas	X	X
Allianz Group	X	X
Aviva plc	X	X
AXA	X	X
CNP Assurances	X	X
Generali	X	X
Grupo CATALANA OCCIDENTE		X
IF P&C Insurance		X
Legal & General Group Plc	X	X
Mapfre S.A.	X	X
Phoenix Group Holdings		X
Prudential plc	X	X
RSA (Royal Sun Alliance)	X	X
Sampo plc		X
SCOR	X	
Standard Life Aberdeen plc		X
Swiss Re	X	
Unipol	X	X
UNIQA Insurance Group	X	
Vienna Insurance Group AG Wiener Versicherung Gruppe	X	
Zurich Insurance Group	X	

Solo level	2014	2016
Aegon N.V.	X	
Ageas	X	X
Allianz SE	X	
Assicurazioni Generali Spa	X	
AXA	X	
CNP Assurances	X	X
Croatia osiguranje d.d.	X	X
European Reliance General Insurance S.A.	X	
Gjensidige Forsikring Konsern	X	
Grupa Powszechnego Zakładu Ubezpieczeń Spółka Akcyjna	X	X
Grupo Catalana Occidente, S.A.	X	
JADRANSKO osiguranje d.d.	X	
Legal & General	X	X
MAPFRE SA	X	
Minerva Insurance Company Public Ltd	X	
Munich Re Group	X	
PRIME INSURANCE	X	
Prudential PLC	X	
Sava Reinsurance Company	X	
Tryg A/S	X	
UnipolSai Assicurazioni S.p.A.	X	X
UNIQA Insurance Group AG	X	
Zavarovalnica Triglav, d.d., Ljubljana	X	
Zurich Insurance Group	X	

EIOPA press releases related to the EIOPA EU- wide stress test

2014 Insurance Stress Test	
March 13th, 2014	EIOPA invited insurance and actuarial associations (Insurance Europe, CRO Forum, AMICE, Actuarial Association of Europe, CFO Forum) for the consultation to provide comments on stress test reporting templates
April 8th, 2014	Letter from the ESRB Chair to the Chair of EIOPA on the two scenarios and the qualitative questionnaire - scenario announcement
April 30th, 2014	List of technical details in the calculations carried out for EIOPA Stress Test 2014 regarding the Volatility Adjustment, launch of the EU wide stress test
May 28th, 2014	The announcement of Stress Test 2014 specifications
December 1st, 2014	Press Conference on EIOPA Stress Test's Results
2016 Insurance Stress Test	
March 14th, 2016	Invitation to the consultation /workshop
March 17, 2016	Scenario for the European Insurance and Occupational Pensions Authority's EU-wide insurance stress test in 2016
April 13th, 2016	Consultation
May 24th, 2016	Launch of the EU-wide insurance stress test 2016
June 1st, 2016	Insurance Stress Test 2016 technical specifications
December 15th, 2016	Publication of the results for the Insurance Stress Test 2016 for solos
2018 Insurance Stress Test	
April 9th, 2018	Adverse scenario for the European Insurance and Occupational Pensions Authority's EU-wide insurance stress test in 2018
April 16th, 2018	EIOPA workshop with industry
May 14th, 2018	Insurance Stress Test 2018 technical specifications
December 14th, 2018	Publication of the insurance stress test results of 2018 for the European insurance sector, including individual results
April 26th, 2019	EIOPA's Insurance Stress Test 2018 recommendations

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