Nijmegen School of Management
Department of Economics and Business Economics
Master's Thesis Economics (MAN-MTHEC)

Dutch Insurers' Reaching for Yield in the Bond Market

By Noud Latta (S1021046)

Nijmegen, 19 August 2022

Program: Master's Program in Economics
Specialisation: Financial Economics
Supervisor: Koen van der Veer

Abstract

This study examines 'reaching for yield' behaviour of Dutch insurance companies in the corporate and sovereign bond market during the period after the introduction of Solvency II regulation. Reaching for yield can be defined as the tendency of insurers to engage in riskier assets in order to optimize yields within regulatory constraints. This study contributes to the existing literature by specifically examining 'reaching for yield' behaviour of insurers in the context of Solvency II regulation. I provide evidence for 'reaching for yield' behaviour of Dutch insurers in the corporate and sovereign bond market by using confidential security-level transaction data for 24 Dutch insurers. Related to that, I rule out the probability that 'reaching for yield' behaviour may be due to the superior ability of insurers to pick under-priced investments. Additionally, I define the risks that Dutch insurers engage in to optimize yields and find that Dutch insurers tend to shift towards bonds that carry significant liquidity risk. Finally, I refute the financial stability concerns regarding 'reaching for yield' behaviour by providing evidence that Dutch insurers act countercyclical by increasingly purchasing 'high-yield' bonds during the Covid-19 pandemic.

Table of Contents

1 Introduction

Dutch insurers face difficulties to obtain sufficient returns within the current low yield environment. Traditionally, insurance companies invest into safe fixed-income securities to match assets with long-term liabilities (Gründl et al., 2016). However, since the European Central Bank (ECB) started with the purchase of long-maturity government and corporate bonds in 2015, insurers find difficulties to reach the target return (Killins & Chen, 2020). More specifically, the term premium on safe government and corporate bonds decreased and was no longer sufficient to cover for pre-determined future payment obligations.

The low-yield environment within the Eurozone coincided with the introduction of the prudential solvency II framework. Solvency II imposes risk-based solvency constraints on European insurers (Heinrich & Wurstbauer, 2018). Consequently, European insurers are obliged to hold on to a costly amount of buffer, depending on the balance sheet's risk-weighted assets. In other words, the solvency constraints impose a costly burden on insurers for engaging in risky investments. Within the low-yield environment one would expect insurers to increasingly 'search for yield' by shifting their exposure from safe 'low-yield' bonds to riskier 'high-yield' alternatives to obtain sufficient returns (Killins & Chen, 2020). However, shifting to lower-rated assets within the solvency II framework results in a relatively high and costly compulsory buffer. Hence, insurers find difficulties to invest in alternatives for 'low-yield' bonds that offer both sufficient return and limit the burden of holding additional capital.

Since safe bonds do not provide sufficient returns and investing into lower-rated assets results in additional capital requirements, insurers started to 'reach for yield' within regulatory constraints (The European Central Bank, 2019). 'Reaching for yield' can be defined as the tendency of insurers to optimize returns by taking on additional priced risk, without increasing capital requirements (Becker & Ivashina, 2015). Thus, insurers that obtain higher returns by optimizing yields within credit rating buckets is not due to insurer's superior ability to pick under-priced investments. Reaching for yield is rather a form of regulatory arbitrage in which insurers take on hidden tail risks that are not sufficiently covered by the Solvency II framework.

Importantly, 'reaching for yield' behaviour raises financial stability concerns as it may reverse when volatility tends to rise (Czech & Roberts-Sklar, 2019). Insurers could contribute to financial

distress by selling high-risk investments during periods of increased uncertainty (Becker and Ivashina, 2015). Hidden tail risks become increasingly visible during stress events. As a result, the credit ratings on assets carrying hidden tail-risks may depreciate when economic stress rises. Therefore, insurers tend to sell high-yield assets to circumvent additional capital requirements.

Consequently, Dutch insurers could contribute to financial instability. Reaching for yield implies procyclical behaviour because investors tend to buy more risky bonds in response to decreasing yields (Ellul et al., 2018). In other words, insurers herd the price trend. Nevertheless, the literature does not find conclusive evidence for 'reversing' reaching for yield behaviour when volatility rises. Multiple studies conclude that insurers are shock absorbers that profit from buying lower priced assets in times of financial distress (Czech & Roberts-Sklar, 2019; De Haan and Kakes, 2011; Fache Rousová & Giuzio, 2019; Timmer, 2018). In contrast, other studies do find evidence for procyclical behaviour of insurers (Bijlsma and Vermeulen, 2016; Duijm and Bisschop, 2015; Ellul et al., 2018). The aim of this study is to fill the gap in the literature and find conclusive evidence on whether Dutch insurers behave pro- or countercyclical. It seems plausible that studies focussing on the corporate and sovereign bond market identify insurers as shock absorbers, while insurers act procyclically during stress events in the equity market.

The research question is formulated as follows: "Do Dutch insurers reach for yield and behave procyclically when operating in a prolonged low yield environment?". To empirically address the research question, this study employs a fixed-effects model. The model considers all fixed-income securities that 24 Dutch insurers engaged in over the period between the first quarter of 2016 and the second quarter of 2021. This is the relevant period to investigate 'reaching for yield' behaviour because the regulatory Solvency II framework became effective in 2016.

This study combines the methodology of Becker and Ivashina (2015) with the methodology of Czech and Roberts-Sklar (2019) to test whether Dutch insurers engaged in 'reaching for yield' behaviour. It employs a fixed-effects model to examine whether Dutch insurers increased their share in 'high-yield' bonds within credit-rating buckets. I find that Dutch insurers 'reach for yield' in both the corporate and sovereign bond market. Subsequently, I follow Becker and Ivashina (2015) by implementing a Fama and Macbeth (1973) bond return model. Accordingly, I provide evidence for underperformance of Dutch insurers in both the corporate and sovereign bond

market. This refutes the probability that the increased share in 'high-yield' bonds is a reflection of superior bond-picking. Finally, I address the financial stability concerns of 'reaching for yield' behaviour by investigating whether Dutch insurers behave procyclically in the bond market. Similar to Czech and Roberts-Sklar (2019), I use one stress event to identify whether 'reaching for yield' behaviour reverses during volatile periods. I find that Dutch insurers act as shock absorbers by increasingly investing in 'high-yield' bonds during the Covid-19 pandemic.

This is the first study to examine 'reaching for yield' behaviour of Dutch insurers in the context of Solvency II regulation. Although, 'reaching for yield' behaviour of insurers has been extensively examined for US rating-based capital regulation (Becker and Ivashina, 2015; Czech & Roberts-Sklar, 2019), it has not been considered within the Solvency II framework yet. The literature related to risk-taking in the regulatory Solvency II framework rather tends to focus on the overall efficiency of rating-based capital regulation (Drenovak et al., 2018; Boermans & Van der Kroft, 2020; Murray & Nikolova, 2021). This study additionally addresses reaching for yield behaviour of insurers in the sovereign bond market, while Becker and Ivashina (2015) and Czech and Roberts-Sklar (2019) exclusively focus on the corporate bond market. Furthermore, this study shows that Dutch insurers tilt their portfolios towards bonds that carry hidden tail-risks such as illiquidity to effectively optimize yields. I uniquely distinguish between Fama and Macbeth (1973) regressions for net purchases and net sales to reveal the risks that are increasingly exploited by Dutch insurers during the sample period. Finally, it is the first study to consider insurer's procyclicality by examining whether 'reaching for yield' behaviour reverses during stress events like the introduction of the Covid-19 pandemic.

The remainder of this study has the following structure. The next section covers the literature review, in which I analyse Dutch insurers in the context of the prolonged low yield-environment, reaching for yield within regulatory Solvency II constraints and procyclical behaviour. Subsequently, section 3 considers the proposed methodology to empirically test "reaching for yield" and procyclicality. After that, section 4 covers the data that I use to address the research question. Eventually, I present the results about Dutch insurers in the context of reaching for yield behaviour, engagement in hidden tail-risks, and procyclicality. Finally, I summarize the entire study followed by a concise conclusion.

2 Literature Review

2.1 The impact of a prolonged low yield environment on insurer's solvability

Insurance companies bear the risk for the policyholder to be adversely affected by a pre-specified future event (Gründl et al., 2016). In exchange, the insurance company receives a premium. Premium proceeds are invested in assets with different durations to cover for future fixed-payment obligations. Insurance companies are considered as key institutional investors in the European asset market, with an estimated combined portfolio value of approximately €10 trillion (Le Blanc, 2021). Historically, insurers prefer to invest premium proceeds in long-maturity bonds because these provide fixed cash flows over a pre-defined period of time (Killins & Chen, 2020). The yields on long-maturity bonds serve as a term premium, guaranteeing a fixed payment for policyholders in the distant future. In other words, long-maturity bonds with stable yields serve as adequate instruments to cover insurer's long-term liabilities. Therefore, insurers are heavily invested into government and corporate bonds. In fact, the portfolios of European insurers even consist for 64% of government and corporate bonds (European Capital Markets Institute, 2020).

The large safe bond holdings of European insurers started to turn out problematic as the short-term policy rate approached the zero lower bound. Approaching the zero lower bound implied that conventional expansionary monetary policy became ineffective within Europe (Bernanke, 2020). The liquidity trap asked for a new monetary tool to stir economic conditions. Hence, the European Central Bank (ECB) decided in 2015 to conduct unconventional monetary policy by means of the Asset Purchasing Programme (APP). The APP mainly comprised increasing the money supply by purchasing government and corporate bonds. Since bond prices and yields are inversely related, the increased demand for bonds increased the bond price and decreased the yield (Chodorow-Reich, 2014).

Unconventional monetary policy has significant effects on the balance sheet of European insurers. The valuation of insurer's assets and liabilities will change substantially as yields on bonds decrease (Jareño et al., 2019). First of all, unconventional monetary policy increases the demand for government and corporate bonds, which increases the value of those debt-securities on the asset-side. Moreover, unconventional monetary policy has certain spill-over and portfolio

rebalancing effects to equity markets, indicating that insurer's equities on the assets-side are also beneficially boosted. The study by Chodorow-Reich (2014) examined the effect of unconventional monetary policy on US insurers after the credit crisis of 2008. He found that unconventional monetary policy had pre-dominantly positive and stabilizing effects for US insurers because of the boosted valuation of assets. Koijen and Yogo (2015) showed similar results, stating that US insurers sold annuity products to boost asset value on the balance sheet after the financial crisis.

Nonetheless, a prolonged low yield environment could also negatively affect insurers through low rates of return on their investments. Especially life insurers are hit hard by a substantial decrease in yields, as they offer annuity products that promise a pre-specified return at maturity (Heinrich & Wurstbauer, 2018). When yields on long-maturity bonds fall below the promised returns on annuities, insurers will incur losses on annuity products (Ellul et al., 2018).

Furthermore, the net present value of liabilities increases because decreased yields on bonds will result in lower discount rates (Kräusll et al., 2017). Related to that, insurers deal with an ongoing duration gap (Möhlmann, 2020). This implies that the average duration of insurer's liabilities is significantly higher than the average duration of insurer's assets. As a consequence, the market value of liabilities will increase more substantially than the market value of assets. Therefore, the low yield environment can put pressure on the solvability of European insurers (Jareño et al., 2019).

In conclusion, the boosted valuation of assets is not able to outweigh the negative consequences of persistently low yields for insurer´s solvability (Killins and Chen, 2020). Insurers are, therefore, forced to shift gradually from safe bonds to riskier alternatives. In the literature this is referred to as 'reaching for yield' (Becker & Ivashina, 2015).

2.2 Insurers' 'Reaching for Yield'

As already mentioned in the previous section, a prolonged low yield environment adversely affects insurance companies because they often have entered into fixed rate annuity products, for which payments have to be met in the future (Rajan, 2006). Once yields in the bond market fall, and assets with shorter durations than liabilities mature, the purchase of the same safe 'lower-yielding' bonds turn out insufficient to meet future commitments. Hence, insurers are

forced to invest in 'higher-yielding' alternatives in order to fulfill future payment obligations and remain solvable.

The propensity of insurers to invest in riskier assets to achieve higher yields within a prolonged low-yield environment is often referred to as the 'search for yield' (Rajan, 2006) or 'reaching for yield' (Becker & Ivashina, 2015; Czech & Roberts-Sklar, 2019). More specifically, the risk-appetite of insurers increases when interest rates remain low for a prolonged period of time. 'Reaching for yield' may not only be induced by motives of remaining solvable, it is also strongly related to compensation schemes of investment managers (Rajan, 2006). Investment managers are generally compensated based on the performance of assets under management. Compensation structures based on performance incentivize investment managers to optimize yields and act in the best interest of the policyholders. Consequently, investment managers tend to take on hidden tail-risk to outperform the index return.

Nevertheless, the ability of insurers to 'reach for yield' has tightened with the introduction of Solvency II regulation (Heinrich & Wurstbauer, 2018). In 2016, European insurers were put under stricter supervision with this new harmonized regulatory framework. Solvency II aims to prevent 'too-big-to-fail' insurance companies from becoming insolvent (Becker, 2016). Insolvency within the insurance sector is socially undesirable as the public may have to bail-out and save insolvent insurers from bankruptcy. Therefore, the European regulator designed a harmonized regulatory framework in order to limit risk-taking by insurers. To comply with Solvency II regulation, insurers have to maintain an amount of equity capital dependent on its balance sheet's risk-weighted assets (Douglas et al., 2017). This amount of buffer, usually referred to as the Solvency Capital Requirement (SCR), can be determined by the regulator's standard formula or an approved internal model.

One generally expects that imposed capital requirements will prevent insurers from investing into risky assets. Despite persistently low yields, most insurers maintained their portfolio exposure for the largest part in 'investment grade' assets (Czech & Roberts-Sklar, 2019).[1] In that sense, risk-based regulation proved to be effective. However, within regulatory constraints,

[1] The term 'investment grade' refers to assets receiving a credit-rating between BBB- and AAA+. On the contrary, assets receiving a credit-rating between unrated and BB+ are considered as 'speculative-grade' or 'high-yield'.

insurers tend to take on risks that are not incorporated in the standard formula (Choi & Kronlund, 2018). In other words, imperfect risk measurement allows insurers to search for assets with higher yields that comply with the Solvency II benchmarks, but yet possess hidden tail-risks. This 'reaching for yield' behavior can be considered as a form of regulatory arbitrage, where the insurer searches for loopholes to increase yields without incurring higher capital requirements (Becker and Ivashina, 2015).

The Solvency II framework assesses the creditworthiness of assets under management by considering credit ratings. Therefore, 'reaching for yield' within regulatory constraints can be identified as insurers that obtain higher yields than the benchmark return within a certain credit rating bucket (Choi & Kronlund, 2018). Hence, the first hypothesis is formulated as follows:

'*Dutch insurers reach for yield by investing in bonds that, on average, significantly outperform the benchmark return within the same credit rating bucket'.*

To identify 'reaching for yield' properly, one has to rule out the possibility that insurers outperform the benchmark within particular credit rating buckets due to their superior ability to pick underpriced bonds (Becker and Ivashina, 2015). The general expectation is that insurers take on priced risks that are not sufficiently covered by Solvency II regulation to increase their investment returns. Therefore, the second hypothesis is formulated as follows:

'*Dutch insurers reach for yield by investing in bonds that carry priced risks that are not sufficiently covered by Solvency II regulation*.'

The next section will dig deeper into procyclical behavior of insurers as a consequence of 'reaching for yield'. 'Reaching for yield' seems to be attractive during economically sound periods. However, insurers will slow down their 'search for yield' once recessionary periods emerge.

2.3 Insurers' procyclical behavior within a prolonged low-yield environment

In the literature, procyclicality is often defined as herding behavior that follows the market trend (Rajan, 2006). Long-term investors aim to establish a reputation of well-performing financial institutions. Therefore, long-term investors engage in reputational herding by strategically imitating other market participants (Scharfstein & Stein, 1990). This reputational herding is reinforced by unintended consequences of compensation schemes that trigger investment managers to follow the herd in order to share in potential profits. Besides compensation schemes, Papaioannou et al., (2013) derive four other drivers of pro- or countercyclicality. In the first place, institutional investors consistently underestimate liquidity risk during times of financial stability. As a consequence, insurers may encounter liquidity problems during an economic recession, which might result in increased asset sales. Second, quantitative models are not able to predict severe economic stress. Hence, financial institution's asset management is often unprepared once an economic downturn occurs, which may result in panic sales. Third, reporting requirements could reinforce the short-sighted investment horizon of financial institutions as they might focus on quarterly and annual reporting. However, reporting requirements do not per definition drive procyclicality, as specific reporting requirements bind financial institutions towards a long-run perspective. Finally, regulatory flexibility during financially unstable circumstances eases capital restrictions for financial institutions. More specifically, Solvency II regulation for insurers features some countercyclical components such as adjustments in capital requirements during extremely volatile financial circumstances (i.e. volatility adjustment). Nonetheless, capital requirements within the Solvency II framework are highly dependent on credit ratings. Credit ratings may induce insurers to shift from low-rated assets to higher-rated assets during financially unstable times in order to reduce the costs of capital requirements and acquire additional cash.

In addition to all these factors, 'reaching for yield' is believed to be a major driver of procyclical behavior (Becker and Ivashina, 2015). 'Reaching for yield' during periods of high uncertainty is particularly unattractive for the following reasons. In the first place, default probabilities of high-risk assets may increase substantially during economically unstable times, leading to lower adjusted credit ratings. As a consequence, insurers may have to sell those high-risk assets and

shift their exposure towards safer investments to circumvent higher capital requirements. Besides that, periods of economic stress often coincide with higher interest rates as the willingness to supply credit staggers. A high interest rate regime slows down the propensity to 'reach for yield' since investing in safer assets becomes already sufficient to cover for pre-determined future commitments. Furthermore, investment managers may encounter increased pressure from regulators to limit risk on the balance sheet during economically unstable times (Gennaioli et al., 2012). This increased pressure may incite investors to limit 'reaching for yield' behavior.

Traditionally, insurance companies are considered shock absorbers as they have a tendency to take advantage of buying at lower prices during economic busts and selling at higher prices during economic booms (Timmer, 2018). Insurers operate as buy-and-hold investors on the asset side in order to match liabilities and close the duration gap (Fache Rousová & Giuzio, 2019). Therefore, insurer's asset-liability management has a long-term focus and is relatively unaffected by short-term financial conditions.

Especially within the current low yield environment mixed evidence exists on whether insurance companies play a pro- or countercyclical role. Timmer (2018) concludes that German insurance companies act countercyclically during both recessionary and non-recessionary periods. The earlier study by De Haan and Kakes (2011) provides the same results for Dutch insurance companies. Moreover, Czech and Roberts-Sklar (2019) find that US insurers did not change their investment behavior as a response to the 'taper tantrum' in 2013. During this period the Fed increased interest rates. Nevertheless, insurers did not act in a procyclical manner by decreasing their exposure to bonds. Important to note here is that these studies do not consider insurers with weak leverage positions as stabilizers (Timmer, 2018).

On the other hand, the study of Duijm and Bisschop (2015) found that insurance companies shifted procyclically from bonds to equities. In other words, during financially stable times Dutch insurers proportionally shifted from bonds to equities, while economic downturns induced Dutch insurers to shift back from equities to bonds. Bijlsma and Vermeulen (2016) also find procyclical investment behavior by Dutch insurers during the sovereign debt crisis of 2015. Dutch insurers contributed to financial instability within the Eurozone by selling distressed Southern European

government bonds. Fache Rousová and Giuzio (2019) argue that the Dutch financial system is relatively more market-based than, for example, the German financial system. This may explain why Dutch insurers act more procyclically. In other words, funding is a relatively market-based process in the Dutch system, which implies that Dutch insurers more often engage in asset market transactions. Besides that, the extent to which an insurance sector depends on annuity products determines the degree of 'reaching for yield' behaviour (Ellul et al., 2018). As mentioned before, low returns on the asset side will complicate the ability of insurers to cover for the pre-determined annuity payments in the future. Therefore, the larger the exposure to annuity products, the bigger the chance that insurers will shift towards more risky assets and the more insurers will contribute to asset market bubbles in financially stable times. Furthermore, the countercyclical role of insurers weakens or even becomes procyclical as the negative duration gap between assets and liabilities increases (Timmer, 2018). As mentioned before, insurers feature a duration gap between assets and liabilities that will grow during periods of persistently low yields. To close the duration gap, insurers have to invest in assets with longer durations that often feature higher credit risk.

In conclusion, the literature offers no indisputable evidence that procyclicality is a direct implication of insurers' reaching for yield behaviour. Therefore, this study aims to find conclusive evidence on whether Dutch insurers behave pro- or countercyclically. It expects that 'reaching for yield' will lead to procyclical behaviour of Dutch insurance companies within a prolonged low yield environment. The third hypothesis is as follows:

'*Reaching for yield for insurers is especially pronounced during economically stable periods, while the propensity to reach for yield slows down during particularly uncertain periods'*.

It seems evident that Dutch insurers will increase risk-taking during periods of persistently low yields due to i.e. high exposure to annuity products and the growing duration gap. Subsequently, this willingness to take risks reverses during times of increased uncertainty. Consequently, after prolonged 'reaching for yield' during economically stable times with persistently low yields, insurers will revert to relatively safe assets as uncertain periods will dawn.

3 Methodology

3.1 Reaching for Yield behavior

This study aims to empirically test whether Dutch insurers significantly 'reach for yield' within a prolonged low-yield environment. 'Reaching for yield' can be identified as the propensity of Dutch insurers to gradually shift from 'low-yield' to 'high-yield' assets as a result of persistently low yields. The distinction between 'high-yield' and 'low-yield' assets is as follows: an asset is considered 'high-yield' when it outperforms the benchmark, while it is considered 'low-yield' when it underperforms the benchmark (Choi & Kronlund, 2018). In this study, the benchmark is the corporate or sovereign effective index yield applying to a specific credit-rating bucket. Since regulatory Solvency II restrictions limit the ability of Dutch insurers to switch between rating classes, the focus will be on 'reaching for yield' behavior within the same credit rating bucket. This study examines the period after the introduction of the regulatory Solvency II framework. I consider the timeframe between the first quarter of 2016 and the second quarter of 2021. Besides that, I take into account all fixed-income securities that 24 Dutch insurers engaged in to draw conclusions for the entire Dutch insurance sector. According to calculations of KPMG (2021), the 24 insurers capitalize at least 80% of both the Dutch life and non-life insurance market. This study combines the approach of Czech and Roberts-Sklar (2019) with the approach of Becker and Ivashina (2015) in order to accurately examine Dutch insurer's reaching for yield behavior. In accordance with both studies, it relies on a fixed effects model as reproduced in regression equation 1.

$$(1)\ \ln(TN)_{i,t} = \alpha_i + \beta_1 RFY_{i,t-1} + \beta_2 TP_{i,t-1} + \beta_3 VIX_{i,t} + \varepsilon_{i,t}$$

Where i denotes the individual bonds that Dutch insurers engage in and t denotes the period of time expressed in quarters. The dependent variable $\ln(TN)_{i,t}$ represents the logarithm of the nominal net transaction volume in fixed-income securities. In line with Czech and Roberts-Sklar (2019), I take into account nominal transactions to filter out potential asset value changes, which allows to primarily focus on transaction volume. Instead of separating the buying and selling

propensity, this study derives the net transaction volume for each security. Since this study solely considers insurers, it is not necessary to compare distinct financial institutions as net buyers or net sellers of particular assets. Additionally, this study follows the approach of Becker and Ivashina (2015) by sorting all executed fixed-income transactions of Dutch insurers into the following credit rating buckets: AAA, AA, A, BBB, BB, and B.

The independent variable of interest captures the 'reaching for yield' factor. This study designs a new version of the 'reaching for yield' factor employed by Choi and Kronlund (2018) and Czech and Roberts-Sklar (2019). I specify this renewed 'reaching for yield' factor as follows:

$$(2)\quad RFY_{i,t-1} = Y_{i,t-1} - Y^{B}_{i,t-1}$$

Where $Y_{i,t-1}$ is the lagged trade-weighted average quarterly yield of a particular security (i) and the benchmark $Y^{B}_{i,t-1}$ is the lagged EURO corporate or sovereign index yield applying to the credit-rating bucket in which the security is located. This study deviates from Czech and Roberts-Sklar (2019) by employing a different benchmark. Instead of taking into account the lagged average yield of all bonds in the same credit rating bucket as bond i, it employs the lagged EURO index yield applying to the credit-rating bucket in which a particular bond i is located.

Thus, the reaching for yield factor $RFY_{i,t-1}$ is the difference between the lagged trade-weighted average yield on a particular security (i) and the lagged EURO index yield applying to the credit rating bucket in which this security is located. The interpretation for the reaching for yield factor is as follows: Dutch insurers reach for yield when they significantly engage in securities with yields that outperform the benchmark. Dutch insurers initially process the yield developments in the bond market. In response to decreasing yields, Dutch insurers tend to reallocate their portfolios towards riskier securities to maintain their target return. Hence, Dutch insurers reach for yield as their net buying position in outperforming securities tends to grow. Note that I consider the lagged reaching for yield factor to reduce endogeneity problems as large transactions of Dutch insurers could affect bond prices.

In line with Czech and Roberts-Sklar (2019), this study controls for volatility and the risk-free term-premium. The Eurostoxx50 volatility index (VIX) takes into account market-wide stress

within Europe. I expect that the volatility index has a general positive effect on the net transaction volume within 'investment grade' credit rating buckets. When market-wide stress increases, insurers tend to engage in a flight-to-safety. This often involves significantly reducing exposures to risky stocks by shifting portfolio holdings towards relatively safe bonds. Moreover, the lagged difference between the 10-year and 1-year government bond yield indicates the risk-free term-premium that applies to Dutch insurers. I expect that the lagged risk-free term-spread has a positive effect on the net transaction volume in fixed-income securities. Insurers are rewarded with higher yields for investing in securities featuring longer maturities when the risk-free term-premium rises. Since Dutch insurers find difficulties to close the ongoing duration gap between assets and liabilities, they will invest more in bonds when the term-premium has a general tendency to rise.

A fixed effects regression adequately tests for 'reaching for yield' behaviour within the Dutch insurance sector. First of all, it is able to employ panel data and therefore tests 'reaching for yield' behaviour for multiple fixed-income securities (i) over multiple time periods (t). Moreover, all time-invariant and security-specific factors are captured by the α_i term. This study aims to generalize 'reaching for yield' behaviour for the entire Dutch insurance sector. Hence, filtering time-invariant and security-specific factors provides substantial benefits. Furthermore, I incorporate panel-corrected standard errors for each fixed effects model to rule out potential heteroskedasticity, cross-sectional dependence, and autocorrelation. Finally, I run a dickey-fuller test which indicates that both the dependent variable and the main independent variable consist of stationary data. [2]

3.2 Identifying Tail-risks

Subsequently, this study aims to identify the priced risks that insurers engage in to increase yields while limiting the incurrence of costly capital requirements. It employs an extended version of the Fama and French (1989) bond return model. The Fama and French (1989) bond return model explains the variance in bond yields by the variation in the default premium and maturity

[2] See D.1 in the appendix for the Dickey-fuller test

premium. In line with Becker and Ivashina (2015), this study additionally incorporates the variance in the systematic risk premium and the liquidity premium.

This study differs from Becker and Ivashina (2015) as it runs a Fama-Macbeth (1973) regression on all individual fixed-income securities that Dutch insurers engage in. The Fama-Macbeth (1973) regression is a traditional asset-pricing model that enables me to identify the tail-risks that Dutch insurers engage in by employing panel data. While Becker and Ivashina (2015) divided the sample in high-insurance holdings and low-insurance holdings, this study divides the sample in net purchases and net sales.

The Fama and Macbeth (1973) methodology features a two-stage procedure. The first stage derives the sensitivities of all fixed-income securities $i = 1, 2, \dots, N$ to the incorporated risk factors with time-series regressions.

$$(3)\ \mathrm{R_{i,t}} - Rf_t = a_i + \beta_i^D * f_t^D + \beta_i^{DU} * f_t^{DU} + \beta_i^S * f_t^S + \beta_i^L * f_t^L + \varepsilon_{i,t}$$

Where $\mathrm{R_{i,t}} - Rf_t$ denotes the average excess return of a particular fixed-income security (i), for a specific quarter (t). More specifically, Rf_t denotes the Euro Treasury Bill index. The Treasury Bill index yield is the risk-free rate of return because all securities that constitute this index are state-guaranteed Furthermore, $f_{i,t}^D$ denotes the vector of default risk, $f_{i,t}^{DU}$ denotes the vector of duration risk, $f_{i,t}^S$ denotes the vector of systematic risk, and $f_{i,t}^L$ denotes the vector of liquidity risk. First of all, the vector of default risk $f_{i,t}^D$ is the difference between the AAA Euro index yield and the BB Euro index yield. In other words, the default premium captures the yield difference between 'investment grade' and 'speculative grade' bonds. Second, the vector of duration risk is the difference between the 10-year Dutch government bond yield and the 1-year Dutch government bond yield. Third, the vector of systematic risk factor is the Euro index yield applying to the credit-rating bucket in which the specific bond is located. Fourth, the Pastor and Stambaugh (2003) liquidity factor captures liquidity risk. It specifically accounts for aggregate market-wide liquidity. Finally the $\varepsilon_{i,t}$ is the idiosyncratic return of bond (i) for a particular quarter (t).

Subsequently, the second stage employs the obtained beta estimates from the previous time-series regressions as independent variables to run cross-sectional regressions.

$$(4)\ \mathrm{R_{i,t}} - Rf_t = a_{i,t} + \beta_{i,t}^{CR} * \lambda_t^{CR} + \beta_i^{DU} * \lambda_t^{DU} + \beta_i^{S} * \lambda_t^{S} + \beta_i^{L} * \lambda_t^{L}$$

Where the lambdas (λ) denote the risk premia of the risk factors, while the betas (β) denote the beta estimates derived from the time-series regressions. The $a_{i,t}$ term captures the pricing errors which indicates whether a security is over- or underpriced. More specifically, the $a_{i,t}$ reveals whether Dutch insurers have the ability to pick underpriced investments. Dutch insurers tend to invest in assets with risky returns when the alpha indicates a negative sign.

3.3 Procyclicality

Finally, this study aims to empirically test whether increased risk-taking by Dutch insurers contributes to procyclicality. This is the first study to identify procyclicality by testing whether reaching for yield behavior of Dutch insurers reverses as economic uncertainty tends to rise. Similar to Czech and Roberts-Sklar (2019), this study chooses one stress event within the sample's timespan to identify procyclical behaviour by Dutch insurers. In this case, the key stress event is the introduction of the Covid19 pandemic. To identify whether Dutch insurers behave procyclical during this stress event, I construct a dummy variable that equals one for the introduction of the Covid19 pandemic in Europa (October 2019-March 2020) and equals zero for all other periods. Subsequently, I interacted the dummy variable with the reaching for yield factor as reported in regression equation 4.

$$(5)\ \ln(TN)_{i,t} = \alpha_i + \beta_1(RFY * Covid.19)_{i,t} + \beta_2 RFY_{i,t-1} + \beta_3 Covid.19_{i,t} + \beta_4 TP_{i,t-1} + \beta_5 VIX_{i,t} + \varepsilon_{i,t}$$

4 Data

This study covers the period between the first quarter of 2016 and the second quarter of 2021 for all fixed-income securities that 24 Duch insurance companies engaged in. It considers confidential quarterly insurer-specific transaction data from the Centralised Securities Database

(CSDB). In contrast to Becker and Ivashina (2015) and Czech and Roberts-Sklar (2019), this study has only access to transactions executed by Dutch insurers. More specifically, it has no access to transaction data pertaining other financial institutions. Before processing the data, I match the transaction data with the credit rating data by employing the International Securities Number (ISIN). I obtain the credit rating data from the Solvency II database. Similar to both Becker and Ivashina (2015) and Czech and Roberts-Sklar (2019) , I sort the matched transaction data in the following six credit-rating buckets: AAA, AA, A, BBB, BB, and B-UR.

After that, I process the data by creating a panel dataset for both corporate and government bonds. First, I calculate the net position for every identical security that Dutch insurers engaged in. Next, I take the cumulative value of this net position for each security (i) during a particular quarter (t). In this way, I create net transaction volumes that are identical for every security (i) and for each time period (t).

Similarly, I derive the weighted-average yield for each security (i) during a particular time period (t). This study aims to compare the weighted-average yield of each security (i) with the benchmark that applies to that specific security during a particular period (t). This enables me to detect whether Dutch insurers increasingly engage in 'high-yield' bonds. I use Refinitv Eikon to deal with missing yields by complementing the most recurring observations.

Moreover, I gather the Eurostoxx50 Volatility Index (VIX), the term premium, the corporate indices, and the sovereign indices from Refinitv Eikon. At last, the Pastor and Stambaugh (2003) liquidity factor is retrieved from WRDS.

Table 1 reports the summary statistics. The net transaction volume indicates a mean of -0.364, which reveals that Dutch insurers sold more corporate bonds than they bought during the period after the introduction of Solvency II regulation. Moreover, the reaching for yield factor indicates a mean of -0.2 which implies that Dutch insurers generally tend to invest in 'low-yield' corporate bond that underperform the benchmark. These findings also apply to the sovereign bond market sample.[3]

[3] See table A.1 in appendix A for the summary statics of the sovereign bond market sample.

TABLE 1. SUMMARY STATISTICS FOR THE CORPORATE BOND MARKET

$LN.TN.$ denotes the logarithm of the nominal net transaction volume in fixed-income securities for every security (i) during quarter t, in the period between 2016Q1 to 2021Q2. RFY is the reaching for yield factor that captures the higher return that could be attributed to holding 'high-yield' investments. The term premium is computed by taking the difference between the 10-year and the 1-year Dutch government bond yield. VIX denotes the Eurostoxx50 volatility index. Covid.19 denotes the dummy variable that equals one for the periods considered as the introduction of the Covid-19 pandemic and zero for all other periods. The excess yield is the difference between the yield to maturity on a specific fixed-income security (i) and the risk-free Euro T-bill rate. The Index denotes the Euro corporate effective index yield that applies to a specific credit rating bucket. Liquidity risk is captured by the Pastor and Stambaugh (2003) liquidity factor. The default premium denotes the difference between the AAA corporate Euro index yield and the BB corporate Euro index yield.

Variable	Obs	Mean	Std. Dev.	Min	Max
LN.TN.	18,258	-0.364	7.854	-19.988	20.282
RFY	18,258	-0.200	2.121	-17.809	37.127
Term Premium	18,258	0.779	0.419	0.193	1.311
VIX	18,258	20.11	6.451	12.990	35.993
Covid.19	18,258	0.109	0.311	0	1
Yield	18,258	0.919	1.890	-1.500	-48.500
Euro Index Yield	18,258	0.733	1.747	-0.186	17.824
Excess Yield	18,258	1.381	1.883	-1.111	49.027
Risk-free Rate	18,258	-0.463	0.120	-0.635	-0.264
Default Premium	18,258	2.054	0.840	1.028	4.961
Liquidity Factor	18,258	-0.029	0.073	-0.258	0.100

5 Results

5.1 Reaching for Yield

Before analyzing the statistical results, it is important to visualize the root cause of Dutch insurers' 'reaching for yield' behavior. Figure 1 depicts the index yields in the 'investment grade' segment of the European corporate bond market. It demonstrates that yields in the market have been persistently decreasing since the financial crisis of 2008. As mentioned before, Dutch insurers are expected to act upon persistently low yields by taking on additional risks that are not sufficiently covered by the standard formula. Therefore, this study aims to observe whether Dutch insurers 'reach for yield' when operating in a prolonged low yield environment. Since the movements in the Euro corporate and sovereign bond indices capture the market-wide tendency of yields to decrease, it could prove an accurate benchmark to examine 'reaching for yield'.

However, this study considers the period after the introduction of Solvency II regulation in 2016. At this point in time yields already decreased to historically low levels, as one can observe in figure 1. Previous studies on reaching for yield all consider timeframes between 2008 and 2016

(Becker & Ivashina, 2015; Czech & Roberts-Sklar, 2019). During these periods, reaching for yield behavior was a direct response to heavily decreasing yields in the bond market. However, after the introduction of Solvency II regulation only marginal falls in yields occurred. Therefore, it is interesting to see whether reaching for yield arises when yields remain persistently low, or whether it is just a response to decreasing yields.

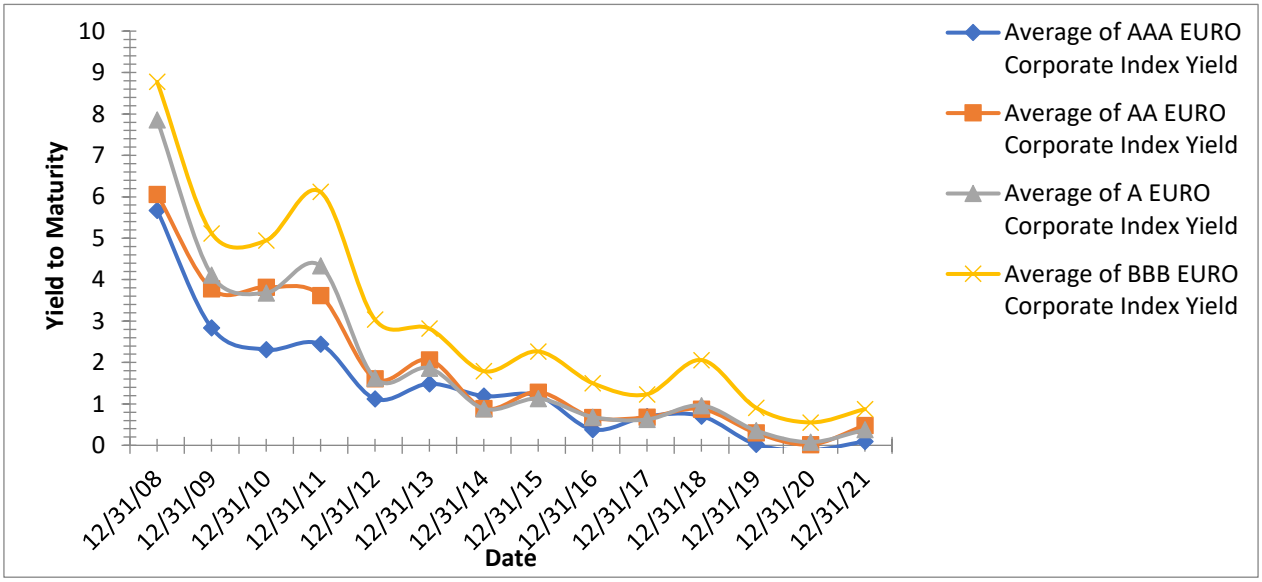

Figure 1. Investment Grade Euro Corporate Indices Yields through Time

The results in table 2 reveal that Dutch insurers engage in reaching for yield behavior within the corporate bond market since the introduction of Solvency II regulation. Dutch insurers increase purchases with 1.8% in a particular security (i) as the yield on this security tends to outperform the benchmark by 10 bps in the previous period. In other words, Dutch insurers are net buyers of 'high-yield' corporate bonds.

The control variables indicate the theoretically proposed signs. Dutch insurers increase purchases with 59.68% as the risk-free term-premium increases by 10 bps. Hence, Dutch insurers see an opportunity to close the duration gap by increasingly investing in corporate bonds when the term-premium tends to rise. Similarly, Dutch insurers increase purchases by 16.3% as volatility rises by one unit. This already indicates that Dutch insurers act countercyclical in the corporate bond market.

TABLE 2 . REACHING FOR YIELD IN THE CORPORATE BOND MARKET

The dependent variable is the logarithm of the nominal net transaction volume in fixed-income securities for every security (i) during quarter t, in the period between 2016Q1 to 2021Q2. RFY_{t-1} is the lagged reaching for yield factor that captures the higher return that could be attributed to holding 'high-yield' bonds. The lagged term premium is computed by taking the difference between the 10-year and the 1-year Dutch government bond yield. VIX denotes the Eurostoxx50 volatility index. The t-values are reported between parentheses. *** p < 0.01; ** p < 0.05; * p < 0.1.

LN.TN.	Coef.	St.Err.	t-value	p-value	Sig
RFY(t-1)	0.180	0.069	2.619	0.009	***
Term Premium (t-1)	5.968	0.182	32.742	0.000	***
VIX	0.163	0.009	16.650	0.000	***
R-squared	0.066		Number of obs		18,258

*** p<.01, ** p<.05, * p<.1

Nevertheless, the results in table 3 do not present statistically significant results of reaching for yield behaviour of Dutch insurers in the sovereign bond market. Yet, table 3 shows similar statistically and economically significant results for the term-premium and volatility index.

TABLE 3 . REACHING FOR YIELD IN THE SOVEREIGN BOND MARKET

The dependent variable is the logarithm of the nominal net transaction volume in fixed-income securities for every security (i) during quarter t, in the period between 2016Q1 to 2021Q2. RFY_{t-1} is the lagged reaching for yield factor that captures the higher return that could be attributed to holding 'high-yield' bonds. The lagged term premium is computed by taking the difference between the 10-year and the 1-year Dutch government bond yield. VIX denotes the Eurostoxx50 volatility index. The t-values are reported between parentheses. *** p < 0.01; ** p < 0.05; * p < 0.1.

LN.TN.	Coef.	St.Err.	t-value	p-value	Sig
RFY(t-1)	0.152	0.141	1.077	0.282	
Term Premium (t-1)	8.836	0.231	38.249	0.000	***
VIX	0.307	0.014	22.74	0.000	***
R-squared	0.101		Number of obs		14,429

*** p<.01, ** p<.05, * p<.1

In line with Becker and Ivashina (2015), the results in table 4 show that 'reaching for yield' behaviour in the corporate bond market is mainly existent for 'investment-grade' asset classes. 'Speculative-grade' bonds carry excessive risks that insurers usually tend to avoid because of their high capital requirements. Therefore, it is convenient to distinguish between 'investment grade' and 'speculative-grade' bonds. In other words, Dutch insurers find it unappealing to 'reach for yield' in 'speculative-grade' asset classes.[4]

Surprisingly, the results in table 5 show that reaching for yield in the investment-grade sovereign bond market is existent. Dutch insurers increase purchases by 8.7% in a particular 'investment-grade' sovereign bond (i) as the yield on this security tends to outperform the benchmark by 10 bps in the previous period. Furthermore, the results indicate that Dutch insurers find it unappealing to take excessive risks in 'speculative-grade' rating classes.[5]

TABLE 4 . REACHING FOR YIELD IN THE INVESTMENT-GRADE CORPORATE BOND MARKET

The dependent variable is the logarithm of the nominal net transaction volume in fixed-income securities for every security (i) during quarter t, in the period between 2016Q1 to 2021Q2. RFY(t-1)*IG is the lagged reaching for yield factor multiplied by a dummy variable that equals one for investment-grade bonds and zero for speculative-grade bonds. RFY_{t-1} is the lagged reaching for yield factor that captures the higher return that could be attributed to holding 'high-yield' bonds. The lagged term premium is computed by taking the difference between the 10-year and the 1-year Dutch government bond yield. VIX denotes the Eurostoxx50 volatility index. The t-values are reported between parentheses. *** p < 0.01; ** p < 0.05; * p < 0.1.

LN.TN.	Coef.	St.Err.	t-value	p-value	Sig
I(RFY(t-1)*IG)	0.953	0.134	7.110	0.000	***
RFY(t-1)	-0.177	0.087	-2.024	0.043	**
Term Premium (t-1)	5.906	0.182	32.376	0.000	***
VIX	0.172	0.010	17.436	0.000	***
R-squared	0.068		Number of obs	18,258	

*** p<.01, ** p<.05, * p<.1*

[4] Table B.1 in the appendix further substantiates this finding by specifically assessing reaching for yield in the 'speculative-grade' corporate bond market as well

[5] Table B.2 in the appendix further substantiates this finding by specifically assessing reaching for yield in the 'speculative-grade' sovereign bond market

TABLE 5 . REACHING FOR YIELD IN THE INVESTMENT-GRADE SOVEREIGN BOND MARKET

The dependent variable is the logarithm of the nominal net transaction volume in fixed-income securities for every security (i) during quarter t, in the period between 2016Q1 to 2021Q2. RFY(t-1)*IG is the lagged reaching for yield factor multiplied by a dummy variable that equals one for investment-grade bonds and zero for speculative-grade bonds. RFY_{t-1} is the lagged reaching for yield factor that captures the higher return that could be attributed to holding 'high-yield' bonds. The lagged term premium is computed by taking the difference between the 10-year and the 1-year Dutch government bond yield. VIX denotes the Eurostoxx50 volatility index. The t-values are reported between parentheses. *** p < 0.01; ** p < 0.05; * p < 0.1.

LN.TN.	Coef.	St.Err.	t-value	p-value	Sig
I(RFY(t-1)*IG)	0.870	0.276	3.155	0.002	***
RFY(t-1)	-0.303	0.195	-1.550	0.121	
Term Premium (t-1)	8.744	0.233	37.546	0.000	***
VIX	0.307	0.013	22.750	0.000	***
R-squared	0.101		Number of obs	14,429	

*** p<.01, ** p<.05, * p<.1*

5.2 Identifying Tail-risks

Table 6 presents the results of the Fama and Macbeth (1973) regression. Importantly, it shows that Dutch insurers do not have a significant ability to pick under-priced investments within the corporate bond market. The alpha is insignificant for both purchases and sales, which indicates that Dutch insurers engage in corporate bonds with risky returns.

Thus, the results in table 6 rule out the possibility that Dutch insurers possess the superior ability to pick under-priced investments. Yet, the results in table 6 also specify the types of priced risks that Dutch insurers increasingly engaged in. I compare the bonds in which Dutch insurers have a net buying propensity with the bonds in which Dutch insurers have a net selling propensity. Most remarkably, liquidity risk is highly significant for net purchases, whereas it is insignificant for net sales. This indicates that Dutch insurers have significantly searched for illiquidity in the corporate bond market during the period after the introduction of Solvency II regulation. Moreover, both the purchases and sales carry significant systematic and duration risk. However, the coefficients only marginally differ, which indicates that Dutch insurers did not significantly increase their exposure towards systematic and duration risk in their corporate bond portfolios.

TABLE 6. PERFORMANCE OF DUTCH INSURERS IN THE CORPORATE BOND MARKET

The dependent variable denotes the excess yield which is the difference between the yield to maturity on a specific fixed-income security (i) and the risk-free Euro T-bill rate. The intercept ("α") captures the ability of Dutch insurers to pick bonds that outperform the market. Systematic risk denotes the market index that applies to a specific credit rating bucket. Duration risk denotes the difference between the 10- and 1-year Dutch government bond yield. Liquidity risk is captured by the Pastor and Stambaugh (2003) liquidity factor. Default risk denotes the difference between the AAA corporate Euro index yield and the BB corporate Euro index yield. The t-values are reported between parentheses. *** p < 0.01; ** p < 0.05; * p < 0.1.

Excess Yield:	Net purchases	Net sales
Intercept ("Alpha")	-0.001	0.023
	[-0.028]	[0.805]
Systematic Risk	0.205***	0.165***
	[4.316]	[3.773]
Duration Risk	0.280**	0.314***
	[2.393]	[2.657]
Liquidity Risk	2.893***	-0.256
	[4.755]	[-0.276]
Default Risk	0.118	-0.093
	[1.550]	[-0.941]
Observations	8,076	10,191
R^2	0.928	0.941

Table 7 provides similar results for the sovereign bond market. The Fama and Macbeth (1979) regression generates negative and insignificant alpha's for both the net purchases and net sales specifications. Hence, the results reveal the inability of Dutch insurers to pick under-priced investments in the sovereign bond market.

Additionally, table 7 specifies the prices risks that Dutch insurers engage in. Similar to the results for the corporate bond market, table 7 reveals that both the purchases and sales carry significant systematic and duration risk. Again, the coefficients only marginally differ between purchases and sales. Opposed to the results for the corporate bond market, Dutch insurers do not significantly reach for illiquid government bonds after the introduction of Solvency II regulation.

TABLE 7. PERFORMANCE OF DUTCH INSURERS IN THE SOVEREIGN BOND MARKET

The dependent variable denotes the excess yield which is the difference between the yield to maturity on a specific fixed-income security (i) and the risk-free Euro T-bill rate. The intercept ("α") captures the ability of Dutch insurers to pick bonds that outperform the market. Systematic risk denotes the market index that applies to a specific credit rating bucket. Duration risk denotes the difference between the 10- and 1-year Dutch government bond yield. Liquidity risk is captured by the Pastor and Stambaugh (2003) liquidity factor. Default risk denotes the difference between the AAA corporate Euro index yield and the BB corporate Euro index yield. The t-values are reported between parentheses. *** p < 0.01; ** p < 0.05; * p < 0.1.

Excess Yield :	Net purchases	Net sales
Intercept ("Alpha")	-0.022	-0.012
	[-0.990]	[-0.848]
Systematic Risk	0.199***	0.145***
	[4.960]	[3.421]
Duration Risk	0.490***	0.736***
	[7.484]	[9.563]
Liquidity Risk	1.633	0.269
	[1.567]	[0.366]
Default Risk	0,056	-0.153
	[0.324]	[-1.265]
Observations	7,480	6,895
R^2	0.967	0.966

5.3 Procyclicality

Table 8 reveals that Dutch insurers significantly 'reached for yield' in the corporate bond market during the introduction of the Covid-19 pandemic. During the Covid-19 pandemic, Dutch insurers increased purchases with 41.9% in a particular security (i) as the yield on this security outperformed the benchmark by 100 bps in the previous period. These results contrast Becker and Ivashina (2015), who provide several theoretical reasons for 'reversed' reaching for yield behavior during volatile periods. However, these results are in line with Czech and Roberts-Sklar (2019), who state that insurers are shock-absorbers and therefore act countercyclical during stress events. In other words, insurers tend to increase purchases in bonds during stress events

in order to profit from buying at lower prices. The evidence for countercyclicality remains consistent when I only consider the 'investment grade' corporate bond market.[6]

TABLE 8. REACHING FOR YIELD IN THE CORPORATE BOND MARKET DURING COVID-19

The dependent variable is the logarithm of the nominal net transaction volume in fixed-income securities for every security (i) during quarter t, in the period between 2016Q1 to 2021Q2. RFY(t-1)*Covid.19 is the lagged reaching for yield factor multiplied by a dummy variable that equals one for the periods considered as the introduction of the Covid-19 pandemic and zero otherwise. RFY_{t-1} is the lagged reaching for yield factor that captures the higher return that could be attributed to holding 'high-yield' bonds. The lagged term premium is computed by taking the difference between the 10-year and the 1-year Dutch government bond yield. VIX denotes the Eurostoxx50 volatility index. The t-values are reported between parentheses. *** p < 0.01; ** p < 0.05; * p < 0.1.

LN.TN.	Coef.	St.Err.	t-value	p-value	Sig
I(RFY(t-1)*Covid19)	0.419	0.105	3.983	0.000	***
RFY(t-1)	0.095	0.070	1.351	0..177	
Covid.19	-0.567	0.193	-2.945	0.003	***
Term Premium (t-1)	5.834	0.193	30.169	0.000	***
VIX	0.174	0.065	17.462	0.000	***
r-squared		0.067	Number of obs		18,258

*** p<.01, ** p<.05, * p<.1

Furthermore, table 9 presents the results of reaching for yield behaviour in the government bond market. The interaction term is insignificant, which implies that Dutch insurers do not act procyclical in the government bond market during the Covid-19 pandemic. Despite the insignificance, the coefficient is positive and therefore indicates countercyclical behaviour of Dutch insurers within the sovereign bond market. The insignificance of the interaction term remains persistent when I only consider the 'investment grade' sovereign bond market.[7]

.

[6] Table C.1 in the appendix further substantiates the results of table 8 by specifically assessing reaching for yield in the 'investment grade' corporate bond market during covid-19.

[7] Table C.2 in the appendix further substantiates the results of table 8 by specifically assessing reaching for yield in the 'investment grade' sovereign bond market during covid-19.

TABLE 9. REACHING FOR YIELD IN THE SOVEREIGN BOND MARKET DURING COVID-19

The dependent variable is the logarithm of the nominal net transaction volume in fixed-income securities for every security (i) during quarter t, in the period between 2016Q1 to 2021Q2. RFY(t-1)*Covid.19 is the lagged reaching for yield factor multiplied by a dummy variable that equals one for the periods considered as the introduction to the Covid-19 pandemic and zero otherwise. RFY_{t-1} is the lagged reaching for yield factor that captures the higher return that could be attributed to holding 'high-yield' bonds. The lagged term premium is computed by taking the difference between the 10-year and the 1-year Dutch government bond yield. VIX denotes the Eurostoxx50 volatility index. The t-values are reported between parentheses. *** p < 0.01; ** p < 0.05; * p < 0.1.

LN.TN.	Coef.	St.Err.	t-value	p-value	Sig
I(RFY(t-1)*Covid19)	0.112	0.162	0.695	0.487	
RFY(t-1)	0.105	0.148	0.708	0..479	
Covid.19	-0.330	0.216	-1.528	0.127	
Term Premium (t-1)	8.756	0.242	36.246	0.000	***
VIX	0.309	0.014	22.839	0.000	***
r-squared		0.100	Number of obs		14,429

*** p<.01, ** p<.05, * p<.1*

6 Conclusion

In this study, I have examined 'reaching for yield' behaviour of Dutch insurance companies in the corporate and sovereign bond market during the period after the introduction of Solvency II regulation. Additionally, I have examined whether this 'reaching for yield' induces procyclical behaviour of Dutch insurers and therefore contributes to financial instability. This study argues that the risk-appetite of Dutch insurers increases as interest rates remain low for a prolonged period. However, the introduction of Solvency II dilutes risk-taking behaviour because rating-based regulation imposes costly capital requirements on risky assets. Consequently, Dutch insurers optimize yields within regulatory constraints by engaging in hidden tail-risks. This form of regulatory arbitrage is commonly referred to as 'reaching for yield'. 'Reaching for yield' behaviour by Dutch insurers raises financial stability concerns because it implies price trend herding. In other words, insurers buy more risky bonds in response to decreasing yields. Nevertheless, the literature provides no conclusive evidence for 'reversed' reaching for yield behaviour when bond prices are in a downward spiral.

In the first place, this study answers the research question by providing evidence for reaching for yield behaviour of Dutch insurers in both the corporate and sovereign bond market. In line with expectations, I find that Dutch insurers tend to increasingly invest in bonds that carry outperforming yields. Initially, I did not find significant 'reaching for yield' behaviour in the sovereign bond market. However, after incorporating an interaction term with a dummy for 'investment grade' bonds it turns out that Dutch insurers tend to 'reach for yield' in safer bonds, while this behaviour is not appealing for 'speculative-grade' bonds.

Subsequently, I verify that 'reaching for yield' implies risk-taking by ruling out the probability that Dutch insurers have a superior ability to pick under-priced investments. More specifically, in both the corporate and sovereign bond market the alpha indicates a negative sign. Importantly, the Fama and Macbeth regressions also reveal the priced risks that Dutch insurers engage in to optimize yields. I find that Dutch insurers hoard corporate bonds with significant liquidity risk. Thus, Dutch insurers 'reach for yield' by engaging into illiquid corporate bonds.

Finally, this study proves that Dutch insurers have acted countercyclically during the Covid-19 pandemic. Contrary to expectations, I find increased 'reaching for yield' behaviour of Dutch insurers during the start of the pandemic. Therefore, the results of this study reveal that Dutch insurers take advantage of lower prices by increasingly purchasing corporate bonds during stress events.

The results of this study have several important implications. Despite the introduction of Solvency II regulation, Dutch insurers are still able to take excessive risks within regulatory constraints. Dutch insurers avoid costly capital requirements by exploiting hidden tail-risks within credit-rating buckets. Imperfect risk-measurement allows insurers to tilt their portfolios to more illiquid bonds. Therefore, the regulator faces the challenge to circumvent regulatory arbitrage and accurately incorporate hidden tail-risks in pilar I of the Solvency II framework. Furthermore, the results of this study imply that Dutch insurers tend to act countercyclically in the bond market. The literature was ambiguous on whether the investment strategies of insurers are pro- or countercyclical. The findings partly solve for this ambiguity by arguing in line with Becker and Ivashina (2015), Czech and Roberts-Sklar (2019), and Timmer (2018) that

insurers are shock absorbers in the bond market. Nonetheless, this behaviour may be different for equities and other financial instruments (Duijm & Bisschop, 2018; Tower & Impavido, 2009).

Unfortunately, this study suffers from various data limitations. In the first place, the Solvency II database only provides access to credit rating data since 2016. Therefore, I am unable to accurately identify how rating-based regulation affects risk-taking behaviour of Dutch insurers because I cannot compare the period before and after Solvency II regulation. Moreover, I initially intended to also consider 'reaching for yield' behaviour in the market of mortgage loans. However, the transaction volumes, mortgage rates and credit ratings comprised too much missing values or were even unavailable.

I recommend future research to focus on further identifying hidden tail-risks that are not sufficiently covered by the risk assessment of the Solvency II framework. To regulate hidden tail-risk, it is important to understand tail-risk and to determine to which extent insurers hoard bonds that carry it. Furthermore, future research could focus on other financial markets than the corporate and sovereign bond market. Dutch insurers hold, for instance, large volumes in mortgage loans. In fact, Dutch insurers have the largest exposure towards mortgage loans of all European countries (The European Central Bank, 2019). Therefore, it would be useful to see how 'reaching for yield' behaviour unfolds in the mortgage market.

7 References

Becker, B. (2016). How the Insurance Industry's Asset Portfolio Responds to Regulation. *The Economics, Regulation, and Systemic Risk of Insurance Markets*, 153–164. https://doi.org/10.1093/acprof:oso/9780198788812.003.0008

Becker, B., & Ivashina, V. (2015). Reaching for Yield in the Bond Market. *The Journal of Finance*, *70*(5), 1863–1902. https://doi.org/10.1111/jofi.12199

Bernanke, B. S. (2020). The New Tools of Monetary Policy. *American Economic Review*, *110*(4), 943–983. https://doi.org/10.1257/aer.110.4.943

Bijlsma, M., & Vermeulen, R. (2015). Insurance Companies' Trading Behaviour During the European Sovereign Debt Crisis: Flight Home or Flight to Quality? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2587052

Chodorow-Reich, G. (2014). Effects of Unconventional Monetary Policy on Financial Institutions. *Brookings Papers on Economic Activity*, *2014*(1), 155–227. https://doi.org/10.1353/eca.2014.0003

Choi, J., & Kronlund, M. (2018). Reaching for Yield in Corporate Bond Mutual Funds. *The Review of Financial Studies*, *31*(5), 1930–1965. https://doi.org/10.1093/rfs/hhx132

Czech, R., & Roberts-Sklar, M. (2019). Investor behaviour and reaching for yield: Evidence from the sterling corporate bond market. *Financial Markets, Institutions & Instruments*, *28*(5), 347–379. https://doi.org/10.1111/fmii.12122

De Haan, L., & Kakes, J. (2011). Momentum or contrarian investment strategies: Evidence from Dutch institutional investors. *Journal of Banking & Finance*, *35*(9), 2245–2251. https://doi.org/10.1016/j.jbankfin.2011.01.027

Douglas, G., Noss, J., & Vause, N. (2017). The Impact of Solvency II Regulations on Life Insurers' Investment Behaviour. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2999604

Drenovak, M., Rankovic, V., Urosevic, B., & Jelic, R. (2018). Bond Portfolio Management Under Solvency II Regulation. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3319426

Duijm, P., & Steins Bisschop, S. (2015). Short-Termism of Long-Term Investors? The Investment Behaviour of Dutch Insurance Companies and Pension Funds. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2762200

European Capital Market Institute. (2020). *Activities Report*. https://www.ecmi.eu/about-ecmi/activities-reports/activities-report-2020

Ellul, A., Jotikasthira, C., Kartasheva, A. V., Lundblad, C. T., & Wagner, W. (2018). Insurers As Asset Managers and Systemic Risk. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3096147

Fache Rousová, L., & Giuzio, M. (2019). Insurers' Investment Strategies: Pro- or Countercyclical? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3428292

Fama, E. F., & French, K. R. (1989). Business conditions and expected returns on stocks and bonds. *Journal of Financial Economics*, *25*(1), 23–49. https://doi.org/10.1016/0304-405x(89)90095-0

Fama, E. F., & MacBeth, J. D. (1973). Risk, Return, and Equilibrium: Empirical Tests. *Journal of Political Economy*, *81*(3), 607–636. https://doi.org/10.1086/260061

Gennaioli, N., Shleifer, A., & Vishny, R. (2012). Neglected risks, financial innovation, and financial fragility. *Journal of Financial Economics*, *104*(3), 452–468. https://doi.org/10.1016/j.jfineco.2011.05.005

Gründl, H., Dong, M. I., & Gal, J. (2016). The evolution of insurer portfolio investment strategies for long-term investing. *OECD Journal: Financial Market Trends*, *2016*(2), 1–55. https://doi.org/10.1787/fmt-2016-5jln3rh7qf46

Heinrich, M., & Wurstbauer, D. (2018). The impact of risk-based regulation on European insurers' investment strategy. *Zeitschrift für die gesamte Versicherungswissenschaft*, *107*(3), 239–258. https://doi.org/10.1007/s12297-018-0403-8

Jareño, F., Tolentino, M., González, M. D. L. O., & Medina, M. N. (2019). Interest rate exposure of European insurers. *International Journal of the Economics of Business*, *27*(2), 255–268. https://doi.org/10.1080/13571516.2019.1681789

Killins, R. N., & Chen, H. (2020). The impact of the yield curve on the equity returns of insurance companies. *International Journal of Finance & Economics*, *27*(1), 1134–1153. https://doi.org/10.1002/ijfe.2205

Koijen, R. S. J., & Yogo, M. (2015). The Cost of Financial Frictions for Life Insurers. *American Economic Review*, *105*(1), 445–475. https://doi.org/10.1257/aer.20121036

KPMG. (2021, December). *Analyse van de Nederlandse Verzekeringsmarkt*. https://home.kpmg/nl/nl/home.html

Kräussl, R., Lehnert, T., & Rinne, K. (2017). The search for yield: Implications to alternative investments. *Journal of Empirical Finance*, *44*, 227–236. https://doi.org/10.1016/j.jempfin.2017.11.001

Le Blanc, M. (2021, August). *Insurer's Tripe Trouble: Fragile balance between SCR, return on capital and duration*. ING. https://think.ing.com/reports/insurers-triple-trouble

Möhlmann, A. (2020). Interest rate risk of life insurers: Evidence from accounting data. *Financial Management*, *50*(2), 587–612. https://doi.org/10.1111/fima.12305

Murray, S., & Nikolova, S. (2021). The Bond-Pricing Implications of Rating-Based Capital Requirements. *Journal of Financial and Quantitative Analysis*, *57*(6), 2177–2207. https://doi.org/10.1017/s0022109021000132

Papaioannou, M. G., Park, J., Pihlman, J., & van der Hoorn, H. (2013). Procyclical Behavior of Institutional Investors During the Recent Financial Crisis: Causes, Impacts, and Challenges. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2338386

Pástor, Ľ., & Stambaugh, R. F. (2003). Liquidity Risk and Expected Stock Returns. *Journal of Political Economy*, *111*(3), 642–685. https://doi.org/10.1086/374184

Rajan, R. G. (2006). Has Finance Made the World Riskier? *European Financial Management*, *12*(4), 499–533. https://doi.org/10.1111/j.1468-036x.2006.00330.x

Scharfstein, D. S., & Stein, J. C. (1990). Herd Behavior and Investment. *The American Economic Review*, *80*(3), 465–479. http://www.jstor.org/stable/2006678

Timmer, Y. (2018). Cyclical Investment Behavior Across Financial Institutions. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3723425

Tower, I., & Impavido, G. (2009). How the Financial Crisis Affects Pensions and Insurance and Why the Impacts Matter. *IMF Working Papers*, *09*(151), 1. https://doi.org/10.5089/9781451872989.001

The European Central Bank. (2019, May). *Financial Stability Review*. www.ecb.europa.eu

8 Appendix

Appendix A: Summary Statistics

TABLE A.1 SUMMARY STATISTICS FOR THE SOVEREIGN BOND MARKET

$LN.TN.$ denotes the logarithm of the nominal net transaction volume in fixed-income securities for every security (i) during quarter t, in the period between 2016Q1 to 2021Q2. RFY is the reaching for yield factor that captures the higher return that could be attributed to holding 'high-yield' investments. The term premium is computed by taking the difference between the 10-year and the 1-year Dutch government bond yield. VIX denotes the Eurostoxx50 volatility index. Covid.19 denotes the dummy variable that equals one for the periods considered as the introduction of the Covid-19 pandemic and zero for all other periods. The excess yield is the difference between the yield to maturity on a specific fixed-income security (i) and the risk-free Euro T-bill rate. The Index denotes the Euro sovereign effective index yield that applies to a specific credit rating bucket. Liquidity risk is captured by the Pastor and Stambaugh (2003) liquidity factor. The default premium denotes the difference between the AAA sovereign Euro index yield and the BB sovereign Euro index yield.

Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
LN.TN.	14,429	-0.278	8.881	-19.988	20.282
RFY	14,429	-0.158	1.332	-9.732	18.828
Term Premium	14,429	0.741	0.404	0.198	1.312
VIX	14,429	20.27	6.491	12.990	35.993
Covid.19	14,429	0.108	0.310	0	1
Yield	14,429	0.459	1.545	-1.500	24.208
Euro Index Yield	14,429	0.617	0.915	-0.446	9.391
Excess Return	14,429	0.917	1.537	-1.195	24.475
Risk-free Rate	14,429	-0.461	0.106	-0.635	-0.264
Default Premium	14,429	1.904	0.470	1.163	3.322
Liquidity Factor	14,429	-0.031	0.074	-0.258	0.100

Appendix B: Reaching for yield in the 'speculative-grade' bond market

TABLE B.1 REACHING FOR YIELD IN THE SPECULATIVE-GRADE CORPORATE BOND MARKET

The dependent variable is the logarithm of the nominal net transaction volume in fixed-income securities for every security (i) during quarter t, in the period between 2016Q1 to 2021Q2. RFY_{t-1} is the lagged reaching for yield factor that captures the higher return that could be attributed to holding 'high-yield' bonds. RFY(t-1)*IG is the lagged reaching for yield factor multiplied by a dummy variable that equals one for investment-grade bonds and zero for speculative-grade bonds. The lagged term premium is computed by taking the difference between the 10-year and the 1-year Dutch government bond yield. VIX denotes the Eurostoxx50 volatility index. The t-values are reported between parentheses.
*** p < 0.01; ** p < 0.05; * p < 0.1.

Table: Regression results

LN.TN.	Coef.	St.Err.	t-value	p-value	Sig
I(RFY(t-1)*HY)	-0.953	0.134	-7.110	0.000	***
RFY(t-1)	0.776	0.105	7.374	0.000	**
Term Premium (t-1)	5.906	0.182	32.376	0.000	***
VIX	0.172	0.010	17.436	0.000	***
R-squared	0.068		Number of obs		18,258

*** p<.01, ** p<.05, * p<.1*

TABLE B.2 REACHING FOR YIELD IN THE SPECULATIVE-GRADE SOVEREIGN BOND MARKET

The dependent variable is the logarithm of the nominal net transaction volume in fixed-income securities for every security (i) during quarter t, in the period between 2016Q1 to 2021Q2. RFY_{t-1} is the lagged reaching for yield factor that captures the higher return that could be attributed to holding 'high-yield' bonds. RFY(t-1)*IG is the lagged reaching for yield factor multiplied by a dummy variable that equals one for investment-grade bonds and zero for speculative-grade bonds. The lagged term premium is computed by taking the difference between the 10-year and the 1-year Dutch government bond yield. VIX denotes the Eurostoxx50 volatility index. The t-values are reported between parentheses.
*** p < 0.01; ** p < 0.05; * p < 0.1.

Table: Regression results

LN.TN.	Coef.	St.Err.	t-value	p-value	Sig
I(RFY(t-1)*HY)	-0.870	0.276	-3.155	0.002	***
RFY(t-1)	0.567	0.199	2.857	0.04	***
Term Premium (t-1)	8.744	0.233	37.546	0.000	***
VIX	0.307	0.013	22.750	0.000	***
R-squared	0.101		Number of obs		14,429

*** p<.01, ** p<.05, * p<.1*

Appendix C: Reaching for yield in the Investment Grade Bond Market

TABLE C.1 REACHING FOR YIELD IN THE INVESTMENT GRADE CORPORATE BOND MARKET DURING COVID-19

The dependent variable is the logarithm of the nominal net transaction volume in fixed-income securities for every security (i) during quarter t, in the period between 2016Q1 to 2021Q2. RFY(t-1)*Covid.19 is the lagged reaching for yield factor multiplied by a dummy variable that equals one for the periods considered as the introduction of the Covid-19 pandemic and zero otherwise. RFY_{t-1} is the lagged reaching for yield factor that captures the higher return that could be attributed to holding 'high-yield' bonds. The lagged term premium is computed by taking the difference between the 10-year and the 1-year Dutch government bond yield. VIX denotes the Eurostoxx50 volatility index. The t-values are reported between parentheses. *** p < 0.01; ** p < 0.05; * p < 0.1.

Table: Regression results

LN.TN.	Coef.	St.Err.	t-value	p-value	Sig
I(RFY(t-1)*Covid19)	0.431	0.166	2.604	0.009	***
RFY(t-1)	0.712	0.110	6.470	0.000	***
Covid.19	-0.226	0.200	-1.130	0.258	
Term Premium (t-1)	6.026	0.199	30.338	0.000	***
VIX	0.188	0.010	18.074	0.000	***
r-squared		0.074	Number of obs		17,047

*** p<.01, ** p<.05, * p<.1*

TABLE C.2 REACHING FOR YIELD IN THE INVESTMENT GRADE SOVEREIGN BOND MARKET DURING COVID-19

The dependent variable is the logarithm of the nominal net transaction volume in fixed-income securities for every security (i) during quarter t, in the period between 2016Q1 to 2021Q2. RFY(t-1)*Covid.19 is the lagged reaching for yield factor multiplied by a dummy variable that equals one for the periods considered as the introduction to the Covid-19 pandemic and zero otherwise. RFY_{t-1} is the lagged reaching for yield factor that captures the higher return that could be attributed to holding 'high-yield' bonds. The lagged term premium is computed by taking the difference between the 10-year and the 1-year Dutch government bond yield. VIX denotes the Eurostoxx50 volatility index. The t-values are reported between parentheses. *** p < 0.01; ** p < 0.05; * p < 0.1.

Table: Regression results

LN.TN.	Coef.	St.Err.	t-value	p-value	Sig
I(RFY(t-1)*Covid19)	0.169	0.184	0.919	0.358	
RFY(t-1)	0.566	0.207	2.730	0.006	***
Covid.19	-0.284	0.201	-1.411	0.158	
Term Premium (t-1)	8.708	0.242	35.919	0.000	***
VIX	0.311	0.014	22.931	0.000	***
r-squared		0.102	Number of obs		14,153

*** p<.01, ** p<.05, * p<.1*

Appendix D: Methodological Tests

TABLE D.1 DICKEY FULLER TEST FOR FIXED-EFFECTS MODEL VARIABLES

Variable Name	*Dickey-Fuller*	*p-value*
LN.TN. (corporate)	-16.74	0.01
RFY (corporate)	-16.747	0.01
LN.TN. (government)	-11.954	0.01
RFY (government)	-20.442	0.01
Term Premium	-2.6702	0.294
VIX	-3.1443	0.097