DNB Working Paper

No. 677 / March 2020

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EUROSYSTEEM

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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

Working Paper No. 677

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The Netherlands

March 2020

Product diversification as a performance boosting strategy? Drivers and impact of diversification strategies in the property-liability insurance industry[*]

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Abstract

We investigate the relationship between product diversification and performance in the Dutch property-liability (P&L) insurance industry for the period 2007-2018. We employ a two-step approach: we first investigate the drivers of diversification and, as a second step, we investigate the impact of diversification on risk and return. Our results suggest that the impact of diversification can be beneficial, as it reduces an insurer's risk. Diversification is however also associated with lower returns, while it is not significantly related to risk-adjusted returns. Furthermore, the impact of diversification on performance is contingent upon an insurer's size and its extent of diversification.

Keywords: insurance companies, diversification, risk, performance

JEL classification: G22, G32, L25

[*] The authors thank Dirk Broeders, Annick van Ool, Arco van Oord, Koen van der Veer, Ralph Verhoeks, and participants of the DNB research seminar for useful comments. Any remaining errors are our own. The views expressed in this paper are those of the authors and do not necessarily reflect those of De Nederlandsche Bank.

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1. Introduction

Over the last years, insurance companies have experienced various challenges stemming from the macroeconomic environment. The financial crisis of 2007-2009 had an immediate impact on the insurance industry, primarily via their investment portfolios (Schich, 2010). And since then, the continued low interest rate environment in the US and Europe has put further pressure on the business model of insurers (Berdin et al., 2015). To maintain their financial position, insurance companies are thus forced to adapt their business model, carefully manage their risks and seek for opportunities to either increase their income, cut their costs or lower their risk. One way to do so is through product diversification, i.e. by being active in multiple business lines.

In general, diversification is about spreading risks and thereby potentially lowering total risk (Markowitz, 1952). With product diversification an insurer may be better able to deal with disappointing results or shrinking demand in one specific line of business. This may hence reduce the risk of an insurer. More specifically, diversification may reduce income volatility by combining revenue streams that are non-perfectly correlated (Lewellen, 1971). Product diversification may however also generate positive effects for an insurer's return via economies of scope. By offering insurance products in various lines of business, the fixed production costs can be shared among multiple business units (Teece, 1980). Companies may also diversify to create a larger internal capital market; by generating funds from one business and invest it in the other external funding costs will be avoided (Besanko et al., 2009). Diversification thus has the potential to increase an insurer's profit, through cost reduction, and/or decrease its risk. On the other hand, proponents of a focused strategy often argue that by having a more strategic focus on a specific industry segment or line of business firms can maximize their value via specialization. They moreover argue that diversification can also come at a cost. Costs from diversification may, for example, arise from higher agency or monitoring costs or an inefficient allocation of capital among different parts of a diversified firm (Rajan et al., 2000).

This study investigates the relationship between product diversification and the risk-return profile in the Dutch property-liability[1] insurance sector for the years 2007-2018 using

[1] We focus on the non-life (property-liability, sometimes also termed as property-casualty) insurance sector, because the underlying risks in the non-life industry are expected to be less correlated (i.e. fire and unemployment) than in the life industry (the main risk related to life insurance products is longevity risk). Hence, the potential for diversification is higher in the non-life industry.

a unique firm-level data set constructed on the basis of supervisory data.[2] To measure product diversification, we exploit information on premiums written at the insurer-business line-year level.[3] We define returns as net operational result over assets, and thereby exclude investment and extraordinary returns. Risk is defined as the volatility in returns, measured by the standard deviation over the three preceding years. Risk-adjusted return is then obtained as the ratio between return and risk.

The relation between diversification and risk is assumed to be endogenous, since risk prone insurance companies may be more likely decide to diversify in order to reduce their risk (i.e. an anticipation effect). We therefore employ an instrumental variable approach, consisting of two steps. As a first step, and to get a better understanding of the underlying mechanisms of product diversification, we investigate the drivers of diversification. What makes insurance companies decide to enter a specific line of business? Second, we investigate the impact of diversification strategies on the risk-return profile of Dutch property-liability (P&L) insurance companies. The results from the first step are used for the construction of the instrument in the second step.

Empirical studies on the relation between product diversification[4] and performance for insurance companies on performance are relatively scarce and show mixed results.[5] While some studies point to a so-called diversification discount, i.e. a negative relationship between diversification and performance (e.g. Liebenberg and Sommer, 2008 and Cummins et al., 2010; Pavić and Pervan, 2010); others find evidence suggestive of diversification benefits, i.e. a positive relationship (e.g. Elango et al., 2008 and Shi et al., 2016; Krivokapic et al., 2017). Existing studies also differ in their empirical approach (regression analysis versus other estimating techniques), strategy to address potential endogeneity concerns[6], measures of

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[2] We combine supervisory data for the period 2007-2015, governed by a mainly national regulatory framework (Solvency I) with data for the period 2016-2018, governed by the EU-wide Solvency II regulatory framework.

[3] We distinguish between 10 lines of business in the P&L insurance industry: Invalidity insurance; Fire and other damage to property; Motor vehicle liability; Motor vehicle, other; General liability; Legal expenses; Assistance; Marine, aviation and transport; Miscellaneous financial loss; and Credit and suretyship.

[4] We use the term product diversification to refer to activity of insurers across business lines within the P&L industry. In related work, the term corporate diversification has also been used, see for instance Liebenberg and Sommer (2008).

[5] In a related line of research, several papers investigate the impact of product diversification on banks (examples are Klein and Saidenberg, 2000; Mercieca et al., 2007; Berger et al., 2010) and financial conglomerates (Schmid and Walter, 2009; Laeven and Levine, 2007).

[6]Anticipating diversification benefits, an insurer may actually be triggered to take more risks, for example by loosening the acceptance standards for contracts. As the extent to which an insurance company is diversified is found to be related to its risk profile (Campa and Kedia, 2002; Che and Liebenberg, 2017), endogeneity is likely to be an issue. Liebenberg and Sommer (2008) take potential endogeneity of the diversification variable into account by employing an instrumental variable approach. More generally however, the presence of a firm-specific component in financial performance measures leads to endogeneity bias in the empirical analysis, if not

performance, control variables used and focus (time period, type of insurers included, etc.). This makes it harder to draw any general conclusions regarding the impact of diversification on insurer performance.

The contribution of our study to the existing literature is fourfold. First, we control for general endogeneity concerns by using fixed effects regressions and lagged independent variables. On top of that and in the spirit of Liebenberg and Sommer (2008), we control for potential specific endogeneity issues caused by the diversification variable and as such additionally employ a fixed effects instrumental variable approach. Second, in addition to investigating the relationship between diversification and return (and risk-adjusted return), we separately consider the relationship between diversification and risk (defined as the volatility in returns). Third, so far most studies on diversification have a focus on the US insurance market. The US market however differs from other insurance markets in quite some aspects, among which the regulatory framework, valuation methods, direct versus indirect selling to customers etc. By using data for the Dutch insurance sector, we present evidence on the relationship between diversification and performance for a European insurance market. Finally, we explore the existence of non-linearities in the relationship between diversification and performance. We not only investigate whether the relationship is influenced by the extent of diversification (as some other studies also do, e.g. Elango et al, 2008), but also look into the role of insurer size. Larger undertakings may – for example – have more resources and knowledge to be active in multiple lines of business, i.e. a combination of both economies of scale and economies of scope.

Our baseline results – both OLS and IV - suggest a negative and significant relationship between product diversification and insurers' risk as well as return, while there is no significant relation between diversification and risk-adjusted return. Digging a bit deeper into the relation between diversification and performance by taking into account potential non-linearities and considering subsamples based on the size of insurance companies, our results suggest that the impact of diversification is contingent upon an insurer's size and its extent of diversification. First of all, we find evidence of a non-linear relation between diversification and performance, i.e. diversification generally is associated with (on average) lower risk and return, but the downward impact decreases with the extent of diversification. This result is however not confirmed by the IV estimations. Second, the impact of diversification seems

adequately controlled for by e.g. introducing firm-specific fixed effects. Shi et al. (2016) apply fixed effects regressions in their study on US health insurers.

most pronounced for small insurance companies[7]; results suggest they benefit from diversification in terms of risk reduction, but also experience lower returns. These results are not confirmed for the subsample of large insurers. In sum, our results suggest that the relation between diversification and performance is not straightforward, this may be one explanation for the mixed findings in the literature so far.

We have tested for the robustness of our results by i) replicating the estimations considering a subsample of multiline insurers, i.e. only including insurers that are active in more than one business line; ii) measuring risk (and risk-adjusted return) using the 5-year standard deviation in returns (instead of 3-year). Results of these robustness checks are reported in the appendix, they confirm the main findings of our baseline specification and sample. We have additionally experimented with a more traditional instrumental variable approach along the lines of Liebenberg and Sommer (2008).[8] Specifically, we use a weighted single line variable and an acquisition dummy to instrument for product diversification directly.[9] Unfortunately, this approach suffers from weak instrument problems, as indicated by the overall fit of the first-stage regression (F-stat). As a consequence, this approach yields no usable results.

Our results point to lessons for insurance companies as well as policymakers. The finding that diversification strategies can be potentially beneficial, especially in terms of risk reduction is certainly relevant to insurers looking for the next competitive edge. However, given that the relation between diversification and performance is potentially non-linear and dependent on the size of the insurer, other relevant policy implications may exist. Product diversification, or line of business diversification, is currently explicitly taken into account in the EU regulatory framework. Solvency II regulation allows for the risk-reducing impact of diversification in the calculation of the Solvency Capital Requirement (SCR).[10] While this is in line with our general findings (i.e. risk-reducing impact of diversification), it does ignore potential non-lineairities and dependencies with the size of institutions that we find to exist in our current analysis.

[7] We split the sample based on the sample median of average insurer size across all years, to obtain two subsamples with an equal number of insurers, one with average size higher than the median, the other with average size below or equal to the median.

[8] Unlike Liebenberg and Sommer (2008) we include insurer and year fixed effects in all regressions and employ lagged right-hand side variables throughout.

[9] This diverges from our IV strategy where we construct an instrument by exploiting information at the insurer-year-business line level on the drivers of product diversification.

[10] See Solvency II Delegated Acts. (EU, 2015, Title I, Chapter 5 for calculation of solvency capital requirement and Annex IV for the non-life correlation matrix).

The remainder of this study is organized as follows. Section 2 provides a general overview of product diversification in the Dutch property liability insurance industry. Section 3 contains the first step of our analysis and investigates the drivers of diversification. The results of section 3 are used in section 4, where we focus on the impact of diversification on insurer performance. Section 5 concludes.

2. Product diversification in the property-liability sector in the Netherlands

Throughout this study data[11] are used for 123 P&L insurers, such that the majority (~95-99%) of the Dutch P&L insurance industry is covered in terms of total written premiums. A detailed overview of all variables used in our empirical analysis and the exact definitions can be found in table A.1 in the appendix. With a balance sheet total of EUR 36 billion, the Dutch P&L insurance industry represents 4.7% of the Dutch GDP (based on 2018 data[12]).

Table 1: Lines of business – characteristics

This table shows for each line of business, the total number of insurers active in that line of business, the gross written premiums and its market share. Numbers are based on the year 2018.

Line of business	Number of insurers active in business line	Gross written premiums (EUR millions)	Market share (%)
Invalidity insurance	32	3,862	28
Fire and other damage to property	52	3,260	24
Motor vehicle liability	22	2,380	17
Motor, other	25	1,926	14
General liability	26	879	6
Legal expenses	27	709	5
Assistance	11	322	2
Marine, aviation and transport	17	258	2
Miscellaneous financial loss	13	247	2
Credit and suretyship	2	6	0
Total		**13,847**	**100**

[11] This study makes use of supervisory data available collected by De Nederlandsche Bank. All insurance companies incorporated (with a license) in the Netherlands are required to report supervisory data at least annually. Our data thus includes foreign subsidiaries (licensed), but not foreign branches (not licensed). The data contain information on the business profile and financial position as well as balance sheet information and are available annually for the period 2007-2018. Our unit of observation is an insurance company, active in the P&L market and incorporated in the Netherlands. P&L insurers are not allowed to offer life or health insurance in addition to P&L insurance. We exclude captive insurers, since these companies are wholly owned and controlled by a business that is not an insurer. We also exclude insurers with less than 3 consecutive years of data on our key variables as we use lagged variables and three-year standard deviations in our empirical model. The underlying data are insurer-specific and therefore confidential. Hence, throughout the paper we show only aggregated data or estimation results.

[12] Source for GDP data: Statistics Netherlands (2019, CBS Statline, figures of June 24th, 2019).

Table 1 provides an overview of the different lines of business for the year 2018. In terms of market share, "*Invalidity Insurance*" is the largest line of business, followed by "*Fire and other damage to property*" and the two motor vehicle lines of business. Taken together the top 4 lines of business account for 82.5 percent of gross written premiums in 2018.

Figure 1 shows the distribution of our sample of insurers by the number of business lines in which they operate, both for the year 2008 and the year 2018. The left-hand figure shows that in 2008 a slight majority of insurers – 60 out of 112 - was only active in one line of business. Interestingly, there is another spike at 8 business lines, indicating that another 16 out of 112 insurers are active in 8 lines of business (all but two). Among these are the firms belonging to the larger insurance groups. The distribution looks largely similar in 2018, as can be seen in the right-hand panel of Figure 1.

Figure 1: Distribution of insurance companies by number of business lines

The graphs below shows the distribution of firms by the number of business lines they are active in, for the years 2008 and 2018. The total number of insurers in 2008 is 112 versus 64 in 2018.

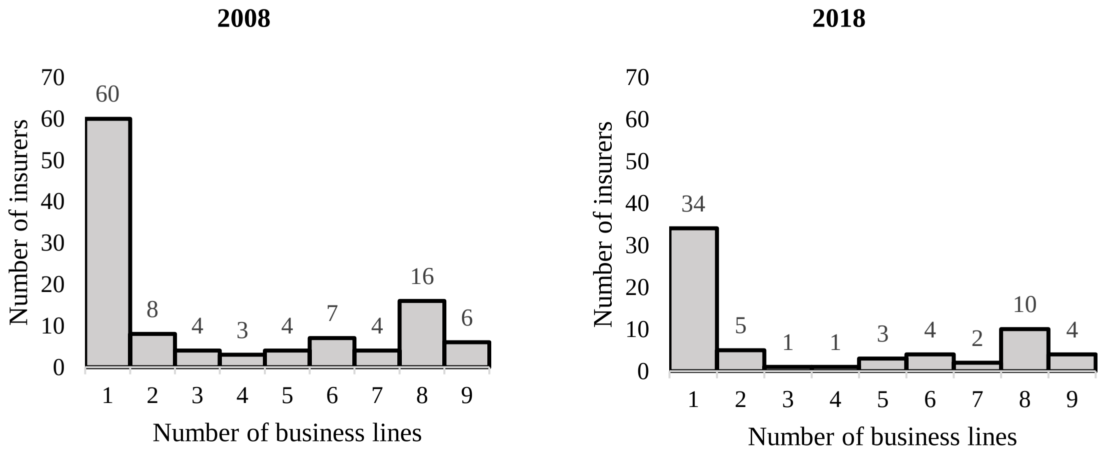
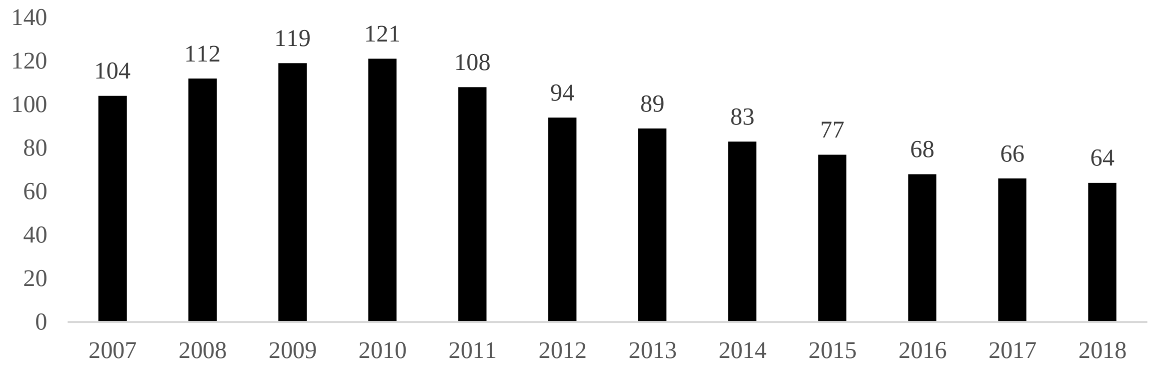


Figure 1 also shows that the total number of insurers decreased over the years.[13] This is due to a consolidation wave that took place in the Dutch insurance industry during the past decade and it is also apparent from Figure 2. Since consolidation – in the form of a merger of two insurers or a take-over of one insurer by the other – has a direct impact on the diversification profile of an insurance company, we take this into account in our analysis.

[13] The number of active insurers has decreased both in our sample and in the overall population of Dutch insurance companies, it is not a result of sample selection.

Figure 2: Number of active insurance companies in sample over time

This graph shows the number of active insurance companies per year.



3. Drivers of diversification

3.1 Methodology and data

The purpose of our analysis on the determinants of diversification by Dutch P&L insurers is twofold. Besides getting a better sense for the underlying drivers of diversification, we are interested in exploiting the exogenous variation in insurers' diversification profile for the construction of an instrument in our analysis on the impact of diversification (next section). Finding a good instrument comes with a challenge since the instrumented diversification measure may not be related to the performance of an insurer (i.e. the exclusion restriction).

The extent to which an insurer is diversified across business lines is usually taken as given in studies that investigate the impact of diversification on performance. Consequently, there are not many studies looking specifically at the drivers of diversification. Exceptions are the studies by Berry-Stölz et al. (2012) and Liebenberg and Sommer (2008).

Berry-Stölz et al. (2012) investigate the determinants of product diversification by property-liability insurers in the US. Their findings suggest that market size and concentration are important drivers of product diversification. In their analysis on the impact of diversification on the performance of insurers, Liebenberg and Sommer (2008) apply an instrumental variable approach to control for the endogeneity of the diversification variable in their empirical analysis. To estimate the extent of diversification in the first step of their analysis, the authors use the age of the insurer, the use of reinsurance and an index capturing the attractiveness of the specific line of business to single-line insurer.

We use the studies by Berry-Stölz et al. (2012) and Liebenberg and Sommer (2008) as a starting point for the construction of our instrument and use the following model:

$$\frac{Premiums_{i,b,t}}{Premiums_{i,t}} = \alpha_b + \theta_t + AGE_{i,t} + SINGLE_{b,t} + ACQ_{b,t} + RELSIZE_{b,t} + \varepsilon_{i,b,t} \quad (1)$$

where $Premiums_{i,b,t}$ denotes the gross written premiums by insurer i, in business line b at time *t*, and $Premiums_{i,t}$ the total written premiums by insurer *i* at time *t*. The ratio thus refers to the share of insurer i's premiums in business line b to its total premiums. $AGE_{i,t}$ represents the age of insurer i in year t. A negative coefficient is expected since the longer the insurer exists, the higher the probability of the insurer expanding its business to multiple business lines and the lower its share in one single business line. $SINGLE_{b,t}$ is an index that captures the attractiveness of a business line for single-line insurers. It is calculated as the percentage of single-line insurers in each business line. A negative coefficient is expected, as a higher value is associated with a higher specificity of the business line considered, and hence with lower concentration in that line of business (ceteris paribus). As mentioned before, the consolidation wave in the Dutch insurance industry may have a direct impact on the diversification profiles of insurers. We therefore include $ACQ_{b,t}$; a dummy variable that is equal to one for the acquiring company in the year after the completion of the merger or takeover. In case of a merger, the acquiring company is defined as the insurer that continues to report. A negative coefficient is expected, as an acquisition may lead to an (acquiring) insurer entering a new business line, such that the share in another specific business line decreases. Lastly, $RELSIZE_{b,t}$ is the share of business line b in the total P&L insurance market. A positive coefficient is expected since a larger market (in relative terms) tends to be more attractive for an individual insurer, i.e. the probability that the insurer is active in that specific line of business is likely to be higher.

3.2 Results

Table 2 shows the regression results from equation (1). The first column shows the results including year fixed effects, but excluding line of business fixed effects. The results in this column are in line with our expectations. The negative and significant coefficient for age implies that the longer the insurer exists the lower its share of premiums in a given line of business. This is in line with our expectations: older companies are active in more lines of business and hence have a lower share of their premiums is in a specific line of business. Similarly, an insurer's activities in a specific business line are lower the higher the attractiveness of that line of business for single-line insurers, as shown by the negative and significant coefficient for single line attractiveness. Also, the negative and significant coefficient for the acquisition dummy confirms our expectation that an acquisition (or merger) may lead to a lower share of activities in a specific business line. Lastly, the positive and significant coefficient for relative market size is in line with our expectations. The higher the total premiums in a specific business line as a share of the total Dutch insurance premiums, the higher the insurer's share in that business line to its total activities.

The second column shows the results excluding year fixed effects, but including line of business fixed effects and the third column shows the results including both types of fixed effects. The coefficients for the independent variables are in line with those in the first column. We will use the estimates from this model for the construction of an instrument in the next section; the analysis on the impact of diversification on an insurer's risk and return profile. The instrument may not be related directly to the risk and return profile of an insurer (exclusion restriction) and therefore we have not included insurer-specific fixed effects. Based on model performance, we use the results of column (3) for the construction of our instrument in the next section.

Table 2: Determinants of product diversification

This table shows the regression results from equation (1) over the period 2007-2018 for all P&L insurers in our sample. The dependent variable is the insurer *i*'s premiums written in business line *b* at time *t* divided by the total premiums of insurer *i* at time *t*. Business line and year fixed effects are included. Standard errors are clustered at the business line-year level, and reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	(1)	**(2)**	**(3)**
$Age_{i,t}$	-0.281***	-0.279***	-0.279***
	(0.0413)	(0.0418)	(0.0417)
$Single_{b,t}$	-1.936***	-1.007***	-1.203***
	(0.183)	(0.298)	(0.282)
$Acquisition_{i,t}$	-0.384***	-0.347***	-0.376***
	(0.101)	(0.0904)	(0.0956)
$Rel\_size_{b,t}$	10.85***	8.254***	10.02***
	(0.728)	(1.586)	(1.510)
# Obs.	3,717	3,717	3,717
R^2	0.282	0.330	0.332
R^2 adj.	0.279	0.328	0.327
Time FE	Yes	No	Yes
Business line FE	No	Yes	Yes

4. Impact of diversification

4.1 Previous findings

In this section, we focus on the impact of diversification on the risk-return profile of Dutch P&L insurers. Diversification may however have other implications. For example, diversification strategies are found to have an impact on the market valuation of listed companies as diversified companies are often found to be valuated lower than their less diversified peers (e.g. Lang and Stulz, 1994; Laeven and Levine, 2007; Schmid and Walter, 2009). Hardwick and Adams (2002), focusing on UK insurers, find that more diversified insurers enjoyed higher growth rates than more specialized insurers, possibly reflecting the effects of economies of scope. In this section we however focus on the studies that are closest to ours, i.e. the studies that focus on the impact of diversification on the return, risk or risk-return profile of P&L insurance companies. Recent studies on the impact of product diversification include Elango et al. (2008), Liebenberg and Sommer (2008), Cummins et al. (2010), Pavić and Pervan (2010), Shi et al. (2016) and Krivokapic et al. (2017).[14]

Starting with Elango et al. (2008), their study investigates the relationship between product diversification and financial performance for the US P&L insurance industry over the period 1994-2002. Financial performance is measured by insurers' risk-adjusted return (measured by after-tax net income). Their findings suggest an interaction between geographical diversification and product diversification, as the performance benefits associated with product diversification depend on the insurer's degree of geographical diversification. More specifically, firms with high levels of both product and geographic diversification are found to be the worst performers, whereas firms with low levels of both types of diversification perform better. Ultimately, the combination of intermediate levels of product diversification and high levels of geographic diversification is found to be positively related to firm performance.

Similar to Elango et al. (2008), Liebenberg and Sommer (2008) also focus on diversification benefits in the US P&L insurance market. These authors solely focus on product diversification, and control for endogeneity by applying a two-stage least squares and Heckman approach. Considering the period 1995-2004, their study provides evidence for a diversification penalty; undiversified insurers consistently and significantly outperform diversified insurers. Diversification is associated with a penalty of at least 1 percent of return on assets or 2 percent of return on equity.

[14] Other studies include, for example, Hoyt and Trieschmann (1991) and Berger et al. (2000).

Cummins et al. (2010), also focusing on US, investigate whether it is advantageous for insurance companies to offer both life and non-life insurance or rather to specialize in one of these two segments. They also investigate potential diversification benefits within each of these segments. Employing a data envelopment analysis for the period 1993-1997, i.e. comparing each firm in an industry to a "best practice" with respect to efficiency, they consider the impact of diversification on economies of scope. The authors find support for revenue efficiency benefits for diversified insurers. However, these revenue benefits associated with diversification are found to be eroded by cost scope diseconomies. Overall, their study hence suggests that a strategic focus appears to be a better strategy than conglomeration/ diversification strategies.

Focusing on the Croatian non-life insurance industry, Pavić and Pervan (2010) investigate the relationship between product diversification and financial performance over the period 2004-2007, measured by both return on assets and return on equity (non risk-adjusted). The authors find support for the strategic focus hypothesis, particularly when return on equity is used as a measure of financial performance, implying that undiversified insurers outperform diversified insurers.

Shi et al. (2016) consider diversification benefits within the US health industry. The authors find a positive relationship between product diversification and (risk-adjusted) performance. Like Shi et al. (2016), Krivokapic et al. (2017) also find evidence for a positive relationship between line-of-business diversification and (risk-adjusted) performance for Serbian non-life insurance companies. That is, diversified insurers thus outperform undiversified insurers. Their focus is on insurance companies within the non-life segment.

4.2 Methodology and data

To test for the impact of product diversification on an insurer's risk-return profile we estimate the following model:

$$R_{i,t} = \alpha_i + \mu_t + \beta_1 * HHI_{i,t-1} + \sum_{k=2}^{K} \beta_k * X_{i,t-1} + \varepsilon_{i,t} \tag{2}$$

where $R_{i,t}$ either stands for the return, risk or risk-adjusted return of insurance company *i* in year *t*. Return is measured by an insurer's operational return on assets (ROA). The return is specified as the premiums minus the claims minus the operating expenses. Thereby we measure the profit stemming from the core business, i.e. excluding investment returns. Risk is measured by the 3-year standard deviation of ROA[15]. The risk-adjusted return is defined as an insurer's return divided by its risk. We estimate equation (2) with Ordinary Least Squares (OLS) and Instrumental Variable (IV) techniques. We include both insurer-specific (α_i) and year (μ_t) fixed effects throughout, and standard errors are robust and clustered at the insurer level in all estimations.

$HHI_{i,t-1}$ represents the one-year lag of our product diversification variable $HHI_{i,t}$, measured by the Herfindahl-Hirschmann Index. $HHI_{i,t}$ is calculated as 1 minus the sum of insurer *i*'s squared market shares in different lines of business:

$$HHI_{i,t} = 1 - \sum_{b=1}^{B} \left(\frac{Premiums_{i,b,t}}{Premiums_{i,t}} \right)^2 \quad (3)$$

$HHI_{i,t}$ uses the gross written premiums by insurer *i* at time *t* in a specific line of business. $X_{i,t-1}$ represents a vector of insurer-specific control variables, one-year lagged. First of all, we control for the share of insurers' foreign activities, i.e. insurers' activities outside the Netherlands ($Foreign_{i,t}$). By expanding across borders, insurance companies may reduce risk as long as there is a non-perfect correlation across country-specific risks. However, operating across borders may lead to higher monitoring costs as well (Doukas and Pantzalis, 2003). Liebenberg and Sommer (2008) find that any potential risk-reduction benefits from geographical diversification are offset by the costs associated with greater managerial discretion. The overall impact of conducting foreign business is thereby expected to be negative.[16] Second, the size of an insurer ($\ln(Size_{i,t})$), defined as the natural logarithm of total assets, is included. We expect the size of an insurer to be positively related to its (risk-adjusted) performance and negatively related to risk, since larger insurers may be able to benefit more easily from cost efficiencies through economies of scale. Third, we control for the leverage

[15] We test for the robustness of this measure by re-estimating the model with risk being measured by the 5-year standard deviation of our ROA measure.

[16] In contrast to Liebenberg and Sommer (2008) and Elango et al. (2008) we measure geographical diversification by the share of foreign activities instead of using a Hischmann-Herfindahl index. We rely on data on total foreign activities, since the foreign activities split by individual countries are not available for all insurers (lower quality). Besides, Dutch insurers do not have a lot of foreign activities. Elango et al. (2008) do not consider the separate impact of geographical diversification, but point to a complex relationship between product and geographic diversification. When combined with intermediate levels of product diversification, high levels of geographic diversification positively relate to firm performance. There are some studies that focus on geographical diversification in the life insurance industry. Biener et al. (2015a) investigate internationalization of Swiss life insurers and find that internationalization positively relates to cost efficiency. Biener et al. (2015b) investigate the relationship between globalization and performance for life insurers. By employing a data envelopment analysis the authors find that the impact of globalization on a life insurer's profitability is negative. The negative impact is found to be partially driven by a decrease in cost efficiency at higher levels of globalization. Focusing on German insurance groups (both life and non-life), Altuntas et al. (2016) find evidence for a negative relationship between an insurer's performance at its home market and its degree of internationalization.

(i.e. solvency) position of an insurer ($Leverage_{i,t}$). This is measured by the insurer's own funds, measured by the excess of assets over liabilities, divided by its total assets. We expect that an insurer's solvency position is positively related to its returns, as Sommer (1996) shows that more solvent insurers are able to charge higher prices. This implies that policyholders are willing to pay a higher price for an insurance contract from a better capitalized (and hence safer) insurance company. Fourth, the extent to which the insurance company reinsures its activities is included ($Reinsurance_{i,t}$), defined as the share of total premiums that is being reinsured. Altough we define our returns variable net of reinsurance activities[17], reinsurance use might act as a proxy for the risk appetite of a particular insurer at a certain point in time. We therefore expect a negative coefficient on risk. Lastly, we include an insurer-specific variable that measures the weighted average concentration in the markets the insurer is active in ($Concentration_{i,t}$). That is, as a first step we calculate for each line of business b the concentration measure (based on Hirschmann-Herfindahl Index), and as a second step we calculate a weighted insurer-specific measure where the weights are determined by the insurer's activities is in each business line. The measure lies between zero and one, whereas the higher the value of this variable, the more concentrated the markets the insurer is active in and the higher the competitive pressure the insurer faces. We therefore expect a negative coefficient of this variable on an insurer's return. With the inclusion of insurer fixed effects, we cannot include any insurer-specific time-invariant variables, such as dummy variables that indicate whether the insurer belongs to a group or whether the insurer is listed on the stock exchange. This information is however captured by the inclusion of insurer fixed effects.

As mentioned before, the extent to which an insurer is diversified is found to be related to its risk profile (Campa and Kedia, 2002; Che and Liebenberg, 2017). An insurer's decision to diversify may depend on its performance and this implies that the relation between diversification and risk may be endogenous. We therefore use both an Ordinary Least Squares (OLS) and an Instrumental Variable (IV) approach to analyze the impact of diversification on an insurer's risk-return profile according to the specification given by equation (2). To construct a valid instrument for our diversification variable, we use the predicted values of the estimated shares per business line[18] obtained from estimating equation (1) to calculate an exogenous HHI-measure according to equation (3). We then use this predicted HHI-measure

[17] We define return as net written premiums minus net written claims minus operating expenses, hence both for premiums and claims the reinsured part is not taken into account. See Table A1 in the appendix for the definition of all variables used in our empirical analysis.

[18] We use the results from Table 2, column 3 to derive the estimates.

as an instrument to be inserted in the first stage of our IV-estimation of the baseline specification given by equation (2).

Table 3 shows the descriptive statistics for the variables that are used in this analysis. It shows that the average return equals 3.1%, but the relative high standard deviation indicates large dispersion among insurers and over years. The same holds for the other dependent variables: both the risk variable – as measured by the volatility in return– and the risk-adjusted return vary significantly. Table A.2 in the appendix shows the within and between standard deviation as well as the average per year for all regression variables. The table shows that for most of the variables (except the risk-adjusted return) the between variation is higher than the within variation, implying that the variation among insurance undertakings is higher than the variation among years. Table A.2 also shows that the leverage ratio – defined as the total own funds over total assets – increased over the period under consideration; insurance companies became better capitalized.

Regarding the main independent variables, Table 3 shows that the median HHI is zero; a diversification measure of zero indicates no diversification across business lines. This means that at least 50 percent of all insurers in our sample are so-called ‘single-line’ insurers. This observation is in line with Figure 1. On average, however, the diversification index equals 0.268, and varies quite a bit as shown by the standard deviation and percentile statistics.

Regarding the other independent, or control, variables, Table 3 shows that Dutch P&L insurers are not very active across borders. On average, insurers underwrite only 4.0% of their premiums outside the Netherlands. And the median of zero implies that less than half of the insurers are active internationally. Actually only a few insurers actually conduct foreign business. The sample shows quite some variation in the size and leverage, as shown by the numbers in table 3. The table also shows that insurers reinsure on average 19.2% of their premiums, but this number again varies over insurers.

Table 3: Descriptive statistics

This table shows descriptive statistics for the variables used in our analysis, for all 123 insurers over the years 2007-2018. Variables are defined in Appendix Table A.1.

	Mean	**Median**	**10%**	**90%**	**St.Dev.**
Dependent variables					
Return	3.089	2.489	-3.631	10.021	6.477
Risk	3.108	2.204	0.617	6.345	3.335
RAR	2.027	1.046	-1.452	6.186	6.713
Independent variables					
HHI	0.268	0.000	0.000	0.778	0.335
Foreign	0.040	0.000	0.000	0.080	0.145
Ln size	10.862	10.332	8.428	14.007	2.144
Leverage	0.465	0.462	0.157	0.767	0.233
Reinsurance use	0.192	0.134	0.000	0.514	0.209
Concentration	0.888	0.902	0.861	0.939	0.096

Table 4 shows the average risk, return and risk-adjusted return for different subgroups, based on either their diversification profile or their size. Specifically, we divide insurance companies into two groups, based on whether their HHI or total assets are below or above the sample median. The first two rows of table 4 show that more diversified insurers have a i) lower return; ii) lower risk; and iii) lower risk-adjusted return. This suggests that diversification will not be beneficial for insurers' return, but has the potential to lower insurers' risk. However, since the risk-adjusted return is also lower, there is an indication that the total impact of diversification is negative. The lower part of table 4 moreover shows that the return, risk, and risk-adjusted return also vary by the size of the insurers. Generally, larger insurance companies have a i) lower return; ii) lower risk; and iii) higher risk-adjusted return.

Table 4: Descriptive statistics by subgroup

This table shows descriptive statistics for the variables used in our analysis, for all 123 insurers over the years 2007-2018.

	Return	**Risk**	**RAR**
Diversification (based on HHI)			
Low	3.636	3.713	2.198
High	2.477	2.432	1.837
Size			
Small	3.412	3.976	1.691
Large	2.771	2.258	2.357

The correlations between the variables used in this model are shown in Table 5. We do not observe correlations higher than 0.7 and hence autocorrelation does not seem to be an important issue. The highest correlation observed is the one between size and leverage; its value is -0.671 indicating that larger insurers tend to hold less capital (in relative terms). We further observe a correlation of 0.600 between size and diversification (HHI), indicating that larger insurance companies tend to be more diversified. Larger insurance companies may have more resources and knowledge to be active in multiple business lines. This may however also imply that the relationship between diversification and performance may be influenced by the size of an undertaking. We test for this in our analysis by conducting a split sample approach; i.e. we run the estimations for subsamples based on the size of insurance undertakings.

Table 5: Correlation matrix

This table shows the sample correlations between the main variables used in our empirical model.

	Return	Risk	RAR	HHI	Foreign	Ln size	Leverage	Reinsur.	Acquis.
Return	1.000								
Risk	0.157	1.000							
RAR	0.396	-0.143	1.000						
HHI	-0.113	-0.218	-0.049	1.000					
Foreign	0.061	0.181	-0.040	-0.002	1.000				
Ln size	-0.082	-0.277	0.007	0.601	0.125	1.000			
Leverage	0.108	0.104	0.051	-0.416	-0.054	-0.651	1.000		
Reinsurance	-0.085	-0.032	-0.063	-0.102	0.077	-0.305	0.264	1.000	
Concentration	0.025	0.036	0.051	0.097	-0.388	-0.179	0.062	-0.123	1.000

4.3 Results

Table 6 shows the results from equation (2) when the insurer's return is taken as the dependent variable. Columns (1) and (2) show the baseline results for all insurers in our sample. The negative and significant coefficients imply that a higher level of diversification is associated with significantly lower returns, as shown by both the OLS (column 1) and IV (column 2) results. Given the complexity of the HHI-measure when interpreting the results, we use a numerical example to discuss the economic interpretation of our results. Specifically, we evaluate the impact of product diversification on return for an insurer with 2.20% return on assets (the median return in our sample). The coefficient of -8.818 in the first column of Table 6 suggests (all else equal) that an insurer with a return of 2.20% and identical market shares of 20% in 5 lines of business (inversed HHI of 0.80) will be confronted with a decrease in return of approximately 13% in response to an expansion of its business to a sixth line of business (such that the HHI-measure increases to 0.83).

Turning to the control variables, first of all a positive and significant coefficient for the share of foreign activities can be observed. While the expected relation between foreign activities and performance is negative (given potential higher monitoring costs), the results in both column (1) and (2) show that a high share of foreign activities is associated with significantly higher returns. This finding contradicts the previous findings by Elango et al. (2008) and Liebenberg and Sommer (2008), i.e. that geographical diversification is associated with lower returns. While the coefficients the other control variables show the expected sign (except for size), they are not statistically significant. Regarding the IV results in column (2), the F-statistic is relatively low in absolute terms, but it is significant at 10%-level, as indicated by the accompanying p-value.

Column (3) and (4) show the results where we test for the existence of a non-linear effect of diversification on performance by including a squared term of the diversification index, HHI. The OLS results in column (3) indicate that while diversification is generally associated with lower returns, for high levels of diversification the negative relationship between diversification and return becomes less negative. Or, in other words, the impact of diversification on return is negative until a certain (high) level of diversification is reached. This finding is in line with Elango et al. (2008). This result is however not confirmed by the IV estimations in column (4). The coefficients for the control variables are similar, except for the coefficient for the size. This coefficient now enters the specification significantly negative. This implies that – contrary to our expectations of economies of scale – the larger an insurer, the lower its returns (all else equal).

As mentioned before, the relationship between performance and diversification may be influenced by the size of the insurer. More specifically, pursuing a diversification strategy may come at a cost; exploring new markets, setting up a business and acquiring knowledge in these new markets. From a theoretical point of view, one may argue that larger insurance companies may have more capabilities, e.g. in-house knowledge of their brand, to successfully diversify among or set up multiple lines of business. We thus also exploit interactions between size and diversification to delve deeper into their combined relationship with the performance of an insurer. We conduct a spilt sample analysis. Columns (5) and (6) show the estimation results for small insurers, while columns (7) and (8) show these results for a subsample of large insurers. The classification small versus large is made on the basis of the median size of the insurers in our sample. The results for smaller insurance companies – columns (5) and (6) – are in line with the baseline results in column (1) and (2). That is; a higher level of diversification is associated with lower returns, and the IV estimation in column (6) even suggests a causal relationship; a higher level of diversification leads to lower returns. This thus implies that smaller companies will benefit from specialization, instead of diversification, when it comes to the return. This does not apply to the subsample consisting of larger insurance companies. The coefficients for the diversification variable in columns (7) and (8) turn out to be insignificant. Hence, the results suggest no relation between diversification and return for larger insurers. The coefficients of the control variables size, leverage and concentration now appear to have a significant relation with an insurer's return. Larger insurers and insurers with more capital (leverage) experience lower returns, all else equal. The negative coefficient for concentration is in line with our expectations and this implies that the higher the concentration in the business lines the insurer is active in (i.e. higher competitiveness), the lower its return.

Columns (9)-(12) show the results for the different subsamples based on the size of the companies, including the interaction with a squared diversification term. While the results for the subsample of smaller companies – columns (9) and (10) – are not providing any significant evidence of a non-linear relation between diversification and return, the results in column (11) do. The results in this column indicate that diversification generally decreases an insurer's return, but the negative impact of diversification decreases with the extent of diversification.

For all specifications, the bottom part of the table shows the summarized first stage results (i.e. the F-stat), while table A.3 in the appendix shows the complete first stage estimations. While the F-stat is generally low, it is significant as shown by the accompanied p-value.

Table 6: Relationship diversification and return

This table shows the baseline regression results from equation (2) over the period 2007-2018. The dependent variable is an insurer *i*'s return on assets at time *t*. Variables are defined in Appendix Table A.1. Robust standard errors are included, and reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively. First stage results for the IV-regressions are given in Appendix Table A.3. (reference to column(s) is provided in the last row below).

	Baseline		**Squared**		**Small insurers**		**Large insurers**		**Small insurers - Squared**		**Large insurers – Squared**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
$HHI_{i,t-1}$	-8.818***	-24.61*	-34.80***	-84.25	-12.84***	-15.56***	0.740	-55.23	-21.63	-34.29	-77.83**	-159.7
	(3.273)	(14.64)	(8.822)	(77.04)	(4.342)	(5.103)	(6.358)	(72.91)	(16.15)	(23.56)	(35.55)	(174.7)
$HHI_{i,t-1}^2$			31.31***	89.44					12.48	28.62	70.23**	143.5
			(11.11)	(98.83)					(25.53)	(40.92)	(31.70)	(157.3)
$Foreign_{i,t-1}$	6.071***	6.380***	5.754**	5.188**	12.40***	12.36***	1.738	3.577	12.33***	12.22***	1.577	1.407
	(2.193)	(2.233)	(2.217)	(2.519)	(3.485)	(3.482)	(1.251)	(3.723)	(3.500)	(3.490)	(1.038)	(1.289)
Ln $size_{t-1}$	-1.501	-1.417	-1.569	-1.688*	-0.716	-0.690	-2.054**	-1.977	-0.716	-0.706	-2.343***	-2.643**
	(0.984)	(1.015)	(0.948)	(0.991)	(1.865)	(1.869)	(0.859)	(1.333)	(1.871)	(1.896)	(0.846)	(1.085)
$Leverage_{i,t-1}$	1.578	0.895	2.341	3.703	8.554	8.286	-6.524**	-7.457**	8.875	9.163	-4.917*	-3.241
	(3.327)	(3.323)	(3.279)	(4.167)	(6.410)	(6.354)	(2.629)	(3.653)	(6.620)	(6.946)	(2.604)	(4.869)
$Reinsurance_{i,t-1}$	-0.354	0.167	-0.375	-0.372	-2.763	-2.681	3.711	6.198	-2.722	-2.631	3.432	3.140
	(1.672)	(1.604)	(1.602)	(1.512)	(2.183)	(2.165)	(2.794)	(4.953)	(2.189)	(2.182)	(2.720)	(2.747)
$Concentration_{i,t-1}$	-22.59	-22.65	-19.51	-13.80	-8.917	-8.367	-32.75	-38.58*	-7.282	-4.904	-31.88*	-30.97**
	(15.84)	(15.92)	(15.89)	(16.76)	(23.03)	(23.34)	(21.74)	(23.35)	(23.50)	(25.20)	(16.88)	(12.99)
# Obs.	963	963	963	963	456	456	507	507	456	456	507	507
R^2	0.096		0.104		0.104		0.228		0.104		0.251	
R^2 adj.	0.081		0.088		0.071		0.203		0.070		0.225	
F-stat first st. (1)		1.669*		2.521**		9.302***		1.976**		82.66***		3.699***
F-stat first st. (2)				4.636***						26.17***		9.027***
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Method	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
First st. results (col. reference)		(1)		(2)-(3)		(4)		(5)		(6)-(7)		(8)-(9)

Table 7 shows the results in case insurers' risk is taken as the dependent variable. The baseline results (columns 1 and 2) show that diversification is generally associated with lower risk. In other words; by diversifying across different lines of business insurance companies can reduce the volatility in their returns. The coefficient of -4.198 in the first column of Table 7 suggests (all else equal) that an insurer with a risk of 2.204 and identical market shares of 20% in 5 lines of business (inversed HHI of 0.80) will be confronted with a decrease in return of approximately 6% in response to an expansion of its business to a sixth line of business (such that the HHI-measure increases to 0.83).

The coefficients for size and reinsurance share both show significantly negative coefficients, implying that – in line with our expectations - larger insurers and insurers that reinsure a larger share of their business enjoy lower risk. These two control variables show significantly negative coefficients for almost all specifications, except the ones based on a subsample of large insurers.

The remaining results in columns (3)-(12) in table 7 are in line with the ones in table 6 (return). That is – in a nutshell – i) there is evidence of a non-linear effect of diversification on performance, that is not confirmed by the IV estimations (columns 3-4); ii) the impact of diversification is mostly pronounced for small insurance companies; they benefit from diversification in terms of risk reduction (columns 5-8); iii) the non-linear effect of diversification can only be found for a subsample of large insurers (columns 9-12).

Table 8 shows the estimation results with the risk-adjusted return as the dependent variable. The diversification variable is insignificant for all specifications, except for the specification in column (6); the IV results for a subsample of small insurers. These results suggest that diversification has a negative impact on the risk-adjusted return. While the previous tables showed that small insurers benefit from diversification by a lower risk, but will be confronted with a lower return table 8 suggests that the negative impact on return outperforms any risk-reduction benefit.

4.4. Robustness checks

We conduct three types of robustness checks. First of all and as shown previously (Figure 1), around half of the insurance companies in our sample are the so-called 'mono-line insurers', i.e. insurers that are active in only one line of business. These insurance companies do thus not add a lot to the variety in the diversification measure since their diversification measure is equal to one. We therefore test for the robustness of our results by running the same estimations for multiline insurers only. Tables A.4 – A.6 in the appendix show these results. The results are in line with the results in tables 6-8, except that the (squared) diversification measure is no longer significant in columns (11) and (12) in table A.5. That is, there is no longer evidence of a non-linear relationship between diversification and risk for a subsample of large insurance companies.

Second, we also test for robustness in the measurement of our risk (and risk-adjusted return) dependent variable. In the default specifications, we measure risk by the 3-year standard deviation in returns. For robustness, we run the same regressions by using a risk measure that is based on the 5-year standard deviation in returns. Tables A.7-A.8 show that these regressions yield similar results, and our dependent variable is thus robust against different definitions of risk and risk-adjusted return.

Third, instead of first predicting insurers' activities per business line (section 3), and using these predictions for the calculation of a diversification measure that we use as instrument, we instrument the diversification measure in the IV-estimation directly (i.e. following Liebenberg and Sommer, 2008). Table A.9 in the appendix shows the results for selected specifications. Contrary to the default estimations, the (instrumented) diversification measure is insignificant in all specifications. The first-stage result moreover indicate that the results may suffer from weak instrumental bias, as indicated by the low F-statistics that are moreover not statistically significant. These results thus also show the difficulties with finding an appropriate instrument. By first estimating insurers' activities per business line we can better exploit the richness of the data, and this results in a better instrument in our default model (on the basis of the F-statistic in the first stage regressions).

Table 7: Relationship diversification and risk

This table shows the baseline regression results from equation (2) over the period 2007-2018. The dependent variable is an insurer *i*'s risk (measured by its volatility in returns) at time *t*. Robust standard errors are included, and reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	Baseline		**Squared**		**Small insurers**		**Large insurers**		**Small insurers - Squared**		**Large insurers – Squared**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
$HHI_{i,t-1}$	-4.198***	-9.978***	-13.57***	-13.53	-5.451***	-7.802***	0.0618	-22.07	-4.816	-1.832	-24.85*	-53.76*
	(1.520)	(3.456)	(3.914)	(13.26)	(1.256)	(2.293)	(2.405)	(16.78)	(5.316)	(9.912)	(14.31)	(32.35)
$HHI_{i,t-1}^2$			11.30**	5.329					-0.901	-9.121	22.27*	43.50
			(5.105)	(18.18)					(8.381)	(16.45)	(13.27)	(29.49)
$Foreign_{i,t-1}$	1.886	1.999	1.771	1.928	5.899	5.870	-0.492	0.235	5.904	5.915	-0.543	-0.423
	(2.137)	(2.126)	(2.166)	(2.175)	(5.301)	(5.304)	(0.545)	(1.219)	(5.306)	(5.316)	(0.565)	(0.831)
Ln $size_{t-1}$	-1.302***	-1.271***	-1.327***	-1.287***	-2.356***	-2.334***	-0.451	-0.420	-2.356***	-2.330***	-0.542	-0.622
	(0.459)	(0.476)	(0.453)	(0.462)	(0.745)	(0.749)	(0.588)	(0.664)	(0.747)	(0.755)	(0.587)	(0.599)
$Leverage_{i,t-1}$	-1.913	-2.163	-1.638	-1.996	-2.946	-3.178	-0.105	-0.475	-2.969	-3.457	0.404	0.804
	(1.566)	(1.597)	(1.579)	(1.714)	(2.742)	(2.769)	(1.827)	(2.012)	(2.777)	(2.911)	(1.885)	(2.023)
$Reinsurance_{i,t-1}$	-2.124**	-1.934**	-2.132**	-1.966**	-2.116*	-2.045*	-1.331	-0.347	-2.119*	-2.061*	-1.419	-1.274
	(0.923)	(0.950)	(0.929)	(0.949)	(1.204)	(1.220)	(1.430)	(1.725)	(1.207)	(1.224)	(1.428)	(1.398)
$Concentration_{i,t-1}$	7.568	7.546	8.679	8.073	-7.907	-7.432	12.13	9.824	-8.026	-8.535	12.41	12.13
	(7.075)	(6.895)	(6.848)	(6.886)	(10.53)	(10.47)	(10.14)	(10.16)	(10.68)	(10.84)	(9.114)	(8.723)
# Obs.	963	963	963	963	456	456	507	507	456	456	507	507
R^2	0.060		0.063		0.103		0.046		0.103		0.053	
R^2 adj.	0.044		0.047		0.070		0.015		0.068		0.021	
F-stat first st. (1)		1.669*		2.521**		9.302***		1.976**		82.66***		3.699***
F-stat first st. (2)				4.636***						26.17***		9.027***
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Method	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV

Table 8: Relationship diversification and risk-adjusted return

This table shows the baseline regression results from equation (2) over the period 2007-2018. The dependent variable is an insurer *i*'s return at time *t*. Robust standard errors are included, and reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively.

	Baseline		**Squared**		**Small insurers**		**Large insurers**		**Small insurers - Squared**		**Large insurers – Squared**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
$HHI_{i,t-1}$	-10.87	-2.708	9.712	-1.137	-3.273	-3.489**	-29.33	3.618	-16.85	-0.930	-24.96	12.92
	(8.041)	(4.349)	(14.55)	(30.58)	(2.293)	(1.513)	(19.13)	(52.20)	(11.59)	(8.732)	(43.55)	(158.3)
$HHI_{i,t-1}^2$			-24.80	-2.357					19.29	-3.909	-3.902	-12.77
			(22.77)	(41.11)					(16.21)	(14.81)	(30.61)	(148.4)
$Foreign_{i,t-1}$	0.690	0.531	0.942	0.562	-0.587	-0.590	3.700**	2.618	-0.695	-0.571	3.709**	2.811*
	(0.829)	(0.677)	(1.054)	(0.859)	(1.296)	(1.282)	(1.603)	(1.897)	(1.318)	(1.271)	(1.593)	(1.457)
Ln $size_{t-1}$	0.171	0.127	0.224	0.134	1.007	1.009	-0.698	-0.744	1.006	1.011	-0.682	-0.685
	(0.692)	(0.713)	(0.700)	(0.724)	(0.916)	(0.915)	(0.989)	(0.910)	(0.914)	(0.920)	(0.985)	(1.111)
$Leverage_{i,t-1}$	-1.461	-1.108	-2.065	-1.182	2.511	2.490	-8.650***	-8.100**	3.008	2.370	-8.739***	-8.476*
	(2.120)	(2.144)	(2.257)	(2.448)	(2.519)	(2.482)	(2.738)	(3.187)	(2.971)	(2.579)	(2.863)	(4.356)
$Reinsurance_{i,t-1}$	-1.948	-2.217	-1.931	-2.203	-2.770*	-2.764*	2.536	1.072	-2.708*	-2.771*	2.551	1.344
	(1.319)	(1.357)	(1.365)	(1.402)	(1.641)	(1.660)	(3.221)	(3.549)	(1.605)	(1.674)	(3.200)	(3.526)
$Concentration_{i,t-1}$	3.310	3.341	0.871	3.108	6.552	6.595	3.632	7.064	9.078	6.122	3.584	6.386
	(8.755)	(8.956)	(7.925)	(9.858)	(17.32)	(17.11)	(7.740)	(11.84)	(19.32)	(16.70)	(7.615)	(11.32)
# Obs.	963	963	963	963	456	456	507	507	456	456	507	507
R^2	0.041		0.045		0.031		0.091		0.035		0.091	
R^2 adj.	0.025		0.027		-0.004		0.061		-0.003		0.059	
F-stat first st. (1)		1.669*		2.521**		9.302***		1.976**		82.66***		3.699***
F-stat first st. (2)				4.636***						26.17***		9.027***
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Method	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
First st. results (col. reference)		(1)		(2)-(3)		(4)		(5)		(6)-(7)		(8)-(9)

Table 9: Relationship diversification and performance: listed versus unlisted insurance companies

This table shows the baseline regression results from equation (2) over the period 2007-2018, distinguishing between insurance companies that are part of a listed insurer and those that are not. The dependent variable is an insurer *i*'s, return, risk or risk-adjusted return (as indicated in the first row below) at time *t*. Robust standard errors are included, and reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively. Variables are defined in Appendix Table A.1.

	Return				**Risk**				**Risk-adjusted return**			
	Listed	**Non-listed**	**Listed**	**Non-listed**	**Listed**	**Non-listed**	**Listed**	**Non-listed**	**Listed**	**Non-listed**	**Listed**	**Non-listed**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
$HHI_{i,t-1}$	-2.850	-8.685**	43.33	-26.34*	-13.87**	-3.713**	-10.81	-9.207***	-1.955	-11.51	-181.3	-3.706
	(5.551)	(3.407)	(72.88)	(15.83)	(4.640)	(1.668)	(18.96)	(3.162)	(11.93)	(8.382)	(358.5)	(4.432)
$Foreign_{i,t-1}$	2.810*	6.575**	-4.168	6.286**	1.082*	2.570	0.619	2.480	1.181	-0.0678	28.28	0.0601
	(1.418)	(2.986)	(10.66)	(2.975)	(0.554)	(2.884)	(2.851)	(2.883)	(2.321)	(0.796)	(55.43)	(0.800)
Ln $size_{t-1}$	0.197	-1.501	0.382	-1.446	0.708	-1.320***	0.720	-1.302***	-2.127	0.0981	-2.846	0.0738
	(1.791)	(1.021)	(2.656)	(1.051)	(0.721)	(0.485)	(0.831)	(0.502)	(3.071)	(0.720)	(11.10)	(0.735)
$Leverage_{i,t-1}$	8.275*	1.388	9.283	0.479	-1.228	-1.680	-1.161	-1.963	-9.842	-1.966	-13.76	-1.564
	(4.106)	(3.671)	(5.691)	(3.672)	(1.239)	(1.731)	(1.581)	(1.754)	(13.97)	(2.301)	(34.13)	(2.317)
$Reinsurance_{i,t-1}$	16.98	-0.624	16.19**	0.0204	4.107	-2.202**	4.055	-2.002**	-11.79	-1.737	-8.733	-2.021
	(9.016)	(1.692)	(7.876)	(1.610)	(3.662)	(0.959)	(3.888)	(0.980)	(22.60)	(1.302)	(28.48)	(1.329)
$Concentration_{i,t-1}$	-70.90	-22.55	-82.02	-22.05	109.4***	6.654	108.7***	6.810	2.568	5.673	45.75	5.452
	(115.6)	(16.02)	(118.6)	(15.97)	(25.42)	(7.164)	(24.77)	(6.964)	(126.6)	(9.225)	(352.3)	(9.335)
# Obs.	80	883	80	883	80	883	80	883	80	883	80	883
R^2	0.379	0.094			0.257	0.062			0.196	0.041		
R^2 adj.	0.221	0.0769			0.0677	0.0446			-0.00861	0.0235		
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Method	OLS	OLS	IV	IV	OLS	OLS	IV	IV	OLS	OLS	IV	IV

5. Conclusion

One potential way for insurance companies to improve performance in highly competitive markets is product diversification, i.e. by being active in multiple lines of business an insurance company may benefit from economies of scope. In our study, we have investigated the drivers and impact of product diversification for Dutch P&L insurers.

Our investigation into the drivers of diversification suggests that the activities of insurers in specific business lines can be explained by the age of the insurer, the attractiveness of the business line to single-line insurers, the relative market share of the business line and mergers and acquisitions in the P&L insurance industry.

Our baseline results – both OLS and IV - show that product diversification decreases an insurer's risk as well as its return, while it has no significant impact on its risk-adjusted return. Digging a bit deeper into the relation between diversification and performance by taking into account non-lineairities and considering subsamples based on the size of insurance companies, our results show that the impact of diversification is contingent upon an insurer's size and its extent of diversification. First of all, we find evidence of a non-linear effect of diversification on performance, i.e. diversification is generally negatively related to both risk and return, but the negative coefficient decreases with the extent of diversification. This result is however not confirmed by the IV estimations. Second, the impact of diversification seems limited to small and non-listed insurance companies; they benefit from diversification in terms of risk reduction, but also experience lower returns. These results are not confirmed by a subsample of large insurers.

In sum, the relation between diversification and performance is not straightforward and this may explain the mixed findings in the literature so far. This has some important policy implications. Product diversification, or line of business diversification, is explicitly taken into account in the EU regulatory framework. Solvency II allows for the risk-reducing impact of diversification in the calculation of the Solvency Capital Requirement (SCR).[22] While this is in line with our general findings (i.e. risk-reducing impact of diversification), it does ignore any non-linearities as well as dependence with the size of institutions that we find to exist.

[22] See Solvency II Delegated Acts (EU, 2015).

6. References

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7. Appendix

Table A.1. Definition of variables

$Premiums_{i,b,t}$	gross written premiums by insurer *i*, in business line *b* at time *t*
$Premiums_{i,t}$	the total written premiums by insurer *i* at time *t*
$AGE_{i,t}$	the age of insurer *i* in year *t*
$SINGLE_{b,t}$	index that captures the attractiveness of a business line for single-line insurers
$RELSIZE_{b,t}$	share of business line *b* in the total P&L insurance market
$R_{i,t}$ (1)	Return
$R_{i,t}$ (2)	Risk
$R_{i,t}$ (3)	Risk-adjusted return
$HHI_{i,t1}$	1 minus the sum of insurer i's squared market shares in different lines of business, where market shares are defined on the basis of gross written premiums.
$Foreign_{i,t}$	share of insurers' foreign activities, i.e. insurers'activities outside the Netherlands.
$\ln(Size_{i,t})$	natural logarithm of total assets
$Leverage_{i,t}$	own funds over total assets, where own funds = excess of assets over liabilities
$Reinsurance_{i,t}$	share of total premiums that is being reinsured
$Acquisition_{i,t}$	dummy equal to 1 for the acquiring insurer in the year after the acquisition or merger.

Table A.2: Descriptive statistics by year

This table shows the descriptive statistics by year as well as the within and between standard deviation for each of the variables used in our analysis on the impact of diversification. Variables are defined in Appendix Table A.1.

	Return	**Risk**	**RAR**	**HHI**	**Foreign**	**lnSize**	**Leverage**	**Reins.**	**Wconc**
St. Dev. Between	5.187	2.384	3.459	0.324	0.133	2.114	0.219	0.188	0.927
St. Dev. Within	4.420	2.379	5.632	0.045	0.084	0.293	0.072	0.091	0.923
				Averages by year					
2007				0.275	0.052	10.678	0.442	0.203	0.908
2008	4.907	4.519	3.264	0.260	0.049	10.550	0.426	0.195	0.904
2009	4.035	4.758	1.428	0.250	0.034	10.591	0.443	0.195	0.901
2010	3.681	4.371	2.264	0.248	0.034	10.613	0.449	0.197	0.899
2011	3.027	3.250	2.685	0.243	0.025	10.688	0.458	0.196	0.870
2012	2.903	2.881	1.569	0.265	0.028	10.875	0.455	0.214	0.886
2013	2.038	2.983	1.379	0.279	0.025	10.962	0.452	0.210	0.886
2014	1.684	2.801	2.102	0.284	0.035	11.022	0.484	0.211	0.877
2015	1.630	2.907	2.847	0.283	0.048	11.186	0.502	0.203	0.877
2016	2.735	2.447	1.149	0.288	0.044	11.229	0.512	0.141	0.876
2017	4.209	2.449	1.722	0.290	0.071	11.316	0.521	0.150	0.876
2018	2.267	2.404	1.306	0.285	0.051	11.341	0.516	0.149	0.872

Table A.3: First-stage regression results (IV estimation)

This table shows the first-stage regression results from estimating equation (2), using fixed effects instrumental variable techniques, over the period 2007-2018. The dependent variable is listed above each column. Robust standard errors are included, and reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively. Variables are defined in Appendix Table A.1.

	Baseline All	**Squared All**	**Squared All**	**Baseline Small**	**Baseline Large**	**Squared Small**	**Squared Small**	**Squared Large**	**Squared Large**
	$HHI_{i,t-1}$	$HHI_{i,t-1}$	$HHI_{i,t-1}^2$	$HHI_{i,t-1}$	$HHI_{i,t-1}$	$HHI_{i,t-1}$	$HHI_{i,t-1}^2$	$HHI_{i,t-1}$	$HHI_{i,t-1}^2$
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(9)**	**(9)**
Predicted $HHI_{i,t-1}$	0.478**	-0.358	-0.414***	1.069***	0.0987**	0.500**	-0.00647	-0.395**	-0.395**
	(0.237)	(0.257)	(0.125)	(0.224)	(0.0417)	(0.190)	(0.182)	(0.173)	(0.173)
Predicted $HHI_{i,t-1}^2$		1.354***	1.185***			0.688**	0.854***	1.070**	1.070**
		(0.402)	(0.232)			(0.328)	(0.285)	(0.409)	(0.409)
$Foreign_{i,t-1}$	0.00202	-0.0326	-0.0156	0.00646	0.0244	0.00547	0.00795	-0.0323	-0.0323
	(0.0167)	(0.0300)	(0.0167)	(0.0313)	(0.0354)	(0.0296)	(0.0150)	(0.0394)	(0.0394)
Ln $size_{t-1}$	-0.00106	-0.00716	-0.00302	-0.00418	0.000684	-0.00607	-0.00456	-0.00313	-0.00313
	(0.0104)	(0.0105)	(0.0113)	(0.00704)	(0.0151)	(0.00738)	(0.00616)	(0.0154)	(0.0154)
$Leverage_{i,t-1}$	-0.0554	-0.0415	-0.0561*	-0.0612	-0.0214	-0.0421	-0.0470	-0.0264	-0.0264
	(0.0380)	(0.0318)	(0.0301)	(0.0497)	(0.0424)	(0.0518)	(0.0517)	(0.0431)	(0.0431)
$Reinsurance_{i,t-1}$	0.0371*	0.0368**	0.0305**	0.0214	0.0511*	0.0277	0.0200	0.0504*	0.0504*
	(0.0191)	(0.0172)	(0.0129)	(0.0201)	(0.0288)	(0.0191)	(0.0127)	(0.0301)	(0.0301)
$Concentration_{i,t-1}$	-0.149	-0.0457	-0.108	0.370	-0.173	0.347	0.0924	-0.204	-0.204
	(0.247)	(0.208)	(0.147)	(0.388)	(0.227)	(0.392)	(0.198)	(0.225)	(0.225)
# Obs.	963	963	963	456	507	456	456	507	507
R^2	0.254	0.445	0.352	0.681	0.056	0.710	0.634	0.157	0.157
F-statistic	1.669*	2.521**	4.636***	9.302***	1.976**	82.66***	26.17***	3.699***	3.699***
p-value F	0.0616	0.0019	0.0000	0.0000	0.0300	0.0000	0.0000	0.0001	0.0001
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table A.4: Relationship diversification and return (Multiline insurers)

This table shows the baseline regression results from equation (2) over the period 2007-2018 for non-life insurers that are active in more than one lines of business (multiline). The dependent variable is an insurer *i*'s return at time *t*. Robust standard errors are included, and reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively. Variables are defined in Appendix Table A.1.

	Baseline		**Squared**		**Small insurers**		**Large insurers**		**Small insurers - Squared**		**Large insurers – Squared**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
$HHI_{i,t-1}$	-8.025***	-12.27***	-34.14***	-48.17	-14.01***	-14.95***	2.452	11.24	-22.13	-4.873	-51.80**	65.82
	(2.773)	(3.481)	(9.950)	(30.71)	(4.105)	(4.359)	(4.325)	(10.01)	(23.11)	(54.37)	(22.28)	(159.9)
$HHI_{i,t-1}^2$			30.64**	49.78					11.05	-14.52	47.87**	-52.75
			(11.55)	(42.11)					(29.73)	(82.65)	(21.10)	(149.3)
$Foreign_{i,t-1}$	0.663	0.804	0.188	-0.184	-0.375	-0.411	1.653	1.350	-0.00834	-0.916	1.385	1.825
	(2.227)	(2.319)	(1.999)	(1.687)	(13.63)	(13.56)	(1.488)	(1.415)	(12.98)	(13.31)	(1.327)	(2.400)
Ln $size_{t-1}$	1.013	1.055	1.004	0.975	5.809	5.834	-0.488	-0.510	5.935	5.685	-0.672	-0.295
	(1.483)	(1.499)	(1.448)	(1.486)	(6.640)	(6.633)	(0.796)	(0.787)	(6.696)	(5.998)	(0.761)	(1.110)
$Leverage_{i,t-1}$	6.011	5.730	7.262*	8.196*	13.30	13.04	-2.059	-1.822	14.13	11.79	-0.722	-3.435
	(4.427)	(4.334)	(4.288)	(4.194)	(10.76)	(10.04)	(3.043)	(2.934)	(11.88)	(11.65)	(2.887)	(6.083)
$Reinsurance_{i,t-1}$	3.931	4.643	3.659	3.104	-5.947	-5.682	6.201	5.211	-5.749	-5.774	5.873	6.158
	(7.040)	(6.835)	(6.397)	(6.428)	(19.92)	(20.13)	(4.856)	(4.095)	(19.94)	(20.59)	(4.692)	(6.290)
$Concentration_{i,t-1}$	3.952	3.554	14.29	20.96	-8.519	-7.649	-3.910	4.649	-3.226	-14.05	-15.55	12.41
	(14.70)	(14.40)	(16.13)	(24.44)	(30.21)	(28.34)	(29.30)	(41.40)	(29.46)	(57.54)	(23.26)	(60.66)
# Obs.	450	450	450	450	123	123	327	327	123	123	327	327
R^2	0.168		0.188		0.201		0.326		0.202		0.347	
R^2 adj.	0.137		0.156		0.080		0.291		0.072		0.311	
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Method	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV

Table A.5: Relationship diversification and risk (Multiline insurers)

This table shows the baseline regression results from equation (2) over the period 2007-2018 for non-life insurers that are active in more than one lines of business (multiline). The dependent variable is an insurer *i*'s risk (measured by its volatility in returns) at time *t*. Robust standard errors are included, and reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively. Variables are defined in Appendix Table A.1.

	Baseline		**Squared**		**Small insurers**		**Large insurers**		**Small insurers - Squared**		**Large insurers – Squared**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
$HHI_{i,t-1}$	-4.012**	-7.507***	-12.63***	-6.789	-4.989**	-7.342***	0.0950	-1.028	3.553	29.70	-16.62	-66.86
	(1.526)	(2.061)	(4.545)	(17.05)	(1.706)	(2.504)	(2.130)	(8.628)	(7.614)	(32.60)	(10.21)	(136.0)
$HHI_{i,t-1}^2$			10.11*	-0.994					-11.62	-53.38	14.75	63.62
			(5.491)	(23.37)					(10.58)	(46.35)	(9.462)	(125.5)
$Foreign_{i,t-1}$	-0.517	-0.401	-0.674	-0.381	2.360	2.270	-1.184**	-1.145*	1.974	0.414	-1.266**	-1.717
	(0.611)	(0.630)	(0.633)	(0.828)	(4.077)	(4.272)	(0.500)	(0.623)	(4.150)	(5.260)	(0.530)	(1.492)
Ln $size_{t-1}$	-1.286**	-1.251**	-1.289**	-1.249**	-4.123**	-4.059**	-0.682*	-0.679*	-4.255**	-4.609**	-0.739**	-0.939
	(0.530)	(0.551)	(0.523)	(0.552)	(1.482)	(1.619)	(0.362)	(0.369)	(1.481)	(2.075)	(0.361)	(0.601)
$Leverage_{i,t-1}$	-3.584*	-3.815*	-3.170	-3.865	-9.372*	-10.01**	-1.435	-1.465	-10.25**	-14.62**	-1.023	0.480
	(1.885)	(1.947)	(1.910)	(2.364)	(4.522)	(4.721)	(1.584)	(1.548)	(4.229)	(7.371)	(1.639)	(4.225)
$Reinsurance_{i,t-1}$	-1.044	-0.457	-1.134	-0.426	-4.655	-3.989	0.104	0.231	-4.864	-4.328	0.00304	-0.912
	(2.093)	(2.229)	(2.188)	(2.432)	(6.339)	(6.741)	(1.885)	(1.383)	(6.226)	(7.002)	(1.867)	(3.059)
$Concentration_{i,t-1}$	8.515	8.186	11.93	7.839	-1.357	0.821	31.23	30.14	-6.926	-22.73	27.65	20.77
	(11.40)	(9.750)	(11.75)	(13.06)	(10.38)	(10.50)	(21.89)	(23.81)	(12.08)	(27.18)	(21.34)	(33.78)
# Obs.	450	450	450	450	123	123	327	327	123	123	327	327
R^2	0.125		0.135		0.238		0.124		0.244		0.133	
R^2 adj.	0.092		0.101		0.123		0.078		0.122		0.086	
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Method	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV

Table A.6: Relationship diversification and risk-adjusted return (Multiline insurers)

This table shows the baseline regression results from equation (2) over the period 2007-2018 for non-life insurers that are active in more than one lines of business (multiline). The dependent variable is an insurer *i*'s return at time *t*. Robust standard errors are included, and reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively. Variables are defined in Appendix Table A.1.

	Baseline		**Squared**		**Small insurers**		**Large insurers**		**Small insurers - Squared**		**Large insurers – Squared**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
$HHI_{i,t-1}$	-11.06	-2.306	5.795	-3.482	-2.832	-2.952	-29.53	16.15	-32.68*	-27.98	-42.98	310.9
	(8.758)	(2.558)	(18.70)	(50.07)	(1.788)	(1.982)	(20.98)	(42.45)	(17.91)	(32.80)	(57.80)	(845.8)
$HHI_{i,t-1}^2$			-19.77	1.630					40.62	36.06	11.87	-284.8
			(27.46)	(67.36)					(24.64)	(46.95)	(39.75)	(784.1)
$Foreign_{i,t-1}$	0.468	0.178	0.775	0.146	-12.24	-12.24	2.639	1.066	-10.89	-10.99	2.573	3.628
	(2.094)	(1.763)	(2.476)	(2.477)	(10.79)	(10.75)	(2.500)	(1.907)	(11.07)	(10.33)	(2.439)	(7.845)
Ln $size_{t-1}$	1.051	0.963	1.057	0.961	3.967	3.970	0.131	0.0172	4.430	4.342	0.0850	1.180
	(1.175)	(1.186)	(1.233)	(1.193)	(3.676)	(3.665)	(1.256)	(1.033)	(3.497)	(3.619)	(1.237)	(3.740)
$Leverage_{i,t-1}$	3.225	3.806	2.418	3.886	11.70**	11.66**	-2.678	-1.448	14.75*	14.78*	-2.346	-10.15
	(3.437)	(3.228)	(4.051)	(4.877)	(5.468)	(5.437)	(3.666)	(3.840)	(7.277)	(8.262)	(3.711)	(23.57)
$Reinsurance_{i,t-1}$	-4.938	-6.408	-4.762	-6.458	-14.52	-14.49	1.836	-3.314	-13.79	-14.26	1.755	1.800
	(5.886)	(5.895)	(6.227)	(6.936)	(10.09)	(10.35)	(6.589)	(5.627)	(9.221)	(9.912)	(6.504)	(13.77)
$Concentration_{i,t-1}$	25.72	26.55	19.05	27.12	1.089	1.200	-2.135	42.37	20.55	17.11	-5.022	84.30
	(20.34)	(24.64)	(22.29)	(33.19)	(21.42)	(20.18)	(40.07)	(76.17)	(26.98)	(35.77)	(45.46)	(175.4)
# Obs.	450	450	450	450	123	123	327	327	123	123	327	327
R^2	0.060		0.064		0.097		0.100		0.114		0.100	
R^2 adj.	0.026		0.027		-0.039		0.053		-0.029		0.051	
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Method	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV

Table A.7: Relationship diversification and risk (risk measured as 5-year volatility)

This table shows the baseline regression results from equation (2) over the period 2007-2018 using an alternative measure for risk. The dependent variable is an insurer *i*'s risk (measured by its *5-year* volatility in returns) at time *t*. Robust standard errors are included, and reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively. Variables are defined in Appendix Table A.1.

	Baseline		**Squared**		**Small insurers**		**Large insurers**		**Small insurers - Squared**		**Large insurers – Squared**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
$HHI_{i,t-1}$	-5.998***	-8.441***	-9.350***	-11.63**	-7.435***	-8.725***	-1.409	3.637	-0.726	-10.38**	-6.376	-0.0267
	(1.544)	(1.676)	(3.459)	(5.713)	(0.931)	(1.571)	(3.171)	(22.42)	(9.100)	(4.437)	(21.00)	(95.77)
$HHI_{i,t-1}^2$			4.117	4.929					-9.802	2.659	4.061	3.509
			(5.303)	(8.322)					(12.37)	(8.430)	(17.27)	(71.02)
$Foreign_{i,t-1}$	0.598	0.708	0.520	0.577	1.460	1.425	0.191	-0.0731	1.457	1.430	0.200	-0.0984
	(0.421)	(0.460)	(0.424)	(0.471)	(1.829)	(1.862)	(0.468)	(1.301)	(1.843)	(1.857)	(0.464)	(0.887)
Ln $size_{t-1}$	-0.967***	-0.939***	-0.986***	-0.972***	-1.762**	-1.758**	-0.391	-0.466	-1.793**	-1.750**	-0.401	-0.485
	(0.338)	(0.342)	(0.339)	(0.320)	(0.687)	(0.683)	(0.461)	(0.639)	(0.698)	(0.688)	(0.454)	(0.450)
$Leverage_{i,t-1}$	-3.247**	-3.407***	-3.093**	-3.168**	-4.237**	-4.317**	-1.443	-1.015	-4.508**	-4.233**	-1.360	-0.890
	(1.251)	(1.244)	(1.269)	(1.317)	(2.089)	(2.066)	(1.799)	(2.343)	(2.208)	(2.026)	(1.828)	(2.368)
$Reinsurance_{i,t-1}$	-0.0234	0.0668	-0.0241	0.0354	0.329	0.373	-0.784	-1.055	0.295	0.377	-0.781	-1.086
	(0.719)	(0.725)	(0.719)	(0.719)	(0.918)	(0.921)	(1.548)	(1.939)	(0.910)	(0.927)	(1.538)	(1.661)
$Concentration_{i,t-1}$	17.82***	17.97***	18.23***	18.41***	18.33***	18.74***	16.54***	17.11***	16.72**	19.12***	16.34***	17.01**
	(3.741)	(3.523)	(3.674)	(3.556)	(6.740)	(6.549)	(4.524)	(5.892)	(6.934)	(6.594)	(4.424)	(7.362)
# Obs.	723	723	723	723	338	338	385	385	338	338	385	385
R^2	0.101		0.102		0.154		0.074		0.157		0.074	
R^2 adj.	0.0827		0.0825		0.117		0.0390		0.117		0.0365	
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Method	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV

Table A.8: Relationship diversification and risk-adjusted return (using 5-year volatility to measure risk)

This table shows the baseline regression results from equation (2) over the period 2007-2018 using an alternative measure for risk. The dependent variable is an insurer *i*'s risk-adjusted return (where risk is measured by its *5-year* volatility in returns) at time *t*. Robust standard errors are included, and reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively. Variables are defined in Appendix Table A.1.

	Baseline		**Squared**		**Small insurers**		**Large insurers**		**Small insurers - Squared**		**Large insurers – Squared**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
$HHI_{i,t-1}$	-2.736	-1.587	1.183	-6.889	-0.588	-0.499	-11.12**	-29.83	-6.435	-5.025	-31.87	-74.22
	(2.355)	(3.044)	(4.735)	(15.02)	(1.493)	(1.040)	(4.203)	(47.93)	(6.262)	(3.392)	(28.10)	(216.7)
$HHI_{i,t-1}^2$			-4.813	8.206					8.542	7.266	16.97	42.51
			(5.529)	(19.75)					(8.824)	(4.989)	(21.36)	(166.6)
$Foreign_{i,t-1}$	1.682	1.631	1.774*	1.412	-1.193	-1.190	2.518**	3.497	-1.190	-1.176	2.555**	3.191**
	(1.035)	(1.024)	(1.048)	(1.422)	(3.020)	(3.012)	(1.132)	(2.401)	(2.996)	(3.018)	(1.137)	(1.598)
Ln $size_{t-1}$	0.538	0.525	0.561	0.469	0.356	0.355	0.452	0.732	0.382	0.377	0.409	0.510
	(0.392)	(0.374)	(0.401)	(0.455)	(0.517)	(0.517)	(0.464)	(0.815)	(0.520)	(0.520)	(0.435)	(0.595)
$Leverage_{i,t-1}$	-0.0115	0.0634	-0.192	0.461	2.410	2.415	-4.637	-6.222	2.646	2.644	-4.291	-4.712
	(1.812)	(1.759)	(1.916)	(2.146)	(1.531)	(1.520)	(3.386)	(4.726)	(1.716)	(1.608)	(3.244)	(4.217)
$Reinsurance_{i,t-1}$	-1.576	-1.619	-1.576	-1.671*	-2.660**	-2.663**	1.804	2.808	-2.631**	-2.654**	1.817	2.432
	(0.962)	(1.007)	(0.965)	(0.992)	(1.100)	(1.109)	(2.040)	(3.323)	(1.090)	(1.107)	(2.075)	(2.515)
$Concentration_{i,t-1}$	-6.226	-6.297	-6.702	-5.570	-8.502	-8.530	-2.433	-4.539	-7.104	-7.482	-3.255	-5.743
	(7.946)	(7.833)	(7.490)	(7.937)	(11.62)	(11.46)	(8.180)	(8.682)	(12.87)	(12.04)	(7.505)	(11.89)
# Obs.	723	723	723	723	338	338	385	385	338	338	385	385
R^2	0.045		0.047		0.067		0.104		0.070		0.106	
R^2 adj.	0.0262		0.0263		0.0261		0.0697		0.0268		0.0692	
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Method	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV

Table A.9: Relationship diversification and return/risk/risk-adjusted return (Alternative IV strategy)

This table shows the baseline regression results from equation (2) over the period 2007-2018 using an alternative instrumental variable (IV) strategy. Specifically, we employ a traditional 2SLS-estimator, using an insurer-specific single-line variable (single-line variable, weighted by insurer), an acquisition dummy and insurer age as instruments (insurer age is dropped due to multicollinearity with insurer and year fixed effects). The dependent variable is an insurer *i*'s return (columns 1-3), risk (columns 4-6) or risk-adjusted return (columns 7-9) at time *t*. Robust standard errors are included, and reported in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% levels respectively. Variables are defined in Appendix Table A.1.

	Return			**Risk**			**Risk-adjusted return**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
$HHI_{i,t-1}$	-69.02	-58.29	-112.1	22.24	-2.027	81.93	-68.04	-11.09	-249.5
	(69.52)	(72.41)	(134.0)	(29.95)	(12.26)	(100.3)	(65.44)	(15.97)	(230.6)
$Foreign_{i,t-1}$	7.248**	11.83***	5.444	1.369	5.942	-3.182	1.808	-0.685	10.94
	(3.046)	(3.669)	(7.697)	(2.527)	(5.273)	(5.068)	(2.534)	(1.251)	(13.73)
Ln $size_{t-1}$	-1.179	-0.296	-1.899	-1.444***	-2.388***	-0.564	0.477	1.079	-0.395
	(1.242)	(1.930)	(2.113)	(0.511)	(0.781)	(1.420)	(0.928)	(0.922)	(3.951)
$Leverage_{i,t-1}$	-1.027	4.075	-8.405*	-0.769	-2.609	1.260	-3.935	1.741	-12.32
	(3.848)	(7.783)	(4.763)	(1.796)	(2.691)	(3.593)	(3.487)	(2.981)	(9.594)
$Reinsurance_{i,t-1}$	1.633	-1.397	8.724	-2.997**	-2.219*	-4.968	-0.0606	-2.536	12.32
	(2.481)	(2.293)	(8.365)	(1.355)	(1.164)	(5.305)	(2.669)	(1.658)	(12.78)
$Concentration_{i,t-1}$	-22.82	0.278	-44.50	7.670	-8.600	20.66	3.089	8.132	-19.31
	(18.88)	(36.85)	(27.32)	(9.642)	(10.89)	(27.31)	(13.75)	(17.85)	(57.22)
# Obs.	963	456	507	963	456	507	963	456	507
F-stat first stage	0.98	0.48	1.93**	0.98	0.48	1.93**	0.98	0.48	1.93**
p-value F-stat	0.4835	0.9536	0.0324	0.4835	0.9536	0.0324	0.4835	0.9536	0.0324
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Method	IV	IV	IV	IV	IV	IV	IV	IV	IV

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