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Martin Hodula, Jan Janků, Martin Časta, and Adam Kučera *

Abstract

This paper tests potential determinants of the development of the insurance sector. Using a rich dataset for 24 European countries spanning two decades, we identify a set of macro-financial factors that are the most robust predictors of growth of gross premiums in the life and non-life insurance sectors. We show that both life and non-life premiums co-move with the business cycle and are positively related to higher savings and a more developed financial system. In addition, we provide new evidence on the role of market concentration and price effects. We find that market concentration matters only for life insurance, whereas the price channel is significant only for non-life insurance. From a policy perspective, our empirical estimates can be used to refine the existing macroprudential stress tests of the insurance sector.

Abstrakt

Tento článek testuje potenciální determinanty vývoje v pojistném sektoru. S využitím rozsáhlého souboru dat za 24 evropských zemí v průběhu dvou desetiletí identifikujeme makrofinanční faktory, které dokáží nejrobustněji predikovat růst hrubého pojistného v segmentech životního a neživotního pojištění. Ukazujeme, že pojistné v životním i neživotním pojištění se vyvíjí souběžně s hospodářským cyklem a vykazuje kladnou vazbu na vyšší úspory a rozvinutější finanční systém. Dále uvádíme nové poznatky o roli tržní koncentrace a cenových vlivů. Zjišťujeme, že tržní koncentrace je důležitá pouze pro životní pojištění, zatímco cenový kanál je významný jen pro neživotní pojištění. Z hospodářskopolitického pohledu mohou být naše empirické odhady využity ke zpřesnění stávajících makroobezřetnostních zátěžových testů pojistného sektoru.

JEL Codes: D4, E32, G22.
Keywords: Business cycle, insurance, life insurance, macro-financial determinants, non-life insurance.

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1. Introduction

A healthy insurance sector is crucial for the functioning of the economy, as it contributes to economic growth and financial stability. By reducing the impact of large losses on firms and households and enabling risk to be pooled, the sector encourages additional output, investment, innovation, and competition. Several empirical studies report evidence that increasing availability of insurance products promotes economic growth (Ward and Zurbruegg, 2000; Haiss and Sümegi, 2008; Lee et al., 2013).

In turn, the stability of the insurance sector might significantly affect the stability of the financial system as a whole. After the Global Financial Crisis (GFC) of 2008–2009, policymakers began to wonder whether the insurance sector could become a source of systemic risk (Jobst et al., 2014). This growing uneasiness stems from the fact that the systemic risk contribution of the insurance sector has risen since the crisis. This concerns the common exposures within the sector as well as its interconnectedness with the rest of the economy (Nyholm, 2012; Acharya and Richardson, 2014; Alves et al., 2015; Valckx et al., 2016).

Given the importance of the insurance sector, central banks and regulatory and supervisory authorities have attempted to incorporate the insurance sector into their prudential analytical toolkits, including their stress testing frameworks, in order to monitor the potential impact of adverse market and economic developments on the insurance sector with implications for systemic risk and financial stability (Jobst et al., 2014). However, studies providing policymakers with analysis of the main drivers of the insurance sector are scarce, at least when compared to the banking sector.

In this paper, we explore a broad set of factors that might drive the insurance sector. We compile a rich dataset of insurance premiums for 24 European countries over the 1997–2017 period. The dataset allows us to analyze separately the determinants of the life and non-life insurance businesses. Our empirical estimates can be utilized to refine the scenarios used in prudential macro stress tests of insurance companies. We provide evidence on the linkages between the dynamics of the insurance sector, as measured by premiums written, and the path of real gross domestic product and other macro-financial variables. Identification of such linkages can serve two purposes: (i) backward-looking evaluation of insurance sector growth rates, and (ii) derivation of forward-looking insurance-specific scenarios from the macroeconomic scenarios used in prudential stress testing (IAIS, 2013).

We show that the insurance sector co-moves with the business cycle. Moreover, and in contradiction to the previous line of work, we assert a significant role of the changing level of concentration in the sector, which affects insurance premiums. We also identify a non-trivial price channel in the case of the non-life insurance sector. Specifically, we demonstrate that changes in the price of a given insurance product are linked to a statistically significant increase in non-life insurance premiums, while we record no such relationship in the case of life insurance.

Furthermore, our estimates suggest that the price elasticity of supply can differ substantially between life and non-life insurance. Specifically, the supply of life insurance is found to be virtually price-inelastic, in contrast to the elastic supply of non-life insurance.

We contribute to the literature on the determinants of the insurance sector in a number of ways. First, the majority of the existing empirical research focuses on explaining growth in the life insurance sector (Browne and Kim, 1993; Outreville, 1996; Beck and Webb, 2003; Li et al., 2007), whereas we explore the non-life sector as well.[1] This enables us to draw a complete picture of the insurance sector. Second, we are among the first to accommodate European data, an area where conclusive evidence on insurance determinants was previously missing. Third, our ability to use micro-level data on individual insurance companies makes it possible to measure the effect of concentration in the insurance market on premiums.[2] Fourth, given our focus on a European sample, we can match insurance premiums with changes in the price index of insurance products. By doing so, we are able to capture price effects that may significantly affect insurance premiums.

We identify two other studies that estimate the determinants of life and non-life insurance premiums (Feyen et al., 2011; Christophersen and Jakubik, 2014). Let us briefly explain how our analysis relates to theirs. First, we cover a substantially wider period, which allows us to track the factors that drive the insurance sector across multiple business cycles. Therefore, we can assess the sector's dynamics while incorporating both boom and bust periods. Second, we propose a novel solution to the issue raised in Beck and Webb (2003) regarding the effects of changes in insurance prices. Premium data by itself does not allow one to observe the actual amount of insurance coverage purchased, as such data is a combination of price and coverage. Thus, not considering price effects introduces substantial noise into the estimation (unless the price is constant across countries, which is unlikely). The two aforementioned studies do not address this issue. Third, we deviate from the interpretation of some typical variables employed in models explaining developments in the insurance sector, such as life expectancy and the concentration ratio. Fourth, we use a cluster-robust estimator, which delivers more precise standard errors than those obtained using standard ordinary least squares (including fixed effects).

The remainder of the paper is organized into five sections. Section 2 provides stylized facts about the European insurance sector. Section 3 introduces our data and methodology. Section 4 describes our baseline specification results. Section 5 subjects our results to a battery of robustness tests. Section 6 concludes.

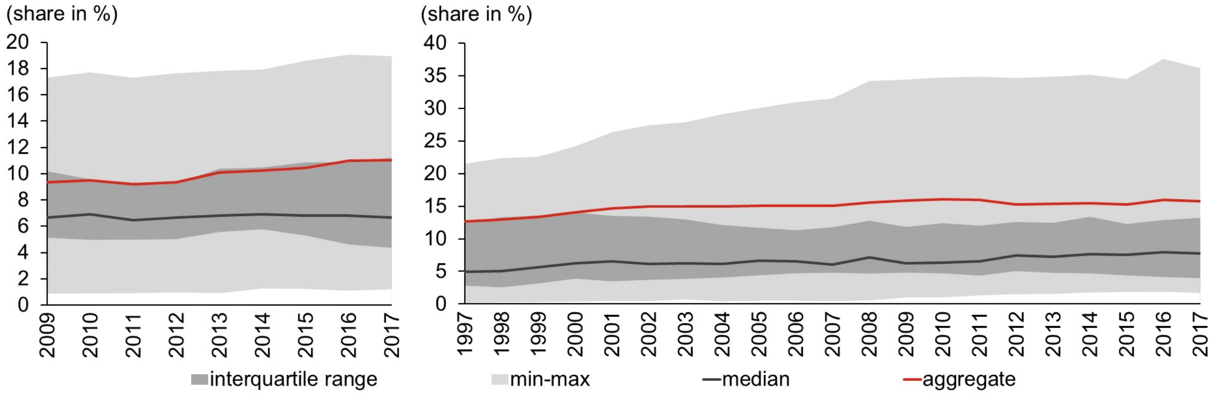
2. Some Stylized Facts on the European Insurance Sector

The insurance sector is an important component of the European financial sector, given the significance of its two main roles: (i) risk transfer by non-life insurance products and the risk components of life insurance products, and (ii) intermediation of the allocation of households' savings in the financial markets by the investment components of life insurance products. The latter role determines the amount of assets under management by insurance companies. The assets of the European insurance sector, composed mostly of financial investments, represented roughly 11% of the total aggregate assets of the European financial sector at the end of 2017. This share has grown slightly over the last decade, from 9.3% in 2009 (Figure 1, left panel). The share of life insurance in the allocation of households' savings on the financial markets rose from under 13% of households' total financial assets in 1997 to more than 16% in 2010 and has remained roughly constant since then (Figure 1, right panel).

[1] Earlier contributions include several country-specific studies (Hammond et al., 1967; Headen and Lee, 1974; Burnett and Palmer, 1984; Babbel, 1985).

[2] Several studies use micro-level data to evaluate the effect of competition on efficiency (Fenn et al., 2008; Bikker and Van Leuvensteijn, 2008) and solvency (Cummins et al., 2017) in the life insurance sector.

Figure 1: Position of Insurance Companies in European Financial System



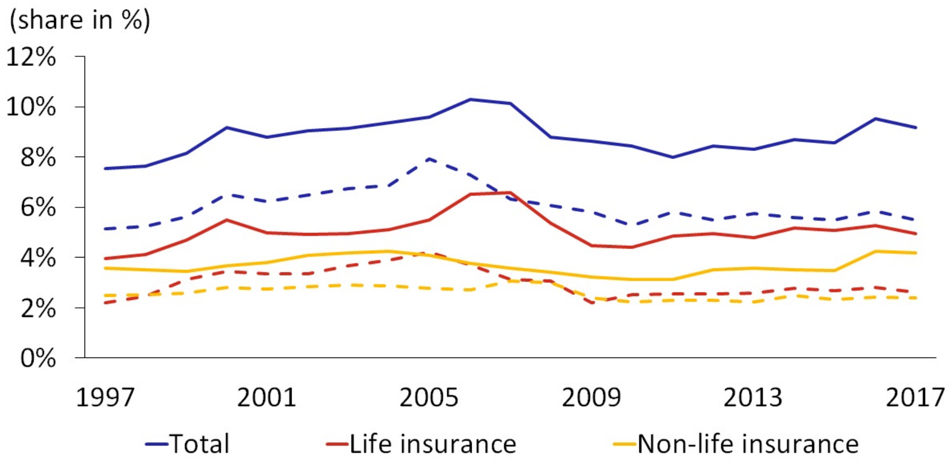
Note: Left panel: insurance companies' assets over total financial system assets (since 2009). The values are calculated as the aggregate for the 24 European countries under analysis, only with Switzerland missing in the case of the share in households' financial assets due to unavailable data. Some countries were excluded in certain years for which data was not available. Right panel: value of households' life insurance products as a share of their total financial assets. The shorter sample in 2009 in the case of the share in total assets is due to unavailable comparable data prior to 2009.
Source: OECD Insurance Statistics Database.

The European insurance sector, however, is very heterogeneous. In most European countries, the share of the insurance sector in total financial assets (and that of life insurance products in households' balance sheets) is less than the aggregate value (see Figure 1, aggregate values vs. other measures in both panels). The aggregate values are driven by a few countries with large financial sectors. Specifically, the United Kingdom, France, and Germany together formed almost 50% of the European financial sector at the end of 2017 by financial assets held. Insurance companies' assets represented more than 10% of the total assets of the financial sector in these countries (and as much as 18.4% in the case of France), while the share of life insurance products in household financial assets was 10.1% in the UK, 16.8% in Germany, and as much as 36% in France. Conversely, both shares were less than 5% for six countries (the Czech Republic, Estonia, Greece, Hungary, Latvia, and Lithuania).

The amount of investment intermediated by insurance companies primarily reflects the size of the life insurance segment. In contrast, non-life insurance may be seen as a regularly paid service rather than a tool for the accumulation of savings. Therefore, gross premiums written serve as a better indicator of the size of the segment. The penetration rate of insurance (the share of gross premiums written in GDP each year) shows the relative importance of the insurance sector in a country's overall economic output (Figure 2). The penetration rate for life insurance was rising until the GFC. This phenomenon is partly explained by declining interest rates and growing stock markets in Western Europe during the pre-crisis period (Lorent, 2008).

Since the crisis, the penetration rate has decreased slightly, mostly due to a long-lasting low-yield environment, which has compressed returns on traditional insurance investment products and motivated households to seek different means of investing their savings (IAIS, 2020). The penetration rate has remained roughly stable in non-life insurance, as the natural needs of economic agents to be protected against uncertainty and the affordability of non-life insurance are closely related to economic performance. Again, and simultaneously, there is sizable heterogeneity in the penetration rate across European countries, as signaled by the difference between the aggregate and median values, especially in the case of life insurance.

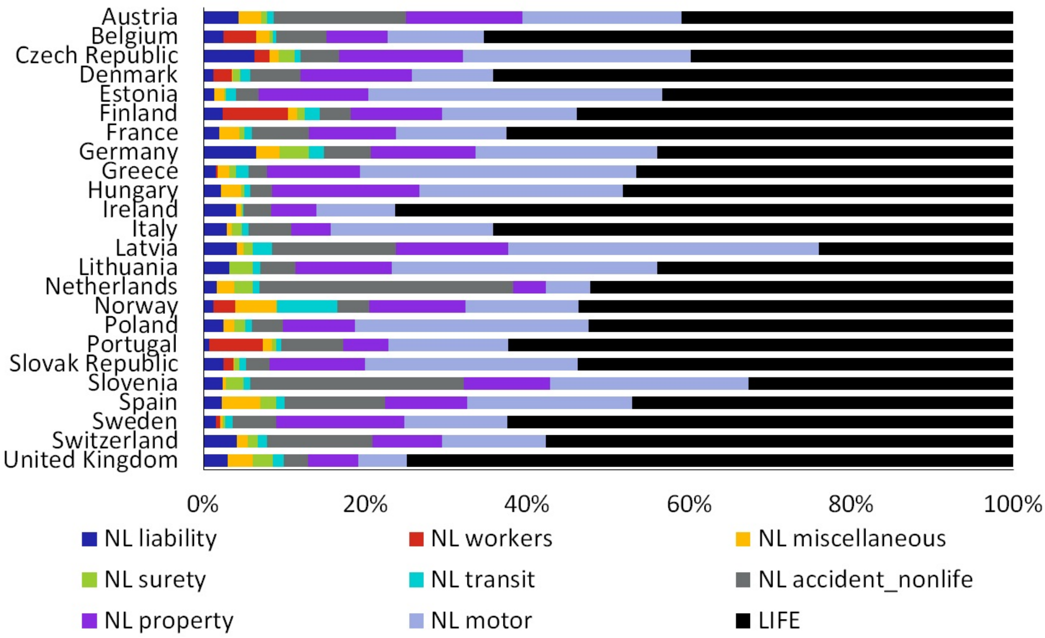
Figure 2: Insurance Penetration Rate in European Countries (Gross Premium Written/Real GDP)



Note: Dashed lines display medians, whereas solid lines display the aggregate values for the 24 European countries under analysis. Some countries were excluded in certain years due to data unavailability.
Source: AXCO Database and OECD National Accounts Database.

The non-decreasing penetration rate against a background of sustained economic growth implies that gross premiums written have been growing steadily over recent decades, except for the period of the GFC. This growth has been recorded for most of the insurance sub-segments, while the volatility of the growth rate has varied significantly across both segments and countries. This is apparent from the width of the grey areas in Figure 1. The differences between countries in the growth rates, levels, and importance of the individual insurance sub-segments (Figure 3) are caused by various factors. These include the level of development of financial markets, the existence of public insurance schemes, the overall wealth and income situation of economic agents, and the natural need to be insured against specific risks. The heterogeneity in life insurance and its penetration is significantly affected by different shares of guaranteed and unit-linked products in life insurance across countries, which has also affected the growth of life insurance in the low-yield environment. Motor, property, and accident insurance account for over 60% of business in the non-life market in all European countries (and more than 80% in most cases). Significant differences among countries can be seen in the importance of accident insurance and also liability and workers' insurance. These empirical observations partly highlight the motivation of this paper. We aim to explain the dynamics of the insurance segments through the lens of gross premiums written, and especially their (dis)connection to overall economic growth, while controlling for differences among countries and insurance sub-segments.

Figure 3: Split of Insurance Sector According to Gross Premiums Written into Sub-Segments in European Countries (average between 1997 and 2017)



Note: Missing data in some years were either filled by linear interpolation or omitted (if missing at the beginning of the time period). NL stands for non-life insurance.
Source: AXCO Database, CNB calculations.

3. Data, Variables, and Baseline Empirical Specifications

We approach the empirical testing of the determinants of the insurance sector by means of multivariate regression analysis. This allows us to assess which of the determinants considered robustly explain the growth of the insurance sector. We estimate two sets of models – for life and non-life insurance – because the insurance sector offers a non-homogeneous set of products, which makes it impossible to model the insurance sector as a whole. Changes in the life and non-life insurance sectors are likely to be determined by different factors even though some determinants may be the same.

Our dependent variable is gross written insurance premiums expressed in growth rates for the life and non-life sectors collected for 24 European countries over more than three decades (1983–2017). However, data on some of the crucial explanatory variables is not available for all those countries since 1983. Our baseline sample therefore consists of a reduced 1997–2017 time span. The full time span (1983–2017) without some control variables serves as a robustness check.

Gross insurance premiums are calculated as the price times the quantity of insurance provided and, as such, can affected by both demand- and supply-side factors. Therefore, premiums are a joint outcome of both demand and supply-side effects. Ideally, we would model the relationship between the supply of, and demand for, insurance separately. However, data limitations restrict empirical testing of such models.[3] Moreover, since we cannot assume that prices of insurance products remain constant, we need to control for price effects. If they were omitted, we would run the risk of biased estimates, as price effects would introduce a substantial amount of noise into the regression.

We address the aforementioned issues in several ways that should jointly ensure unbiased estimates. First, we take advantage of the data harmonization process that has taken place in the European Union, whose countries make up our sample. Among other things, the procedure ensures that inflation data are calculated according to harmonized definitions. This allows us to combine the information on insurance premiums with the Harmonized Index of Consumer Prices (HICP) category "Insurance," which reflects changes in the pricing of insurance services. Second, while the HICP covers only households, we need to filter out the rest of the price effects from the demand side (firms) and the supply side. To this end, we follow Beck and Webb (2003) and assume that the price is a function of several supply-side factors, such as the changing level of financial development, competition, and institutional development. Third, we use panel estimation with country-fixed effects, which should eliminate the rest of the potential bias.

3.1 A Model of Insurance Premiums

Our model of insurance premiums takes the following form:

$$PREMIUMS_{it} = \beta GDP_{it} + \gamma \mathbf{X}_{it}^{'} + \mu_i + \varepsilon_{it}, \tag{1}$$

where the dependent variable $PREMIUMS_{it}$ is the yearly change in gross written premiums in percent. We estimate two sets of models separating life and non-life insurance premiums. Indices i and t stand for countries and time periods (years). The variable GDP_{it} is the annual change in real gross domestic product (real GDP growth) and $\mathbf{X}_{it}^{'}$ is a row vector of control variables. Finally, μ_i captures unobserved country-specific effects and ε_{it} is an error term.

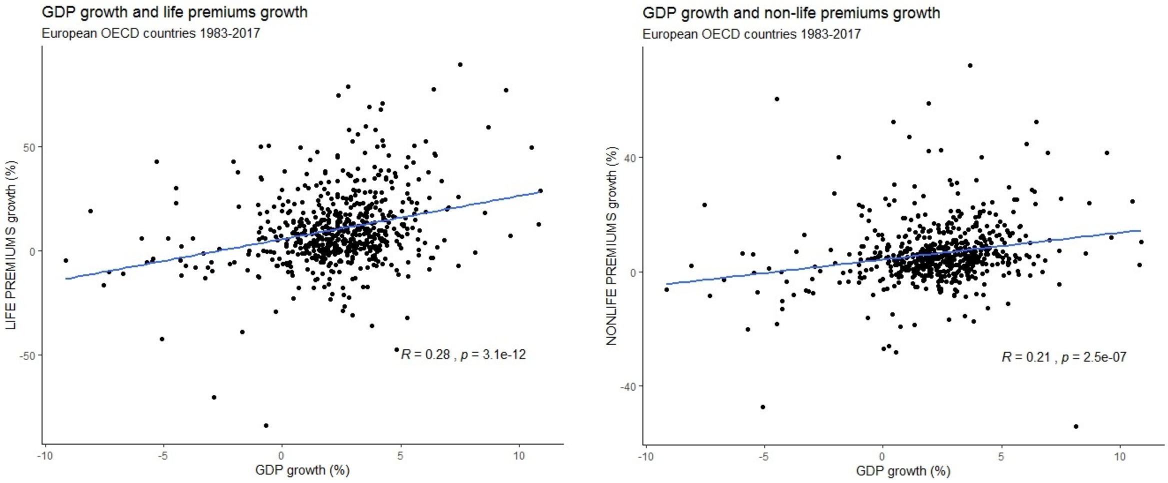
The variable GDP_{it} is a representation of the business cycle, and the related beta parameter can be considered a main parameter of interest. Given the wide range of information about the business conditions that is reflected in GDP, the resulting estimates allow us to identify the degree of connection between the business cycle and the dynamics of insurance premiums in specific segments.[4] The parameter values therefore implicitly shed some light on the position of the insurance sector from the systemic point of view as either an amplifier or an absorber of a possible adverse shock. Such information is crucial for the conduct of macroprudential stress tests, which evaluate the resilience of the financial sector in extreme situations such as an economic or financial crisis (IAIS, 2013). A positive sign between insurance premiums and real GDP growth is expected, because an under-performing economy probably puts more strain on demand for insurance.

Figure 4 shows the simple correlations between life and non-life insurance premium growth and real GDP growth (both in percent). Although the scatter plots do not show a particularly strong relationship between those variables, the correlation coefficients are statistically significant and positive as expected. A stronger correlation between real GDP growth and insurance premiums emerges for life insurance premiums.

[3] Distinguishing between demand- and supply-side effects is problematic even in bank lending studies (Jiménez et al., 2017).

[4] The analysis would need to be widened in order to provide a complete evaluation of the cyclicality of the insurance sector and its implications for systemic risk. This would additionally need to involve an analysis of cyclicality in insurance claims, provisions, lapses, and the investment behavior of insurance companies, most importantly. However, such analysis is beyond the scope of this paper.

Figure 4: Correlation Between Life and Non-Life Premium Growth and Real GDP Growth



Source: AXCO database and OECD Economic Outlook.

3.2 Control Variables

Control variables were selected based on a review of the existing empirical studies (Table A1). Some new, not previously considered, ones were added. For the life insurance premium model, the vector $X_{it}^{'}$ comprises $\mathbf{X}_{it}^{'} = [SOLVENCYII_{it}, SSCGOVREV_{it}, INSHICP_{it}, LIFEEXP_{it}, ADR_{it}, SAVINGS_{it}, FDI_{it}, LCONCENT_{it}, CRISIS_{it}]$.

For the non-life premiums model, the vector is: $\mathbf{X}_{it}^{'} = [SOLVENCYII_{it}, SSCGOVREV_{it}, INSHICP_{it}, FDI_{it}, NCONCENT_{it}, EXPORT_{it}, CRISIS_{it}]$. The variables are described in more detail below and in Table A1. Tables A4 and A5 show the correlation matrices of the independent variables.

The dummy variable $SOLVENCYII_{it}$ equals 1 since 2016 and 0 otherwise. It allows us to distinguish the period since the adoption of the Solvency II Directive, which harmonizes EU insurance regulation and in particular introduces a rule on the amount of capital that EU insurance companies must hold to reduce the risk of insolvency. As a related aspect for our analysis, the transition to Solvency II led to a re-classification of certain lines of business, so failing to account for it would result in false attribution of the premium volatility after 2016. Especially in the case of health insurance, Solvency II brought in a substantial change by dividing it into life and non-life segments according to its similarity to one segment or the other. Another innovation is that the risk management system and capital requirements have undergone significant changes, which may also have affected individual insurers due to adaptation to the new conditions. Previous studies date from the period prior to the Solvency II Directive and thus do not include such a dummy in their models.

The variable $SSCGOVREV_{it}$ represents the ratio of social security contributions to overall government revenues. We expect a negative sign because a more generous social security system probably lowers the necessity for additional private insurance (a substitute *sui generis*). From this point of view, social security protection (on average) acts as substitute for, rather than a complement of, life insurance. As Table A1 shows, most studies assume that social security schemes provide protection against mortality risk and should therefore affect life insurance demand negatively. Some studies, however, argue that the effect could be ambiguous (Browne and Kim, 1993; Feyen et al., 2011).

The variable $INSHICP_{it}$ is the change in the harmonized consumer price index of insurance products. This variable represents the price part of the growth in insurance premiums. The variable fully captures price growth in the non-life sector from the perspective of households. The life sector is not covered, so the variable serves more as an approximation of price growth in life insurance.[5] Rising prices of insurance products should naturally increase the volume of insurance premiums (a positive expected sign). The reviewed studies usually employed a general inflation variable, since they relied on large international panels, which prohibited them from categorizing inflation in insurance services. General inflation, however, cannot be used to capture price effects but serves rather as a proxy for monetary uncertainty (Beck and Webb, 2003). Given our focus on European countries, we can benefit from the harmonization procedure for measuring inflation across different product and service categories and match insurance premiums with changes in the price index of insurance products.

Life expectancy $LIFEEXP_{it}$ and the age dependency ratio ADR_{it} together control for demographic trends. Higher life expectancy implies a more sophisticated health care system and could therefore reduce the demand for private security. At the same time, life expectancy captures the economic level of the country, and it can be assumed that insurance growth will be lower in more developed countries, as current insurance saturation is higher (a negative expected sign). However, an aging population, captured by ADR_{it}, featuring a growing number of retirees, may imply decreased demand for insurance because of the lower purchasing power of retired persons. Previous studies have reported strongly mixed estimates, ranging from very negative (Feyen et al., 2011) to positive (Outreville, 1996) or not significant (Beck and Webb, 2003). We incorporate the two variables mainly to find out what is driving the mixed estimates and to explain them. The main problem seems to be that the above-mentioned studies do not consider the fact that higher life expectancy may covertly reflect a country's level of development.

The variable $SAVINGS_{it}$ is the savings rate and reflects the part of disposable income that, together with the incurrence of liabilities, is available to acquire financial and non-financial assets. We suppose that a higher savings rate enhances the growth of insurance premiums. This is because investment in life insurance can also reflect a savings motive. Previous studies do not include any variable for savings in the regressions (Table A1), but, for example, Headen and Lee (1974) show that the demand for life insurance depends on net saving. They argue that the short-run behavior of life insurance demand is affected by household portfolio decisions. Given a portfolio of financial assets, the flows into specific assets are a function of decisions to save as well as decisions as to portfolio composition. They expect higher rates of net saving to be positively associated with life insurance demand, since life insurance is hypothesized as a primary financial asset alternative for low-asset holders.

The financial development index FDI_{it} is taken from Svirydzenka (2016) and is meant to capture the level of financial development. We use year-to-year changes of FDI as our explanatory variable. While banks are typically the largest and most important part of the financial sector, in more developed systems mutual funds and pension funds also play substantial roles. The combination of such financial institutions and markets facilitates a higher rate of provision of financial services

[5] More specifically, according to the Classification of Individual Consumption by Purpose (COICOP), it is category CP125 – Insurance. This does not cover life insurance, but includes health, education, and social protection services, as well as insurance and financial services.

and probably a higher volume of insurance premiums. Previous studies generally rely on a single indicator to capture the level of financial development. Outreville (1996) was the first to document a positive relationship between life insurance consumption and the complexity of the financial structure defined as the ratio of quasi-money (M2–M1) to the broad definition of money (M2). This empirical strategy was also adopted by Li et al. (2007). Beck and Webb (2003) and Feyen et al. (2011) approximate the level of financial development by the ratio of private credit/total banking assets to GDP. This approach, however, might be insufficient, as the diversity of financial systems across countries implies a need to look at multiple indicators to measure financial development (Sahay et al., 2015). Using a composite indicator such as FDI_{it} thus allows us to incorporate information from multiple segments of the financial system.

The variables $LCONCENT_{it}$ and $NCONCENT_{it}$ capture changes in the concentration ratios of the life and non-life insurance sectors. The concentration ratio is calculated using micro-level data on individual insurance companies. Specifically, we collected information on insurance premiums for 15,083 life insurance companies and 18,291 non-life insurance companies and calculated the market share of the four largest insurance companies.[6] Details on the concentration ratio are provided in Figure A1. Higher market concentration should, according to the theory of imperfect competition, lead to somewhat restricted market supply, and the effect on the quantity of insurance premiums should be negative (quantity channel). However, higher market concentration also enhances the price channel of insurance premium growth (positive effect). We are therefore unsure a priori about the overall effect. The way we calculate the concentration ratio differs substantially from the rest of the empirical studies. Outreville (1996) and Feyen et al. (2011) create a binary dummy variable indicating whether the market is more or less concentrated. In this respect, Outreville (1996) notes that a concentration ratio would be a more appropriate measure than a simple dummy.[7]

The variable $EXPORT_{it}$ is a proxy for the country's involvement in cross-border trade. It is calculated as the annual growth rate of exports. We expect countries that are more involved in world trade to show higher growth in insurance premiums. This is mainly because some of the risks associated with international trade can be insured against. On the other hand, greater involvement in world trade may mean more foreign competition in the insurance sector (in the form of branches or subsidiaries of foreign insurance companies), which could ultimately lead to a fall in insurance product prices. Thus, we are unsure a priori which of the effects prevail. Trade openness is not regularly included in the previous studies on the determinants of insurance premiums. The one exception is Feyen et al. (2011), who find that the non-life sector seems to be positively and significantly affected by the volume of external trade.

The dummy variable $CRISIS_{it}$ equals 1 in 2008–2009 and 0 otherwise. It represents the exceptional period of the GFC, when insurance premiums fell sharply due to a negative demand shock. It is meant to capture any time-related effects that are not already in the model but may be related to this special event which occurred during the time-span of our data. Theoretically, the crisis could have substantially affected demand for life and non-life insurance, reducing an individual's ability to buy

[6] We also experimented with different cut-offs. Using the three or five largest companies yielded quantitatively similar estimates.

[7] Outreville (1996) only investigates the life insurance sector and controls for market concentration using a simple 0/1 dummy for the absence/presence of monopoly power in the insurance market in the particular country. This procedure seems inadequate, as it does not sufficiently capture the rate of concentration and its variability, which is not constant over time at all. Outreville (1996) himself adds that the appropriate variable to test in this context, if available, would be a measure of the concentration ratio. Similarly, Feyen et al. (2011) construct a dummy variable which assigns 1 to more concentrated markets, for example, markets where the largest market player covers more than 50% of the assets of the market.

insurance products due to unemployment, uncertainty, or lack of funds. No crisis-related dummy has been included in previous studies.

In addition to the variables mentioned above, we tested a number of variables suggested by the relevant literature (Table A1). Some of them could not be included due to collinearity with other variables. This concerns, for instance, the pairing of real GDP growth with the rate of unemployment and private credit growth with the financial development index. Some of the variables showed inconsistent results in our regressions (interest rates and income inequality), and others have very low variability in our sample (education and religion). As we examine the effect of real GDP growth on insurance premiums, we deliberately did not include variables as a share of GDP in the regressions. In such case, there would be a risk of significant collinearity among these variables, and the coefficient on real GDP growth could be significantly affected. This applies in particular to $EXPORT_{it}$ and $SSCGOVREV_{it}$, which are often reported as a share of GDP.

3.3 Estimation Method

Building on the previous literature, we employ panel data and an OLS estimator with one-way fixed effects (FE). In the panel data sample, we have to control for unobserved country-specific effects μ_i (see equation 1). Without controlling for them, the simple OLS estimator would be biased. Most empirical studies therefore employ the fixed-effects estimator in order to allow for cross-country differences. The country-specific effects control for further country-specific heterogeneity such as the geographical location of the country, its cultural and historical heritage, and norms and regional conventions related to insurance policy. They also capture religious differences (although these are less significant across European countries) and the different attitudes of nations to risk.

For all the results, we use a cluster-robust estimator (cluster-robust standard errors at the country level) to allow for within-country correlation of the residuals. This is because in models based on OLS (including FE), statistical inference using clustered standard errors is incorrect (despite the estimates being unbiased).

We also monitor stationarity of the variables in our estimations. An econometric theory for panel data was developed for studies where T is small but N is large. The asymptotic statistical theory was derived by letting N $\longrightarrow \infty$ for a fixed T; this is in contrast to today's time-series analyses, which often operate with a large T. Since time-series data tends to be non-stationary, determining the order of integration of the variables becomes important (for more details, see Smith, 2000).

3.4 Data

The choice of independent variables is based on their theoretical relationship with insurance premium growth. For the purposes of this study, twelve country- and time-specific variables were considered as explanatory variables in our models. Table 1 shows basic descriptive statistics.

Data on insurance premiums was scraped from the AXCO Global Statistics Database. Data on concentration ratios was calculated from microdata on individual insurance companies from AXCO Company Statistics. The variables GDP_{it}, $SSCGOVREV_{it}$, $LIFEEFEXP_{it}$, and ADR_{it} were obtained from OECD Economic Outlook No 106 (November 2019). The data on $INSHICP_{it}$ is from the ECB statistical database. The data on FDI_{it} is from the IMF's Financial Development Index Database. The variables $SAVINGS_{it}$ and $EXPORT_{it}$ are from the World Bank statistical database.[8] We omit

[8] We also considered using Solvency II data, which would be a valuable source of possible additional details on insurance undertakings or country-level control variables. However, the Solvency II data is limited to the last

extreme outliers, i.e., those of more than three times the interquartile range, from the data on life and non-life insurance premium growth. They account for less than 1% of the observations. Let us also add that the number of observations is lower in the regressions where concentration ratios are included. This is because of a lack of micro-data on the concentration ratios of the life and non-life insurance sector (generally available at the earliest since 1997 for some countries). Therefore, as a robustness check, we also employ some regressions without those variables later in the paper.

Table 1: Descriptive Statistics of the Sample (1997–2017)

	n	mean	sd	median	min	max	skew	kurtosis
LIFEPREMIUMS	399	6.91	18.05	4.38	-70.17	157.82	1.86	13.46
NONLIFEPREMIUMS	401	4.79	11.33	3.92	-54.20	71.95	1.03	9.21
SOLVENCYII	499	0.09	0.29	0.00	0.00	1.00	2.81	5.91
GDP_GROWTH	482	2.28	3.36	2.32	-14.81	25.16	-0.27	8.18
SSCGOVREV	482	30.30	9.60	32.07	0.11	45.01	-1.22	1.81
INSHICP	433	3.29	5.51	2.60	-25.30	42.00	1.98	12.68
LIFEEXP	492	78.13	3.39	78.90	69.10	83.70	-0.65	-0.49
SAVINGS	462	4.24	6.28	4.67	-17.00	25.43	-0.64	1.59
ADR	498	49.67	4.27	49.80	38.60	68.70	0.01	1.02
FDI	475	0.00	0.03	0.00	-0.16	0.19	-0.22	4.87
LCONCENT	406	0.06	3.55	-0.18	-13.68	17.25	0.68	2.93
NCONCENT	396	0.21	3.70	-0.28	-14.26	21.47	1.37	7.01
EXPORT	468	7.49	9.07	7.35	-23.44	51.32	0.02	2.57
CRISIS	499	0.10	0.30	0.00	0.00	1.00	2.73	5.47

five years, covering only part of a business cycle (the growth phase and the initial months of the crisis in 2020). Therefore, given the focus in our analysis on understanding the longer-term determinants and the relationships between business cycles, financial cycles, and insurance premium growth, we consider the short period covered by the Solvency II data to be insufficient and leave such analysis for future research.

4. Empirical Results

This section describes the results of the regression analysis of life and non-life insurance premiums. Table 2 presents our benchmark regressions. The first two columns (1) and (2) show the results for the life premiums regressions and the last two columns (3) and (4) present those for the non-life premiums regressions. Moreover, columns (1) and (3) exclude the variable $LIFEEXP$ because we find it to be problematic, although many previous studies include it (for more details, see Section 4.4).

We report point estimates together with cluster-robust standard errors in parenthesis. For clarity, we group the discussion of our estimates into five sub-sections. Since we strive to deliver robust estimates of determinants in the insurance sector, we contrast our results with those of earlier studies if possible and highlight where and why we deviate from them.

4.1 Sensitivity of Insurance Premiums to the Business Cycle

We confirm that life insurance premiums are inherently related to the business cycle. GDP_GROWTH enters significantly with its expected positive sign at the 1% level. Our point estimate for this variable is found to be somewhat sensitive to the inclusion of the life expectancy variable, which is discussed in Subsection 4.4. Excluding life expectancy, the point estimate comes in at 1.06, indicating that a one standard deviation increase in real GDP growth would be associated with a 3.55% increase in life insurance premiums.[9] Since the estimated coefficients are linear in nature, we can state that the life insurance sector is found to be more prone to business cycle turnarounds. This supports the nontrivial conclusion that life insurance can be considered a luxury good.

In addition, we find that non-life insurance premiums are also positively related to the business cycle. The point estimate of 0.55 is somewhat lower than the life insurance estimate, but its significance at the 5% level allows for the effect to be as large as 1.05. A one standard deviation increase in real GDP growth would then translate into a 3.53% increase in non-life insurance premiums.

The positive relationship between insurance premiums and real GDP growth may be further supported by possible shifts in portfolio allocation following adverse financial market developments and possible life insurance policy lapses, for instance. The insurance sector may, on the other hand, still maintain certain counter-cyclical features that are not reflected by the premium dynamics. These include claims paid to banks from credit insurance policies and claims paid to non-financial corporations under various business insurance policies. Therefore, our results show only one aspect of cyclicality and cannot be considered proof of pro-cyclicality of the insurance sector as a whole.

The estimated parameter values can be directly and easily used in macroprudential stress testing by deriving the insurance income dynamics from business cycle scenarios. More specifically, to build a baseline macro-financial scenario, the estimated sensitivity of insurance premiums to GDP_GROWTH provides a direct extension of the business cycle scenario to the insurance premium scenario. In the case of the scenario assuming a systemic financial crisis, the $DUMMY$ variable parameter can additionally be used to obtain a scenario for adverse developments similar to the case of the GFC.

[9] The one standard deviation impact is calculated as the point estimate over one standard deviation.

Table 2: Determinants of Life and Non-Life Premiums, 1997–2017

	Dependent variable:			
	LIFEPREMIUMS		NONLIFEPREMIUMS	
	(1)	(2)	(3)	(4)
GDP_GROWTH	1.056***	0.856***	0.546**	0.448*
	(0.251)	(0.259)	(0.255)	(0.238)
SOLVENCYII	−8.824***	−5.711**	2.163	4.582**
	(3.135)	(2.814)	(1.777)	(2.053)
SSCGOVREV	−1.770***	−1.482**	−0.257	−0.141
	(0.568)	(0.624)	(0.527)	(0.473)
INSHICP	−0.090	−0.289**	0.674***	0.586***
	(0.185)	(0.136)	(0.084)	(0.076)
SAVINGS	0.967***	0.807**		
	(0.285)	(0.315)		
FDI	1.386***	1.250***	−0.385	−0.460
	(0.446)	(0.451)	(0.298)	(0.331)
LCONCENT	0.873***	0.915***		
	(0.303)	(0.292)		
LIFEEXP		−3.370***		−1.412**
		(0.872)		(0.460)
ADR	−0.001	0.743		
	(0.671)	(0.652)		
NCONCENT			−0.009	0.019
			(0.181)	(0.191)
EXPORT			−0.112**	−0.116**
			(0.052)	(0.053)
CRISIS	−8.076**	−6.262*	−3.905**	−3.704**
	(3.423)	(3.189)	(1.708)	(1.618)
Observations	354	354	343	343
N (countries)	24	24	24	24
R^2	0.194	0.225	0.141	0.156
Adjusted R^2	0.113	0.145	0.056	0.069
F Statistic	8.573*** (df = 9; 321)	9.272*** (df = 10; 320)	6.398*** (df = 8; 311)	6.389***(df = 9; 310)

Note: Cluster-robust standard errors are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

4.2 Price Effects Across Life and Non-Life Insurance

We record stark differences in the estimates regarding price effects between the life and non-life insurance sectors. We find changes in *INSHICP* to be associated with a statistically significant increase in non-life insurance premiums, while we record no such relationship in the case of life insurance. In this respect, we largely deviate from the point estimates of other studies, as we are the first to accommodate changes in insurance prices in our regression, while the previous studies either omit price effects or use a general inflation variable.[10]

As Feyen et al. (2011) state, inflation is expected to have a negative effect on the demand for life insurance, as it erodes the value of insurance policies and makes them less attractive. This intuition is confirmed by several other studies (Table A1). Nevertheless, Feyen et al. (2011) ultimately identified a positive sign of the general inflation variable in all their non-life regressions and found this to be surprising.

[10] The statistically insignificant estimate in the model of life insurance might also be due to the fact that *INSHICP* serves as a mere approximation of price growth in the life insurance sector.

We believe that the surprisingly positive sign reported in Feyen et al. (2011) can be at least partly explained by the fact that the general inflation variable largely captures prices of real goods such as cars and real estate. Growth in the prices of such goods naturally raises the prices of non-life insurance premiums. As non-life insurance premiums reflect both quantity and price growth (that is, growth in the volume of premiums, not just the number of contracts), rising prices of real estate (general inflation) lead to rising prices of non-life insurance. Our more precise *INSHICP* variable supports this explanation, as it covers price growth in the non-life insurance sector much better than general inflation.

For the life insurance sector, the variable *INSHICP* shows inconsistent results across our models.[11] This can be partly explained by the above-mentioned intuition of Feyen et al. (2011), who expected inflation to have a negative effect on the demand for life insurance, as it erodes the value of insurance policies and makes them less attractive.[12]

4.3 The Role of Market Concentration

The implications of changes in the concentration of the insurance market have not been sufficiently studied yet. Given our ability to calculate the concentration ratio using micro-data on individual insurance companies, we provide robust evidence on the effects of market concentration and complement the findings of Outreville (1996) and Feyen et al. (2011).

We discover that changes in the level of concentration significantly affect life insurance premiums. The average point estimate across specifications (1) and (2) of 0.89 indicates that a one standard deviation increase in *LCONCENT* is associated with about a 3.02% increase in premiums. The result contradicts that of Outreville (1996), who reports a negative and significant effect. The negative and significant effect could normally be explained by the theory of imperfect competition that a more concentrated sector restricts market supply. However, as he adds, a lot of countries are characterized by the existence of a large number of small companies with small insurance capacity. Countries with high concentration of insurance business in few companies, however, have been more successful in developing insurance services (that is, higher insurance premium growth should be expected with a higher concentration ratio). Thus, the positive sign on *LCONCENT* is theoretically sound. We add that higher market concentration probably enhances the price channel of insurance premium growth, which puts additional upward pressure on insurance premiums, measured as volumes and not just the number of contracts. This explanation is, of course, very closely linked to our debate on the possibilities of the variable *INSHICP*. If this variable does not fully capture price growth in the life insurance sector, its role can be partially taken over by the *LCONCENT* variable.

The reported insignificant coefficient on the concentration ratio in the non-life sector (*NCONCENT*) contrasts with the concentration ratio estimate for the life sector (*LCONCENT*).[13] A superficial

[11] This is not surprising, since our price variable captures developments in the non-life sector much better, while for the life sector it serves rather as an approximation.

[12] Aside from the debate on which of the sectors the variable *INSHICP* explains better, an economic explanation using demand/supply elasticity can also be considered. Economically, the sign and the significance of the $INSHICP_{it}$ parameter could also reflect the elasticity of the demand/supply curve. $INSHICP_{it}$ does not enter significantly in the case of the life insurance sector, which implies that one of the curves is flat. Since $INSHICP_{it}$ is generally regarded as a supply-side variable (Beck and Webb, 2003), its insignificant parameter would point to a flat supply curve. This is supported by the point estimate for the non-life insurance sector, where $INSHICP_{it}$ is found to be statistically significant at the 1% level with a positive sign. This would indicate the supply curve in the non-life insurance sector to be growing, as suggested by the standard market theory.

[13] We add that this result is consistent with the findings of Feyen et al. (2011), who also report insignificant results for non-life premiums in contrast to a positive effect for life premiums.

explanation would be that the price channel of the concentration variable is largely captured by *INSHICP*, so *NCONCENT* has no positive and significant effect. However, we would also have to ask why there is no significant and negative effect of the concentration ratio due to the quantity channel (a limited quantity offered according to the theory of imperfect competition).

We should therefore also consider whether: (i) the whole non-life sector differs substantially from the life sector, so while higher concentration has no effect in the former, it has a significant effect in the latter (and needs closer examination); (ii) the non-life sector is too heterogeneous, so while higher concentration promotes insurance in a particular sub-sector, it suppresses growth in other sub-sectors; (iii) our sample is too heterogeneous, so while non-life insurance in more developed countries may benefit from greater concentration of the sector, the non-life insurance volume in less developed countries may decrease due to concentration. We test both sector and sample heterogeneity as part of our robustness check in Section 5.

4.4 The Role of Demographic Factors

Following the previous line of work on the topic, we include the life expectancy variable in the second regression specification (Table 2, second column). $LIFEEXP$ has a coefficient point estimate of -3.37 at the 1% level of significance. This implies that a country which advances its expected life length by one year would record a decrease in life insurance of 3.37%. This is close to the average point estimate of -3.4 recorded by Feyen et al. (2011).

However, we have a serious objection to the inclusion of life expectancy in the model of life insurance premiums. Feyen et al. (2011) argue that most researchers expect life expectancy to have a negative impact on the demand for life insurance, on the grounds that longer life expectancy is associated with a lower probability of premature death and a lower need for life insurance. The rest of the studies, however, provide very mixed results on this issue. In fact, the relationship might equally be positive, as a longer life could stimulate higher demand for life insurance (pensions).[14]

We test the hypothesis of Feyen et al. (2011) and include the variable also in the regression for non-life premiums (Table 2, fourth column). Surprisingly, we find that it, too, produces a significant and negative coefficient of -1.4 at the 5% level. However, the hypothesis that life expectancy has a negative impact on insurance premium growth (through a lower probability of premature death) cannot be applied to non-life insurance. In fact, the opposite could be expected, because one can argue in a similar way that a lower probability of premature death should incentivize economic agents to insure their property because they will enjoy it for longer. Moreover, we find the life expectancy indicator to be strongly correlated with GDP per capita. Consequently, countries with higher GDP per capita (developed countries) naturally record lower insurance premium growth rates because of a previous higher level of insurance premium saturation.

Overall, we find evidence that life expectancy captures convergence effects rather than improvements in the health care system or in the general health of the population. While it produces highly significant estimates, it needs to be interpreted with caution.

[14] Estimates of the importance of life expectancy as a determinant of life insurance premiums vary from positive (Outreville, 1996) to negative (Li et al., 2007), while most authors report insignificant results (Browne and Kim, 1993; Beck and Webb, 2003).

4.5 Financial Development, Social Security, and Savings

We find higher savings and a more developed financial system to increase the growth of life insurance premiums. Specifically, increasing *FDI* by one unit increases the growth rate of life insurance premiums by approximately 1.3 percentage points (pp) at the 1% level of significance (the average point estimate across specifications (1) and (2) in Table 2). Similarly, increasing *SAVINGS* by 1 pp generates an increase in premiums of around 0.85 pp. These estimates are not surprising given that insurance can be generally regarded as another form of saving. As Yaari (1965) points out, the demand for life insurance is properly considered within the context of the consumer's lifetime allocation process. Each utility-maximizing household has the same degree of relative risk aversion, and during its lifetime any excess gross savings can be converted into any of the financial products offered by insurance companies.

Social security contributions (*SSCGOVREV*) enter significantly with an average impact of -1.63 pp. Social security payments seem to displace private insurance. The more generous these benefits are, the lower the demand for private assurance is likely to be. Our results therefore support the hypothesis that social security schemes at least partially substitute for private life insurance. Social security schemes provide protection against mortality risk and should therefore affect life insurance demand negatively. Our estimates are in line with those of Browne and Kim (1993).[15]

The *CRISIS* dummy shows that the non-life sector was hit especially hard by the GFC. The results for the life sector are also accompanied by a negative sign, but the estimates are not statistically significant. Table A3 in the Appendix shows the same empirical setting, but without the crisis dummy. The results are consistent with those described above, only the coefficients on real GDP growth are somewhat larger, now capturing the entire business cycle. This can be seen as a first robustness check of our results.

5. Robustness Checks

In this section, we demonstrate that our baseline results as reported in Table 2 are robust. First, we enrich our sample period by going back to 1983. By doing so, we nearly double the number of observations in our baseline model of life and non-life insurance premiums. However, this comes at a price, as not all of our control variables are available during the 1983–1996 period. In this exercise, we exclude the savings rate (*SAVINGS*), the concentration ratio (*CONCENT*), and the change in the harmonized consumer price index of insurance products *INSHICP*. As such, this robustness check is mainly used to verify the point estimates regarding the impact of real GDP growth. Second, we split our sample into two sub-samples by differentiating between more developed and less developed (post-communist) countries. This serves as a natural check of the sample homogeneity. In addition, it allows us to check whether our reported estimates were affected by different speeds of adjustment in the convergence process across countries. This may be a concern for the variables *FDI* and *CONCENT*. Third, we dig deeper into the non-life insurance sector and regress each of its sub-sectors separately while keeping the list of controls unchanged. This caters to the fact that the non-life insurance sector is rather heterogeneous on its own, offering a wide range of services.

[15] Let us add, however, that Browne and Kim (1993) and Feyen et al. (2011) consider social contributions also to have a positive effect, because they often provide protection against disability and old age, and the provision of these benefits could produce a positive income effect on personal insurance decisions.

5.1 Enlarged Sample

Table 3 replicates the baseline set of results in Table 2. We confirm the historically important role of real GDP growth in explaining the evolution of both life and non-life insurance premiums. If anything, the point estimates for the longer sample are more pronounced. Averaging across the estimates in columns (1) and (2) gives us an impact of a one standard deviation increase in real GDP growth on life insurance premiums of about 5.1% at the 1% level of significance. Column (3) shows an impact on non-life premium growth of 2.1% at the 5% significance level. In these regressions, however, some of the controls are missing, so real GDP growth could have taken over part of their effects.

Table 3: Determinants of Life and Non-Life Premiums, 1983–2017

	Dependent variable:		
	LIFEPREMIUMS		NONLIFEPREMIUMS
	(1)	(2)	(3)
GDP_GROWTH	1.838***	1.384***	0.660**
	(0.379)	(0.279)	(0.267)
SOLVENCYII	-14.083***	-5.683**	0.257
	(3.147)	(2.279)	(1.883)
SSCGOVREV	0.038	-0.200	-0.247
	(0.674)	(0.533)	(0.328)
FDI	1.433***	1.131***	-0.085
	(0.462)	(0.428)	(0.203)
LIFEEXP		-2.939***	
		(0.586)	
ADR	0.582	0.759	
	(0.545)	(0.575)	
EXPORT			-0.077*
			(0.041)
CRISIS	-8.480	-3.735	-6.734***
	(3.357)	(3.573)	(1.862)
Observations	597	597	594
N (countries)	24	24	24
R^2	0.145	0.215	0.065
Adjusted R^2	0.102	0.174	0.017
F Statistic	16.061*** (df = 6; 567)	22.188*** (df = 7; 566)	6.508*** (df = 6; 564)

Note: Cluster-robust standard errors are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

5.2 Splitting the Sample

Having tested the importance of market concentration in the main text (see Section 4.3), we hypothesized that the effect of changes in the level of concentration in the non-life insurance market can vary substantially across countries with more and less developed insurance sectors. To check this hypothesis, we split our sample into developed and less developed (post-communist) countries. In the process, we can check whether there are any differences in the statistical significance of other determinants as well.

The post-communist countries – namely, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia – are generally characterized by lower social and economic development and less developed insurance sectors than the other countries in our sample (Pye, 2005; Wagstaff and Moreno-Serra, 2009).[16] The differences between the two groups of countries are clearly visible from Figure A2, which plots the average penetration rate for developed and post-communist countries. Table 4 shows the regression results for the split sample.

Table 4: Determinants of Life and Non-Life Premiums in Developed and Less Developed (Postcom) Countries, 1997–2017

	Dependent variable:			
	POSTCOM		DEVELOPED	
	LIFE PR.	NONLIFE PR.	LIFE PR.	NONLIFE PR.
	(1)	(2)	(3)	(4)
GDP_GROWTH	0.346	0.730**	1.214***	0.528*
	(0.571)	(0.337)	(0.286)	(0.299)
SOLVENCYII	-9.540*	1.483	-6.928*	2.710
	(5.318)	(2.028)	(3.695)	(2.396)
SSCGOVREV	-3.081***	0.177	-1.371**	-0.251
	(1.120)	(0.491)	(0.632)	(0.618)
INSHICP	-0.010	0.618***	-0.157	0.951***
	(0.201)	(0.100)	(0.325)	(0.193)
SAVINGS	2.191***		0.716**	
	(0.626)		(0.362)	
FDI	1.951***	0.589*	1.267***	-0.480
	(0.688)	(0.346)	(0.474)	(0.310)
LCONCENT	0.106		1.125***	
	(0.530)		(0.331)	
EXPORT		-0.185**		-0.114*
		(0.090)		(0.062)
NCONCENT		-0.688**		0.054
		(0.305)		(0.193)
ADR	-0.743		-0.071	
	(0.748)		(1.039)	
CRISIS	-14.745***	0.330	-6.713*	-6.133***
	(5.291)	(2.397)	(3.954)	(1.199)
Observations	96	96	258	247
N (countries)	8	8	16	16
R^2	0.358	0.478	0.184	0.116
Adjusted R^2	0.228	0.381	0.101	0.025
F Statistic	4.903***	9.172***	5.860***	3.654***
	(df = 9; 79)	(df = 8; 80)	(df = 9; 233)	(df = 8; 223)

Note: Cluster-robust standard errors are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

Dividing the sample yields several differences compared to our baseline results as they appear in Table 2. For post-communist countries, the market concentration of the non-life sector (*NCONCENT*) enters significantly and negatively at the 5% level of significance (Table 4, column 2). This is in contrast to the insignificant estimates reported for the whole sample (Table 2) and for the more developed countries sub-sample (Table 4, column 4). It is also contradictory to the results of the life sector in the whole sample. This paradox can be answered in two ways. It stems from either the differences between the life and non-life sectors or the differences between developed and post-communist countries.

[16] We use the terms “post-communist” and “less developed” as synonyms, meaning that the post-communist countries have less developed insurance sectors but not necessarily lower levels of GDP per capita than the “developed” countries.

Regarding the differences between the life and non-life sectors, it is possible that the quantity channel (the number of contracts) is more dominant in the non-life sector than in the life sector. In the case of the life sector, we argued that higher market concentration probably enhances the price channel of insurance premium growth, putting additional upward pressure on insurance premiums (as volumes). Higher prices, however, can reduce the number of new contracts as demand for products decreases. This is probably the case of the non-life sector, as the price channel is fully controlled by the variable *INSHICP* in this specification.

As for the differences between developed and post-communist countries, Table 5 presents the descriptive statistics of the concentration ratios in the two sub-samples. It is apparent that the concentration of the insurance market (both life and non-life) is much higher in the post-communist countries, a fact which can be explained by somewhat impeded development of the insurance sector. The fact that concentration decreased significantly over the 2000–2017 period may also explain the negative sign on the concentration ratio in the non-life sector in Table 4 and the insignificant result for the life sector (which contrasts with the statistically significant and positive sign in the developed countries). As pointed out in Fenn et al. (2008), after a certain optimal point a concentrated market structure impedes the development of the non-life sector, and higher concentration ratios could then be associated with lower premium growth rates and lower concentration ratios with higher premium growth rates. The development of the non-life sector (growth of insurance premiums) in post-communist countries was probably driven largely by the process of de-concentration of this highly concentrated segment of the economy. This challenges the hypothesis of Outreville (1996), which we relied on above, that markets with few companies may be more successful in developing insurance services (i.e., higher insurance premium growth might be expected with a higher concentration ratio).

Table 5: Concentration Ratios in Developed and Less Developed (Postcom) Countries

		n	mean	med.	med. change (2000–2017)
LIFE	POSTCOM	155	75.28	75.35	-26.18
	DEVELOPED	307	55.23	51.27	3,55
NON-LIFE	POSTCOM	157	74.71	74.94	-10.04
	DEVELOPED	298	49.57	48.83	17.43

Note: The analyzed period is from 2000 to 2017, because some data on concentration for post-communist countries is missing from 1997 to 2000.

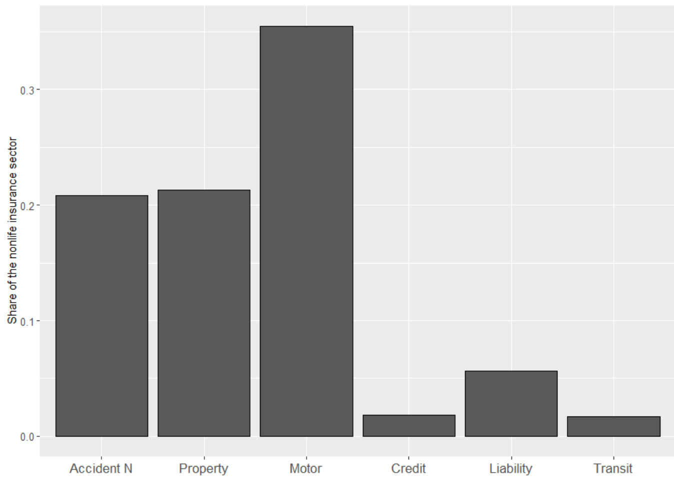
In the life insurance sector, too, the concentration ratio decreased over time in the post-communist countries. This would suggest an increasing quantity of premiums (a negative effect). However, the *LCONCCENT* variable also partly reflects the price channel, which is not fully captured by the *INSHICP* variable in the life sector regression. The result is therefore not significant.

5.3 Estimates for Individual Non-Life Sub-Sectors

Non-life insurance encompasses a broad range of services. It may cover people, property, or legal liabilities. Taken together, it may be just too heterogeneous to analyze, and one might ask whether in-sample heterogeneity affected some of the estimates reported in Table 2, columns (3) and (4). For this purpose, we re-estimate our baseline model specification as it appears in eq. (1), regressing each of the non-life sub-sectors one at a time.

Figure 5 takes a closer look at the non-life sector in our sample. It reveals that non-life insurance is dominated by motor and property insurance, which jointly accounts for more than 55% of non-life insurance. Non-life accident insurance (Accident N) also holds a substantial share. The large share of property and motor insurance in the non-life sector explains why the variable $INSHICP$ is statistically significant in all our regressions for the non-life sector. Price growth in property and motor insurance clearly drives the positive and statistically significant growth in the volume of insurance premiums in the sector as a whole.

Figure 5: Shares of Sub-Categories of Insurance in Non-Life Sector (2016)



Source: AXCO Database

Table A6 in the Appendix shows the estimated coefficients and cluster-robust standard errors for the six non-life sub-sector regressions. Except for the category of transit, all the regressions show that the growth of non-life premiums in particular sub-sectors is substantially influenced by the business cycle. The highest GDP_GROWTH parameter value can be observed in the motor, liability, and accident insurance segments. This may be intuitively well explained by the close linkage between households' and companies' income and/or wealth conditions and demand for the relevant insurance product. A drop in income implies lower demand for motor insurance due to either deferred car purchases or a shift to lower-priced insurance (through a reduction in the coverage or the additional features of the policy, for instance). Further, deferral of car purchases implies aging cars and therefore also lower amounts insured. Occupation-related liability insurance is, in turn, linked to the existence of a profession that requires such insurance and therefore to general employment. Similarly, personal liability insurance may be cancelled by households, as it represents a luxury rather than a necessary good. Analogously, at least part of accident insurance also represents a luxury good linked to traveling and other leisure activities, which may be expected to be limited during an economic downturn. The results further suggest some pro-cyclicality of credit insurance premiums, in line with the interrelated business and credit cycles.

In the case of property insurance, the GDP_GROWTH coefficient obtained can be intuitively explained by two opposing factors. First, the statistically significant positive linkage between premiums and real GDP growth – similarly to other segments that show such a linkage – may be interpreted as being closely related to household income and wealth, a drop in which may imply a reduction in the coverage or the additional features of property insurance policies. This is also related to the prevailing correlation between growth in real estate prices and the business cycle dynamics. The second, opposing, factor is the lower flexibility of this type of insurance, as such products are often connected with long-term mortgages, which makes them more stable over time.

We see this as a possible explanation of why the estimated sensitivity to real GDP growth is less than 1 in the case of property insurance.

Finally, although transit insurance seems to be unrelated to real GDP growth according to the estimated parameter values, it is strongly affected by the *CRISIS* dummy instead. We interpret this as meaning that whereas minor business fluctuations do not change the demand for transit insurance, a major economic downturn (such as the GFC of 2008–2009) still has a severe impact on the segment.

Interestingly, our empirical model explains the property and motor categories better than others. The results are similar to the model of the non-life sector as a whole and are probably determined by the fact that these categories have the lowest level of cross-country heterogeneity in terms of market shares. Both of them involve insurance of "tangible" products, which leads to general similarity. They are directly affected by price effects with low levels of nominal rigidity (see the coefficients on INSHICP for these segments in Table A6) and therefore best correspond to our model design.

On the other hand, the concentration ratio (*LCONCENT*), which turned out to be insignificant in the model for the non-life sector as a whole, is significant (and negative) primarily in the insurance of financial products grouped in the categories of credit (surety, bonds, and credit) and liability, as well as in transit insurance. We explain this as being a consequence of the smaller size of these segments (see Figure 5) combined with a greater need for expert knowledge for the valuation of these insurance products. Growth of credit insurance premiums is also determined by financial development (*FDI*), which also contrasts with the model for the non-life sector as a whole. We consider this an intuitive result, given that greater financial development and therefore also a larger amount of financial assets in the economy and more extensive use of financial products, including loans, increases the need for such insurance. The results above only confirm our prior belief that the non-life sector is quite heterogeneous and the regression for the sector as a whole can produce partially misleading results. The results should therefore be interpreted with caution.

6. Conclusion

In this paper, we provide evidence on the importance of various macro-financial determinants of insurance premium growth. We compile a rich dataset of insurance premiums for both the life and non-life insurance businesses for 24 European countries spanning the 1997–2017 period. We select the potential determinants of insurance premium growth based on a literature survey. In addition, we test for the significance of several variables that have not previously been tested or for which conclusive evidence has been missing. We conduct numerous robustness checks to verify that our estimates are robust.

Our panel estimation confirms that insurance sector premiums, both life and non-life, co-move closely with the business cycle owing to its strong positive and statistically significant relationship with real GDP growth. Moreover, we offer other findings that advance the current knowledge on the topic.

First, we show that a more concentrated insurance market records a higher premium volume in various specifications for the life insurance sector. This is due either to higher price growth in the more concentrated sector or to the fact that a market with few companies can paradoxically be more successful in rapidly developing the sector, or both. In some segments of non-life insurance, and in post-communist countries, we record a negative impact of higher concentration on insurance premium growth. In the case of post-communist countries, this estimate is driven by the fact that the sector was initially highly concentrated, probably to the extent that this concentration was detrimental to the development of the sector as a whole. As our analysis shows, there has been considerable de-concentration in these countries over the last 20 years, which may have led to faster development of the sector as a whole. Given that we fully control for price growth in the non-life sector, the quantity effect of the concentration ratio on non-life premiums is supposed to be negative, as our results suggest.

To our knowledge, we are the first to use micro-level data on individual insurance companies to compute the concentration ratio that we use in our set of regressions. Our estimate can thus be considered a refinement of those other studies which rely on dummy variables to identify a more or less concentrated sector (Outreville, 1996; Feyen et al., 2011). Our analysis encourages further research to determine what level of concentration contributes to faster development of the sector as a whole and what level of concentration is already harmful. Some form of threshold model would be worth considering here.

Second, we discover a significant role of price effects. Since premiums are a joint outcome of volume and price, we include changes in insurance prices in our regression. Given our sample focus on European countries, we can regress insurance premiums on changes in insurance prices as measured by the Harmonized Index of Consumer Prices. Previous studies rely on general inflation, which captures monetary policy uncertainty rather than price effects. In this respect, we believe our procedure allows us to filter out a significant portion of the statistical noise from the estimation by controlling for changes in insurance prices. Therefore, we may record generally more precise parameters compared to the previous line of work. We find that the price channel is significant and positive for the non-life sector, while not statistically significant for the life sector. Knowing this, we explain the inconsistent results of previous studies, noting that on the one hand the general inflation variable largely captures prices of real goods such as cars and real estate. Growth in the prices of those goods then naturally raises prices of non-life insurance premiums. On the other hand, we note that this could indicate that the supply curve in the non-life insurance sector is rising, as suggested by the standard market theory, while the supply curve of the life sector is flat. Another possible explanation is that we failed to filter out all of the price effects from the insurance premiums.

Third, we show that the inclusion of the life expectancy variable in the model of life insurance premiums can be a source of noise and may have been misinterpreted in some of the previous studies. In this respect, we show that life expectancy captures convergence effects rather than improvements in the health care system or in the general health of the population.

Our estimated parameters can be used to refine the existing macroprudential stress tests of the insurance sector. The estimated linkages between the set of determinants of insurance premium growth may serve both for backward-looking evaluation of the development of the insurance sector and for derivation of forward-looking insurance-specific scenarios from the macroeconomic scenarios used in stress testing.

The relevance of our results and the importance of the resilience of the insurance sector are highlighted by the current Covid-19 pandemic. In connection with the pandemic, insurers can expect an increase in claims in life insurance and in certain non-life insurance sectors (credit, income, worker, and business interruption insurance), though possibly mitigated by exclusion clauses for diseases and pandemics. Our results – the proven positive link between real GDP growth and insurance premiums – imply that the insurance business may also be hit by a drop in insurance premiums during the pandemic. Given the possible longer-term negative impact of the pandemic on economic performance, our finding is important, as it signals that the temporary one-off increase in claims may not be the most important channel through which the pandemic affects insurance companies.

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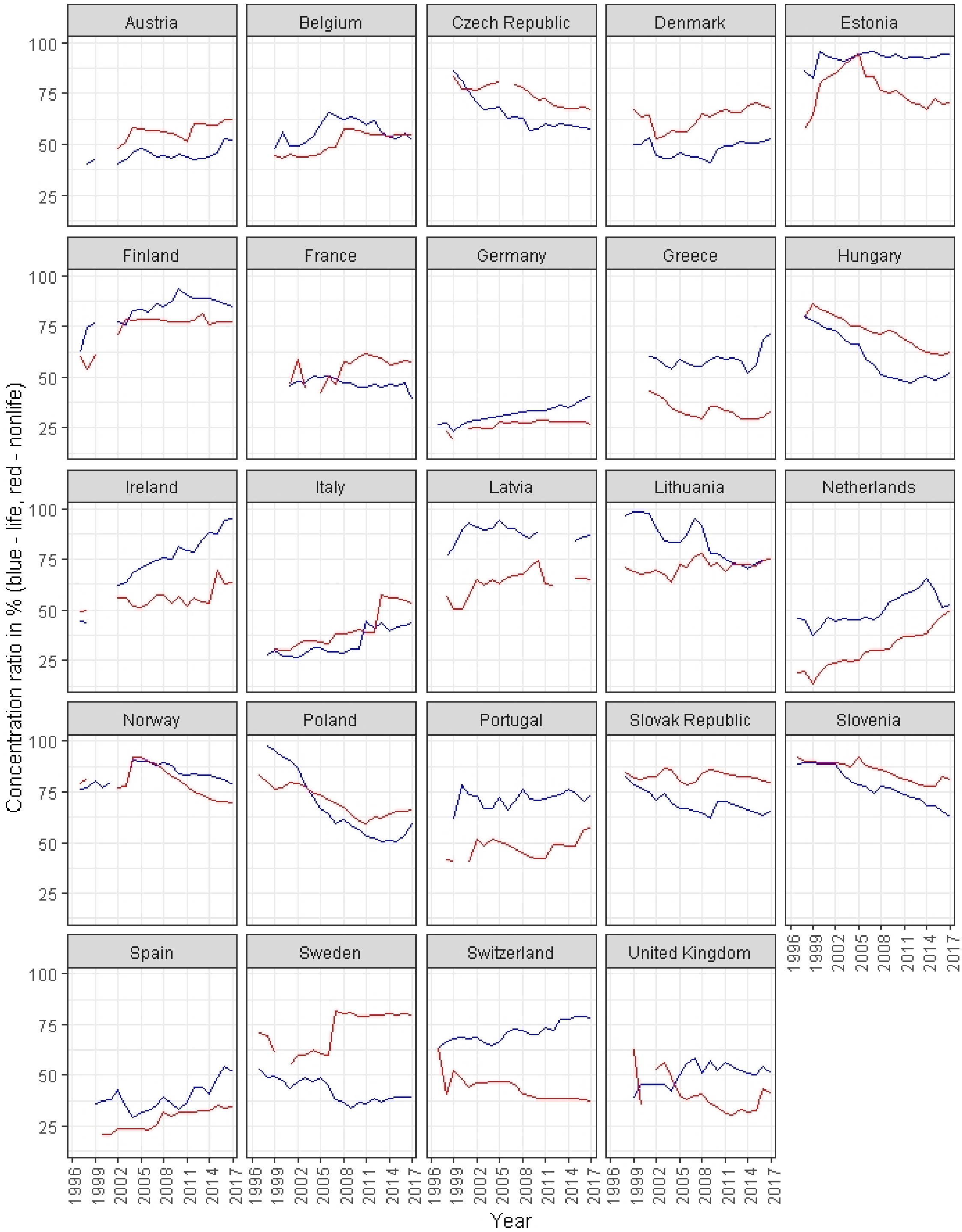
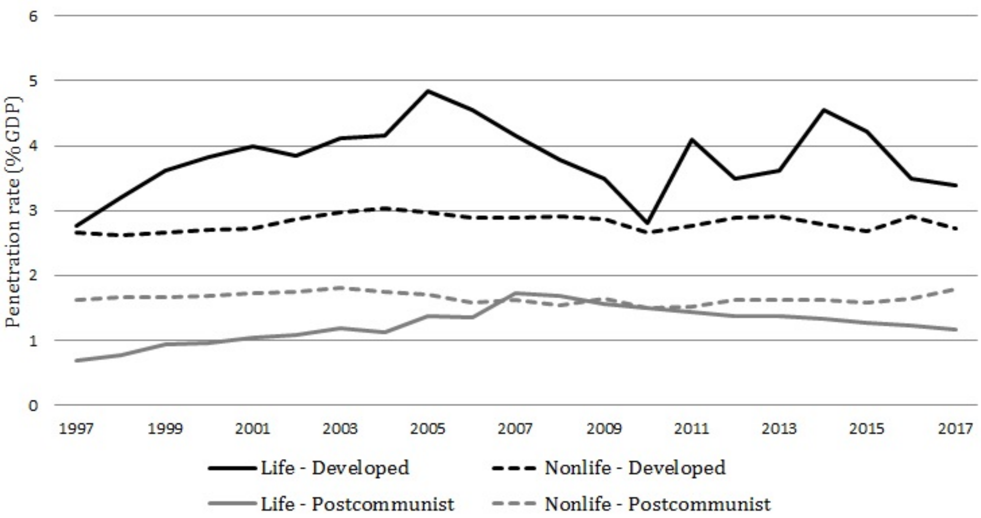
Appendix A: Robustness Checks, Data, and Charts

Figure A1: Concentration Ratios, Life and Non-Life Sector (1997–2017)



Note: Concentration ratios are based on company-level data and calculated as the market share of the four largest insurance companies providing life/non-life insurance in the given year and country.
Source: AXCO Database

Figure A2: Penetration Rates in Developed and Post-Communist Countries (1997–2017)



Source: AXCO Database and OECD Insurance Statistics Database

Table A1: Determinants of Life and Non-Life Insurance: Summary from Literature Review

Variable	Estimated effect	Browne and Kim (1993)	Outreville (1996)	Beck and Webb (2003)	Li et al. (2007)	Feyen et al. (2011)	Christophersen and Jakubik (2014)	Feyen et al. (2011)	Christophersen and Jakubik (2014)
		Life insurance						Non-life insurance	
Included in our modeling framework									
Income (GDP)	Positive	+	+	+	+	+	+	+	+
Social security	Ambiguous		NS	NS	-	-		-	
Inflation rate	Negative	-	-	-	-	+		+	
Life expectancy	Ambiguous	NS	+	NS	-	-			
Age dependency ratio	Ambiguous	+	NS	Mixed	NS	Mixed			
Financial development	Positive		+	+	+				
Market concentration	Negative		-			+		-	
Not included in our modeling framework									
Income inequality	Ambiguous			NS					
Interest rate	Ambiguous		NS	+	-				+
Population size	Positive					+		Mixed	
Population density	Positive		NS			+		Mixed	
Education	Positive	NS	NS	NS	+	NS			
Religion (Muslim)	Negative	-	NS	-		-		-	
Share of state insurers	Negative							-	
Share of foreign insurers	Positive		NS		Mixed				
Legal environment	Positive			+		+		+	
Unemployment	Negative						-		
Credit	Positive					+		+	
Private bond market	Positive					+			
Included in our modeling framework but not covered by the literature									
Savings	Positive								
Openness	Ambiguous								
Solvency II									
Crisis	Negative								

Table A2: Definitions of Variables and Expected Relationships

Variable	Units	Exp. relationship with LIFE P.	Exp. relationship with NONLIFE P.	Description of variable
LIFE P.	% change			Yearly change in premiums in %.
NONLIFE P.	% change			Yearly change in premiums in %.
SOLVENCYII	dummy (0, 1)	-	ambiguous (+/-)	Equals 1 since 2016 and 0 otherwise.
GDP_GROWTH	% change	+	+	Annual percentage real GDP growth rate.
SSCGOVREV	% of revenues	-	-	Social security contributions as % of overall government revenues.
INSHICP	pp change	ambiguous (+/-)	+	Change in harmonized consumer price index of insurance products (COICOP, CP125 – Insurance).
LIFEEXP	years (level)	-		Life expectancy at birth (LEB).
SAVINGS	% of GDP	+		Gross domestic savings as % of GDP
ADR	ratio	-	-	Old-age dependency ratio (aged 65+/aged 15–64)
FDI	change	+	+	Change in Financial Development Index (FDI)
LCONCENT	pp change	ambiguous (+/-)		Change in concentration ratio defined as market share of four largest insurance companies (in %).
NCONCENT	pp Change		ambiguous (+/-)	Change in concentration ratio defined as market share of four largest insurance companies (in %).
EXPORT	% change		ambiguous (+/-)	Annual percentage growth rate of exports.
CRISIS	dummy (0, 1)	-	-	Equals 1 in 2008 and 2009 and 0 otherwise.

Table A3: Determinants of Life and Non-Life Premiums, 1997–2017, CRISIS Dummy Not Included

	Dependent variable:			
	LIFEPREMIUMS		NONLIFEPREMIUMS	
	(1)	(2)	(3)	(4)
GDP_GROWTH	1.345***	1.056***	0.695***	0.585***
	(0.318)	(0.313)	(0.229)	(0.217)
SOLVENCYII	−8.946***	−5.528*	2.519	4.996**
	(3.228)	(2.887)	(1.752)	(2.068)
SSCGOVREV	−1.933***	−1.579**	−0.378	−0.252
	(0.610)	(0.649)	(0.549)	(0.482)
INSHICP	−0.045	−0.272**	0.696***	0.604***
	(0.177)	(0.132)	(0.075)	(0.069)
SAVINGS	0.873***	0.721**		
	(0.287)	(0.324)		
FDI	1.152**	0.886*	−0.455	−0.529
	(0.452)	(0.460)	(0.313)	(0.347)
LCONCENT	0.845***	0.898***		
	(0.306)	(0.294)		
LIFEEXP		−3.667***		−1.457***
		(0.827)		(0.480)
ADR	0.189	0.952		
	(0.699)	(0.651)		
NCONCENT			−0.010	0.020
			(0.184)	(0.194)
EXPORT			−0.116**	−0.121**
			(0.052)	(0.055)
Observations	354	354	343	343
N (countries)	24	24	20	20
R^2	0.178	0.215	0.131	0.147
Adjusted R^2	0.099	0.137	0.048	0.063
F Statistic	8.702*** (df = 8; 322)	9.784*** (df = 9; 321)	6.739*** (df = 7; 312)	6.726*** (df = 8; 311)

Note: Cluster-robust standard errors are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

Table A4: Correlation Matrix, Life Insurance Model

	SOLV.	GDP.	SSC.	INS.	LIFE.	SAV.	FDI	ADR	CRI.
SOLVENCYII									
GDP_GROWTH	0.02								
SSCGOVREV	0.02	-0.10							
INSHICP	-0.03	0.19	-0.09						
LIFEEXP	0.25	-0.23	0.03	-0.19					
SAVINGS	-0.02	-0.23	0.31	-0.06	0.28				
FDI	-0.04	-0.06	-0.06	0.05	-0.03	-0.02			
ADR	0.18	-0.04	-0.23	-0.09	0.10	-0.08	-0.03		
CRISIS	-0.06	-0.35	0.01	-0.11	0.15	0.03	0.14	-0.10	
LCONCENT	0.07	0.07	-0.12	0.06	0.17	-0.01	0.03	0.14	-0.02

Table A5: Correlation Matrix, Non-Life Insurance Model

	SOLV.	GDP.	SSC.	INS.	FDI	NONC.	EXP.
SOLVENCYII							
GDP_GROWTH	0.02						
SSCGOVREV	0.02	-0.10					
INSHICP	-0.03	0.19	-0.09				
FDI	-0.04	-0.06	-0.06	0.05			
NONCENT	0.02	0.07	0.06	0.04	-0.05		
EXPORT	0.00	0.50	-0.04	0.03	-0.19	0.02	
CRISIS	-0.06	-0.35	0.01	-0.11	0.14	-0.03	-0.18

Table A6: Non-Life Premiums Subsectors, OECD Countries 1997–2017

	Dependent variable:					
	Accident N	Property	Motor	Credit	Liability	Transit
	(2)	(3)	(4)	(5)	(6)	(7)
GDP_GROWTH	1.351**	0.851***	1.286***	0.898*	1.455***	0.703
	(0.569)	(0.154)	(0.187)	(0.493)	(0.253)	(0.432)
SOLVENCYII	9.253**	-2.788**	1.875	0.002	-4.045**	0.058
	(4.389)	(1.222)	(1.498)	(3.805)	(2.034)	(3.461)
SSCGOVREV	-1.157	-0.542**	-0.679**	0.646	-0.016	0.434
	(0.781)	(0.217)	(0.265)	(0.671)	(0.371)	(0.613)
INSHICP	0.181	0.290***	0.670***	-0.016	0.109	0.220
	(0.258)	(0.072)	(0.088)	(0.221)	(0.118)	(0.204)
FDI	0.287	0.186	0.203	0.624*	-0.111	-0.149
	(0.445)	(0.123)	(0.150)	(0.377)	(0.218)	(0.347)
NCONCENT	-0.330	0.134	0.060	-0.884**	-0.417**	-0.823***
	(0.365)	(0.100)	(0.123)	(0.370)	(0.172)	(0.283)
EXPORT	-0.160	-0.166***	-0.168**	0.124	-0.227**	-0.080
	(0.192)	(0.054)	(0.065)	(0.172)	(0.089)	(0.151)
CRISIS	0.661	-0.651	-0.511	-3.470	-2.479	-7.521**
	(4.888)	(1.349)	(1.651)	(4.266)	(2.256)	(3.814)
Observations	398	397	399	352	373	399
N (countries)	24	24	24	24	24	24
R^2	0.050	0.206	0.322	0.050	0.149	0.055
Adjusted R^2	-0.030	0.138	0.265	-0.042	0.072	-0.025
F Statistic	2.417**	11.833***	21.793***	2.088**	7.483***	2.672***
	(df = 8; 366)	(df = 8; 365)	(df = 8; 367)	(df = 8; 320)	(df = 8; 341)	(df = 8; 367)

Note: Cluster-robust standard errors are in parentheses. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

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