

# PROPERTY AND LIABILITY INSURANCE DEMAND IN THE CZECH REPUBLIC

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## Abstract

The objective of this study is to investigate empirically the relationship between property and liability insurance industry and macroeconomic and financial determinants in the Czech Republic. Further objective was to analyze selected factors that have an impact on loss ratio to verify the existence of capacity constraint theory. Estimation results revealed that Czech GDP does not have an impact on property and liability insurance, which might be caused by relatively undeveloped financial system. There was found a negative effect of gross capital formation on non life gross premium underwritten, that was probably caused by substitution effect, when company investment replaces the purchase of non-life insurance. Surprisingly, even household consumption was found to have a negative impact on non-life real gross premium. On the other hand, employment had a positive effect on real gross premium, which was in line with theory, since higher employment increases income that can be spent on property and liability insurance. Estimation results of OLS regression suggest that non life insurance cycles in the Czech Republic cannot be explained by capacity constraint theory.

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**Keywords:** Property and liability insurance demand, insurance cycles, capacity constraint theory

## Introduction

The objective of this article is to investigate empirically the relationship between property and liability insurance industry and macroeconomic and financial determinants in the Czech Republic. The focus is to assess the determinants of insurance consumption and statistics show, that households and corporate customers were underinsured in the past. An examination of floods damage revealed, that especially individuals underestimated the risk of floods because more than 50 % of damages were not protected by insurance. As a result the public financial and nonfinancial resources were used to help the victims of the floods to recover the damages.

Property and liability insurance can be defined as buying an indemnity for future losses against paying a premium today, thus transferring future wealth from an uncertain state to a certain one. In theory, property and liability insurance demand is positively correlated with risk aversion and probability of loss. Additionally, the demand is influenced by total wealth, however, the propensity to insure is dependent on the behavior of risk aversion. Mossin (1968) has analyzed four different scenarios, each concerned with rational behavior of an individual buying insurance against given risks. A part of the analyses was also the wealth effect, which was found to be negative if the individual's utility function shows risk aversion, which is decreasing with wealth. In other words, an individual with decreasing risk aversion will assume more risk the larger his wealth is.

The insurance consumption has been explained by expected utility theory in which an individual calculates expected utility of each choice. The option with the highest expected utility is the most preferable choice. Newhouse (1978) claims that the purpose of insurance policy is to convert an uncertain state, which can lead to potentially large loss into a certain tiny loss. Thus the demand for insurance is the demand for certainty because individuals prefer certain losses to actuarially equivalent uncertain ones. However, empirical studies show that individuals prefer uncertain losses to certain ones. Kahneman (1979) empirically invalidated expected utility theory as a descriptive model. If an individual follows diminishing marginal utility of wealth, then a conversion of an uncertain but potentially large loss to certain small loss benefits the consumer because greater loss would cause larger decline in utility. Falciglia (1980) proposes alternative consumption oriented model for non-life insurance demand, which emphasizes the role of interest rates, that cannot be thought of as independent for the demand. His model is based on the maximization of the expected utility of consumption in two periods and the insurer's optimal delay of payment after damages were reported to an insurance company. The role of interest rate derives from the delay mechanism between the time the damage is incurred to financial compensation from insurance coverage. However, the results were inconclusive. The relationship between the interest rates and the demand for non-life insurance was found to be negative only when the hypothesis of decreasing absolute risk aversion was accepted. In other words, higher interest rates discourage the demand for non-life insurance in case the agent is a net saver. The author found out that insurance coverage is an inferior good if decreasing absolute risk aversion dominates and only if the hypothesis of increasing absolute risk aversion is valid, the insurance demand displays downward-sloping curve.

Empirical evidence shows that countries with developed financial markets enjoy faster and more stable long-run growth and on the contrary, as

Merton (2004) claims, with undeveloped financial system which does not provide the means for transformation of technical innovation into implementation, the technological progress does not have substantial impact on the long term economic growth. Concretely, the development of banking sector and stock market was found to have a positive effect on economic growth. Khan (2000) created financial sector development indicator that was comprised of banking sector, stock and bond markets. The author found a positive effect of the financial sector development indicator on economic growth. In his work Haiss (2006) focused on the relationship between insurance sector development and economic growth. The insurance helps companies to mitigate the threat accruing from their business activity such as collection of receivables or loss of property. Moreover, pharmaceutical industry uses product liability insurance heavily and in the absence of this product pharmaceutical companies would not develop new products and services. In conclusion higher insurance consumption may lead to higher expenditure from macroeconomic point of view. Moreover, insurance consumption can increase economic efficiency and income thanks to the evolution of new products and services. Insurance companies are willing to take over the risks of their clients, which may cause higher household consumption.

### **Empirical investigation of property and liability insurance industry demand in the Czech Republic**

My research is limited by the availability of time series for property and liability insurance because different types of non-life insurance are not accessible. Moreover, the data for property and liability insurance are aggregated for the whole industry, even though it would be preferable to work with micro data. In order to identify factors influencing property and liability insurance consumption, prior research was used in this area. Concretely, the economic growth in terms of GDP (gross domestic product) was found to have a positive effect on non-life insurance by several papers. In this research the impact of economic growth on property and liability insurance will be examined. The economic growth is measured as a change of GDP, moreover, in my research I test components of GDP in terms of gross fixed investment and household consumption. I assume that both components of GDP have a positive effect on property and liability insurance. The effect of CPI (consumer price index) on non life insurance has been in previous works inconclusive and several authors have measured negative effect. The influence of CPI is thus unclear - depending on risk aversion and the financial situation of insurers, whether they are net savers or borrowers. Previous research on life insurance consumption found out that real wage had statistically significant positive impact on demand for life

insurance. Above mentioned relationship will be tested in my work. Short term interest rates in terms of PRIBOR (Prague interbank offer rate) will be examined in relation to non-life insurance, however, the expected effect is unclear. A positive effect of the number of employed persons on non life insurance consumption is expected.

In my research I have been using secondary data which have been obtained mainly from CNB (Czech National Bank) and CZSO (Czech Statistical Office). Since the Czech Republic started its transformation from centrally planned economy to market oriented economy in 1989, macroeconomic and financial statistics are available from 1995 and 2001 respectively. For this reason annual time series are short and quarterly statistics must be used.

The description of time series with shortcuts used in the model is presented in table 1.

**Table 1:** Description of time series used in model

<i>Dependent variable</i>	<i>Shortcut</i>	<i>Specification</i>
Real gross premium	RGP	Gross premium underwritten in non-life industry in the Czech Republic modified by consumer price index to get real values.
<i>Independent variables</i>		
Household consumption	HOUSECON	Final consumption expenditure of households modified by consumer price index to get real values.
Gross capital formation	GCF	Gross capital formation modified by consumer price index to get real values.
Consumer price index	CPI	Consumer price index is an index of consumer prices of goods and services which characterizes the average price development in the country.
Average real wage	REALWAGE	Average monthly wage in real terms.
PRIBOR	PRIBOR	Prague interbank offered rate.
Employment	EMPLOYM	Number of employed persons in the Czech Republic
Gross domestic product	GDP	Gross domestic product in the Czech Republic in constant prices.

Source: CNB, CZSO

Depicted time series are tested for stationarity with ADF (augmented Dickey-Fuller) test and majority of data enter regression model with first or second differences. First model tested all variables in table 1 except GDP which was replaced by gross capital formation and household consumption. Regression model in table 2 analyses the relationship between the dependent variable in terms of real gross premium and independent variables. Estimation results showed insignificant negative effect of gross capital formation on gross premium underwritten in the Czech Republic, which was unexpected. The result suggests that non-life insurance market in the Czech Republic is still relatively undeveloped and company investment discourage demand for property and liability insurance. There is probably substitution

effect, when company investment replaces non-life insurance consumption. Surprisingly, household consumption was found to have a negative impact on non-life real gross premium, however, it is worth to mention, that both household consumption and GDP are integrated of order 2 and the rest of time series of order 1. For this reason the effect of household consumption on real gross premium might not be conclusive. The reason for the negative impact of household consumption on real gross premium might be again substitution effect, in which higher household consumption drives out insurance consumption. Other independent variables in table 2 are insignificant, which might change when the model is modified.

**Table 2:** Estimation results for the OLS regression

Dependent Variable: D(RGP)				
Method: Least Squares				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GCF)	-0.036309	0.020207	-1.796914	0.0799
<b>D(HOUSECON,2)</b>	<b>-0.030063</b>	<b>0.009678</b>	<b>-3.106175</b>	<b>0.0035</b>
D(CPI)	127.0080	424.9544	0.298874	0.7666
D(REALWAGE)	92.39663	210.2149	0.439534	0.6626
D(PRIBOR)	280.9627	861.6724	0.326067	0.7461
D(EMPLOYM)	0.000817	0.002980	0.274028	0.7855
C	180.2604	417.8765	0.431373	0.6685
R-squared	0.727195	Mean dependent var		293.1610
Adjusted R-squared	0.686274	S.D. dependent var		3595.131
F-statistic	17.77082	Durbin-Watson stat		2.704052
Prob(F-statistic)	0.000000			

**Source:** Own calculations. In column Prob there are located p-values for each factor influencing the dependent variable real gross property and liability premium in the Czech Republic. Presented time series are tested by ADF test and show stationarity. Bold denotes statistical significance at the 5 % level.

Based on the findings from the previous regression model, household consumption and gross capital formation are replaced by gross domestic product, which is delayed by one quarter in a new model depicted in table 3. Moreover, dummy variable was included in the new model to mitigate the impact of the floods that damaged the Czech Republic in 2002, and the financial damage reached record level of over CZK 75 bln. Above stated model is presented in the equation below and the OLS estimation results are stated in table 3.

$$\Delta RGP_t = a_1 + \beta_1 \Delta GDP_{(t-1)} + \beta_2 \Delta EMPLOYM + \beta_3 \Delta CPI + \beta_4 DUMMY + \varepsilon_t$$

Table 3: Estimation results for the OLS regression

Dependent Variable: D(RGP)				
Method: Least Squares				
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 4.0000)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
<b>DGDP(-1)</b>	<b>0.029060</b>	<b>0.009017</b>	<b>3.222662</b>	<b>0.0025</b>
<b>D(EMPLOYM)</b>	<b>0.011822</b>	<b>0.004716</b>	<b>2.506681</b>	<b>0.0162</b>
<b>DUMMY</b>	<b>9496.394</b>	<b>320.8171</b>	<b>29.60064</b>	<b>0.0000</b>
<b>D(CPI)</b>	<b>1604.942</b>	<b>479.3565</b>	<b>3.348119</b>	<b>0.0018</b>
<b>C</b>	<b>-926.8697</b>	<b>240.9442</b>	<b>-3.846823</b>	<b>0.0004</b>
R-squared	0.506497	Mean dependent var		288.5000
Adjusted R-squared	0.458350	S.D. dependent var		3634.713
F-statistic	10.51987	Durbin-Watson stat		2.417312
Prob(F-statistic)	0.000006			

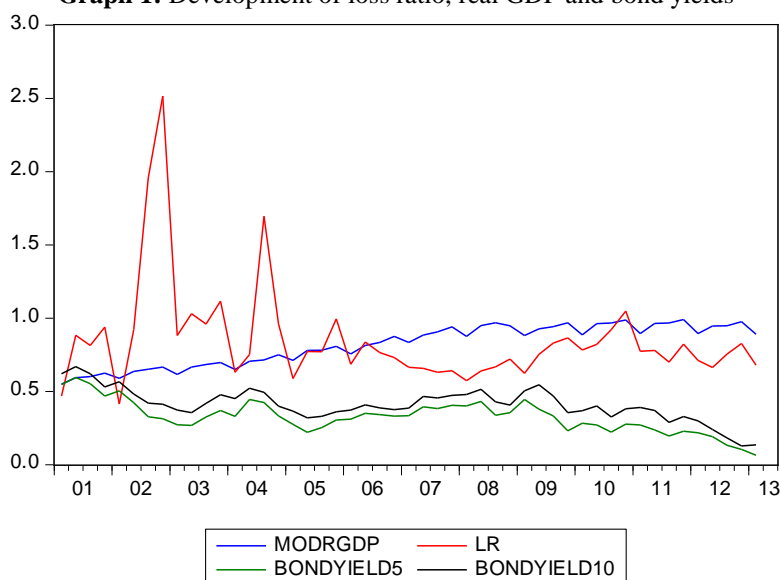
**Source:** Own calculations in Eviews. In column Prob there are located p-values for each factor influencing the dependent variable real gross property and liability premium in the Czech Republic. Presented time series are tested by ADF test and show stationarity. Bold denotes statistical significance at the 5 % level. The regression model in table 3 showed signs of residual autocorrelation, for this reason Newey-West estimator is used to deal with the problem to provide robust estimate of covariance matrix.

The time series of gross domestic product were delayed by one quarter because of different order integration and economic explanation. Real gross domestic product delayed by one quarter has positive influence on non-life real gross premium, which can be seen in table 3. The growth in Czech GDP seems to motivate individuals and companies to consume more property and liability insurance next quarter, which might be caused by higher wealth assuming that the wealth increases with higher GDP. The employment has positive effect on real gross premium, which was expected. Higher employment increases income which can be used to purchase property and liability insurance. Companies usually hire employees when the economy is booming and they have evidence, that the demand for their products will be strong in the future. In the literature the effect of consumer price index on real gross premium is ambiguous and my estimation results show positive impact. The explanation might be, that inflation rate measured by CPI goes up with the interest rates, which rise, when the economic output is increasing.

Many authors have described cycles in property and liability insurance markets by capacity constraint theory. Insurance company has capacity constraint in terms of financial resources that are used to provide insurance to clients. When capacity is low (insurance companies have limited amount of financial resources because e.g. large catastrophes have occurred, insurance industry has lower net worth, which leads to higher insurance prices and higher underwriting margin. As Stewart (1984) claims,

lack of capacity causes underwriting cycles because higher insurance prices mitigate the amount of premium written. Subsequently, profit increases retained earnings that escalate industry net worth, which leads to lower insurance prices and decline in profitability. Gron (1994) claims, that when actual cost inflation is higher than expected, insurance loss payments increase, which may lead to lower underwriting margin. In the case of the Czech Republic the capacity constraint theory cannot be tested due to the lack of data. However, Smith (1989) has found strong relationship between insurance prices as measured by the loss ratio and bond yields. Insurance investment returns are influenced by bond yields, since the majority of insurer assets are invested in bonds. Smith examined U.S. stock property and liability insurance companies during 1950-1982 and found positive effect of bond yields on loss ratio. Graph 1 depicts the development of loss ratio, real GDP and bond yields in the Czech Republic. From the graphical analysis loss ratio (red curve with shortcut LR) shows signs of heteroscedasticity and there is no visible correlation with other variables. Real GDP (blue curve with shortcut MODRGDP) in the Czech Republic has stagnated since 2008 and bond yields (green curve presents bond yields with 5-year maturity and black curve is bond yields with 10 year maturity) have diminished substantially.

**Graph 1:** Development of loss ratio, real GDP and bond yields



**Note:** On the horizontal axis there is portrayed time between 2001 and 2013. Read curve depicts the development of loss ratio in the Czech Republic that spiked during 2002 because of flood damage. Blue curve portrays real GDP in the Czech Republic divided by 1 million and green curve presents bond yield with 5-year maturity and black curve is bond yield with 10-year maturity.

In the equation below a model that analyzes the impact of bond yields and GDP on loss ratio is proposed. The suggested effect of independent variables on loss ratio should be positive.

$$\Delta LR_t = a_1 + \beta_1 \Delta GDP_t + \beta_2 \Delta BONDYIELD5 + \beta_3 \Delta BONDYIELD10 + \varepsilon_t$$

LR – Loss ratio for property and casualty insurance companies in the Czech Republic

GDP – Real gross domestic product in the Czech Republic

BONDYIELD5 – Czech sovereign bond yield with 5-year maturity

BONDYIELD10 – Czech sovereign bond yield with 10-year maturity

Estimation results for the OLS regression are displayed in table 4.

The tested effect of bond yields on loss ratio is inconceivable because their impact is contradictory and statistically insignificant. Real GDP was found to be insignificant and had the positive sign, which is in accordance with theory.

**Table 4:** Estimation results for the OLS regression

Dependent Variable: D(LR)				
Sample (adjusted): 2001Q3 2013Q1				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(BONDYIELD5)	0.012565	0.230241	0.054574	0.9567
D(BONDYIELD10)	-0.039950	0.229143	-0.174348	0.8624
D(RGDP,2)	1.22E-06	7.28E-07	1.676323	0.1009
C	-0.004096	0.058195	-0.070375	0.9442
R-squared	0.061656	Mean dependent var		-0.004328
Adjusted R-squared	-0.003809	S.D. dependent var		0.388037
F-statistic	0.941810	Durbin-Watson stat		2.254620
Prob(F-statistic)	0.428824			

**Source:** Own calculations in Eviews. In column Prob there are located p-values for each factor influencing the dependent variable loss ratio. Presented time series are tested by ADF test and show stationarity. Bold denotes statistical significance at the 5 % level.

Loss ratio is ratio of total loss incurred divided by the total premium earned. The premium earned was positively influenced by delayed GDP, employment and CPI in table 3. On the other hand, incurred losses are probably influenced by other factors than financial or macroeconomic ones.

## Conclusion

My research focused first on factors that determine property and liability insurance consumption in the Czech Republic and second objective was to test selected factors that have an impact on loss ratio. Estimation results revealed that Czech GDP does not have an impact on property and liability insurance, which might be caused by relatively undeveloped financial system. Relatively undeveloped financial system does not have



substantial impact on the long term growth of the economy. Surprisingly, household consumption was found to have a negative impact on non-life real gross premium which was probably caused by the substitution effect, in which higher household consumption drives out insurance consumption. When real gross domestic product was delayed by one quarter, positive influence on non-life real gross premium was measured. The employment had positive effect on real gross premium, which was in line with theory, since higher employment increases income that can be spent on property and liability insurance. The effect of consumer price index on real gross premium was in prior studies ambiguous, however, my estimation results show positive impact. The explanation might be, that inflation rate measured by CPI correlates with the interest rates which rise, when the economic output is increasing. Another objective was to test selected variables on loss ratio to verify whether property and liability insurance cycles are caused by capacity constraint theory. Since the data for verification of the existence of capacity constraint theory were not available, the objective was to test only a part of the theory that counts with positive relationship between insurance prices as measured by the loss ratio and bond yields. In my study the positive relationship was not duplicated, since the tested effect of bond yields on loss ratio was statistically insignificant and inconceivable because bonds yields with different maturity had contradictory impact. Moreover, real GDP was found to have insignificant effect on loss ratio with the positive sign, which was in accordance with theory. Estimation results suggest that property and liability insurance cycles in the Czech Republic cannot be explained by capacity constraint theory.

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