VOLATILITY OR CYCLICALITY: THE POLISH NON-LIFE INSURANCE MARKET

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─Abstract ─

The underwriting cycle is defined as alternating periods of hard markets in which insurance prices and insurer profitability are high and soft markets with low insurance prices and low insurer profitability. Most of the research confirming the existence of cycles relies on the time series behavior of published underwriting information on loss ratios and underwriting profits. In the insurance literature it is suggested that individual insurance markets (national, products markets) are subject to cyclicality. The purpose of this research is to rigorously investigate cyclicality of the Polish insurance market and assess its volatility formally. If a cycle is found, we also investigate the cycle length. We analyzed loss ratio data for the period 1991-2011 (i.e. after the economic transformation) for non-life insurance market in Poland: aggregated and disaggregated into 18 insurance classes. A second-order autoregressive model proposed by Venezian (1985) is used to obtain the parameters for testing for the existence of the underwriting cycle. The coefficient of variation (C_V) and year to year changes in loss ratios are used to assess volatility.

Key Words: *underwriting (insurance) cycle, Polish insurance market, volatility, cyclicality.*

JEL Classification: C22, E32, F44, G22

1. INTRODUCTION

The underwriting cycle refers to a repeating series of phases that insurance markets go through (Niehaus and Terry, 1993; Harrington and Danzon, 1994). The sequence of "hard" and "soft" markets may be observed in prices, profitability, and supply (capacity) for insurance. In a "hard" market, the supply of insurance coverage shrinks amid high and rising insurance prices and profitability. In a "soft" market, the availability of insurance coverage expands as prices and profits tumble. The underwriting cycle does not necessarily synchronize with the general business cycle. In fact it is much more regular than the general business cycle.

Many studies have shown that an underwriting cycle exists in the United States insurance market (Venezian, 1985; Cummins and Outreville, 1987; Doherty and Kang, 1988; Grace and Hotchkiss, 1995; Lamm-Tennant and Weiss, 1997), in other developed countries (Cummins and Outreville, 1987; Lamm-Tennant and Weiss, 1997; Chen et al., 1999), as well as in different lines of insurance (Venezian, 1985; Cummins and Outreville, 1987; Lamm-Tennant and Weiss, 1997; Chen et al., 1999). The average cycle length is about six to seven years (Venezian, 1985; Cummins and Outreville, 1987), but sometimes reaches even 18 years (Lamm-Tennant and Weiss, 1997).

The typical description of the cycle includes four phases. The first phase is characterized by a period of low profitability (recession). In that phase premiums begin to increase and capacity starts to shrink. This is followed by a sudden change to rapidly increasing profitability (crisis) – rates are very high and capacity is restricted because many insurers have left the market. In the third stage (revival), profitability remains high but is no longer increasing. Premiums begin to decrease and capacity increases. Profitability gradually declines during the last stage (boom). The industry returns to a period of low profitability as there is too much capacity and rates are quite low (Gron, 1994).

Many causes for the underwriting cycle have been posited in the literature. One school of thought suggests that the causes are irrational behavior such as competitor-driven pricing and naive rate-making processes. Another school of thought, that is related to the rational expectations/institutional intervention hypothesis, does not agree that insurance markets and insurers are irrational. Instead, it suggests that the underwriting cycle is created by external factors and market characteristics that are outside the control of insurers. These factors include externalities affecting data collection, the regulatory approval process, policy renewal and accounting lags, interest rates changes, stock market inefficiencies, and the general business cycle (Chen et al., 1999).

Numerous studies and debates relating to the two schools of thought exist. Extant studies discuss specific reasons/explanations for the underwriting cycle such as: forecasting errors (Venezian, 1985), insurer moral hazard (Harrington and Danzon, 1994), arbitrage theory (Cummins and Outreville, 1987), risky debt (Cummins and Danzon, 1997), interest rate variation (Fields and Venezian, 1989), capacity constraints (Gron, 1994; Niehaus and Terry, 1993; Winter, 1994) and underwriters' sentiment (Boyer, 2006). Nevertheless, there is no integrated theory concerning the causes of the underwriting cycle.

As we mention earlier an underwriting cycle exists on national insurance markets and in different lines of insurance. However, volatility may be an alternative explanation for the crises and booms observed in the industry, or it may exist in conjunction with cycles. Volatility in this context concerns the relative rate at which market indicators (e.g., loss ratios) move up and down.

Cursory analysis of the results of the Polish insurance market through its history (after the economic transformation) shows some fluctuations. The evidence presented above is based on casual market observations, however, not rigorous statistical analysis. Thus, the purpose of this paper is to provide a rigorous analysis of the non-life insurance market in Poland to determine whether it is just cyclical in nature, volatile or both. As part of this research, the stability of this insurance market will be investigated. The analysis proceeds by analyzing aggregated (for the whole non-life insurance market) and disaggregated (for separate classes) loss ratio data from 1991 to 2011 (1994-2011 in case of disaggregated data). Volatility is assessed through the coefficient of variation and observing changes in loss ratios from year to year. To determine whether an underwriting cycle exists, a second-order autoregressive model proposed by Venezian (1985) is estimated, and the parameters from this model are used to test for the existence of an underwriting cycle. If a cycle is detected, the cycle period is estimated as well.

2. DATA

As in most studies on insurance cycles, first of all, aggregated yearly data for property and casualty insurance are used in this paper. We analyzed loss ratio[1] (LR) data for the recent period 1991-2011 (twenty-one observations), i.e. after the economic transformation. Nevertheless, Stewart (1987) showed that the developments of individual lines of insurance differ and that the cycles do not coincide. Also Venezian (1985), Fields and Venezian (1989), Haley (1995), Lamm-Tennant and Weiss (1997), Berry-Stölzle and Born (2010) found cycles of varying length for different lines of business. Thus, in addition the analysis was extended to all 18 classes of non-life insurance market (branch II). In this case, because of data availability, annual loss ratio data from 1994 to 2011 (eighteen observations) were used to conduct time-series estimation. The summary statistics are found in table 1. All loss ratio data were obtained from the Annual Bulletins

[1] Gross claims paid divided by gross written premiums.

(different years) of Polish Financial Supervision Authority. In addition, for purposes of comparison, written insurance premium in OECD countries are analyzed as a control variable, with the expectation that these data should be relatively stable. (we use the latest available data: 1991-2009) (OECD, 2010).

Table 1: Summary statistics for loss ratio in years 1994-2011

Class of Insurance		loss ratio[a]			class average share
No	Name	mean	min value	max value	
1	Accident	0,36	0,18	0,53	5,04%
2	Sickness	0,40	0,31	0,46	1,21%
3	Motor	0,67	0,53	0,80	27,96%
4	Railway rolling stock	0,20	0,00	0,68	0,05%
5	Aircraft	0,55	0,09	1,58	0,12%
6	Marine	0,72	0,33	1,22	0,59%
7	Transport	0,31	0,14	0,55	0,73%
8	Fire and natural forces	0,48	0,28	1,08	10,70%
9	Other property losses	0,41	0,28	0,58	7,52%
10	Motor vehicle liability	0,67	0,57	0,97	35,22%
11	Aircraft liability	0,38	0,02	4,72	0,14%
12	Marine liability	0,61	0,22	1,53	0,20%
13	General liability	0,34	0,24	0,50	4,34%
14	Credit	0,34	0,10	1,03	1,77%
15	Suretyship	0,25	0,00	0,90	1,11%
16	Financial risks	0,28	0,07	1,06	2,05%
17	Legal protection	0,13	0,00	0,41	0,27%
18	Assistance	0,42	0,15	0,59	0,99%
All 18 classes[b]		0,58	0,50	0,62	100%

[a] loss ratio = claims paid / gross written premium
[b] simple period: 1991 - 2011

3. METHODOLOGY

To assess volatility the time-series behavior of LR is analyzed. We use method proposed by Manikowski (2011) One measure of volatility is the coefficient of variation (C_V). The C_V is a statistical measure of the dispersion of data points in a data series around the mean. It is calculated as follows:

$$C_V = \frac{\text{Standard deviation}}{\text{Mean}} \quad (1)$$

The coefficient of variation is a useful statistic for comparing the degree of variation from one data series to another, even if the means of the series are dramatically different from each other. We compare the C_V for the control variable – OECD premium (0,336) with aggregated and aggregated loss ratios. If estimated C_V for LR is significantly higher than for the control variable (exceeding 150% of its value), we assume volatility (thus, the volatility can be observed if the C_V exceeds 0,5).

Year to year changes in LR are estimated also, as the second measure of volatility. The relationship between LR in period t and t-1 can also be estimated as follows:

$$\Delta LR_t = \frac{LR_t}{LR_{t-1}} \quad (2)$$

where ΔLR_t is the change in loss ratio in period t, LR_t is the value of loss ratio in period t and LR_{t-1} is the value of loss ratio in period t-1. The scale of changes (both minimal and maximal changes) are evaluated. That is, changes are divided into: (1) significant (large) changes: $\Delta LR_t<75\%$ or $\Delta LR_t>125\%$ - demonstrating volatility of the time-series, and (2) insignificant (small) changes: $75\%<\Delta LR_t<125\%$ - suggesting stability of the time-series.[2] We assume volatility if the number of significant changes is higher than the number of insignificant ones.

To determine whether an underwriting cycle exists, a second-order autoregressive model proposed by Venezian (1985) is estimated, and the parameters from this model are used to test for the existence of the underwriting cycle. Parameters needed to measure the cycle period are obtained by estimating the following autoregressive model with ordinary least squares:

$$LR_t = a_0 + a_1 LR_{t-1} + a_2 LR_{t-2} + \omega_t \quad (3)$$

where LR_t is the value of loss ratio in period t, and ω_t is a random error term.

A cycle is present if $a_1 > 0$, $a_2 < 0$ and $(a_1)^2 + 4a_2 < 0$ (Venezian, 1985). This model is now well-established for conducting underwriting cycle tests. The cycle period, assuming a cycle is present, can be expressed as follows:

$$T = \frac{2\pi}{\cos^{-1}\left(\frac{a_1}{2\sqrt{-a_2}}\right)} \quad (4)$$

The tests and analyses of cycles are performed in two steps. First, tests are performed to determine whether underwriting cycles exist. Next, cycle period lengths are estimated, if a cycle is detected. The first stage of the underwriting

[2] These values are based on legal solutions connected with the creation of an equalization provision. According to these rules a significant change of loss ratio means year to year increase of at least 25% or at least 20% decrease.

cycle analysis consists of estimating equation (3) using loss ratio data for whole non-life insurance market (aggregated data) and for each of its 18 classes (disaggregated data). Because of data availability the equation (3) is estimated using two different time series: 1991-2011 (whole non-life market) and 1994-2011 (separate classes). We repeat the analysis just described by adding a linear time trend to each equation. Thus, we obtain 38 sets of results. All equations are estimated using ordinary least squares. The period of the cycle, if a cycle is observed, is estimated from equation (4).

4. RESULTS

The results of the volatility tests are found in Table 2. In terms of the coefficient of variation as well as year to year changes, aggregated LR (for all 18 classes) appears to be stable. When used for comparison, the Cv is over three times lower than for time-series of the control variable (written premium in OECD countries). Moreover, all year to year changes are insignificant (75%<Δ<125%).

Table 2: Volatility tests: loss ratios in years 1994-2011

Class of Insurance		coefficient of variation	min change	max change	No of changes:			Volatility
No	Name				Δ<75%	75%<Δ <125%	Δ>125%	
1	Accident	0,311	78%	121%	0	17	0	No
2	Sickness	0,090	85%	139%	0	16	1	No
3	Motor	0,132	86%	128%	0	16	1	No
4	Railway rolling stock	1,006	0%	1091%	4	4	9	Yes
5	Aircraft	0,630	18%	784%	7	4	6	Yes
6	Marine	0,373	55%	145%	1	11	5	No
7	Transport	0,394	69%	147%	2	12	3	No
8	Fire and natural forces	0,456	44%	387%	3	11	3	No
9	Other property losses	0,189	79%	138%	0	16	1	No
10	Motor vehicle liability	0,181	72%	116%	1	16	0	No
11	Aircraft liability	2,847	3%	637%	7	3	7	Yes
12	Marine liability	0,524	27%	207%	6	6	5	Yes
13	General liability	0,234	67%	156%	1	14	2	No
14	Credit	0,639	32%	256%	7	1	9	Yes
15	Suretyship	0,811	0%	340%	4	5	8	Yes
16	Financial risks	0,950	24%	192%	6	4	7	Yes
17	Legal protection	1,082	0%	1335%	5	10	2	Yes
18	Assistance	0,284	77%	176%	0	14	3	No
All 18 classes[a]		0,101	87%	118%	0	20	0	No
OECD premium[b]		0,336	97%	126%	0	18	1	No

[a] simple period: 1991 - 2011
[b] control variable – simple period: 1991 - 2009

Thus, the aggregated LR is not volatile. Similarly 10 classes (1-3, 6-10, 13, 18) of property-casualty insurance market in Poland are not volatile, either. They looks to be stable both in terms of the Cv and year to year changes. However, for some classes there are several significant year to year changes and Cv is just below the limit – especially we can observe this for class 8 (fire and other natural forces) – but in this case even the presence of volatility would not be surprising, as changing of the LR for that class is natural. In contrast, classes connected with motor vehicle insurance (classes 3 and 10) are very stable. Only in case of 8 classes (4-5, 11-12, 14-17) volatility is confirmed. However, the share in the non-life insurance market for each of these classes is very low, thus volatility is not surprising. Especially, classes 4, 11, 17 are subject to very large fluctuations.

Table 3 reports the results of the underwriting cycle analysis. Loss ratio for the whole non-life insurance market in Poland demonstrates cyclicality. In both models, whether with or without a time trend cycles with a period 5,3 and 6,2 years respectively can be observed.

Table 3: Results of tests for cycle existence for loss ratios in years 1994-2011

Class of Insurance		Without trend[a]		With trend[b]	
No	Name	Cycle	Period	Cycle	Period
1	Accident	Yes	6,63	Yes	5,04
2	Sickness	Yes	4,10	Yes	4,13
3	Motor	No	N/A	No	N/A
4	Railway rolling stock	No	N/A	Yes	5,39
5	Aircraft	No	N/A	No	N/A
6	Marine	No	N/A	Yes	4,03
7	Transport	No	N/A	Yes	5,89
8	Fire and natural forces	No	N/A	No	N/A
9	Other property losses	No	N/A	No	N/A
10	Motor vehicle liability	Yes	4,50	Yes	4,50
11	Aircraft liability	Yes	4,89	Yes	4,23
12	Marine liability	No	N/A	No	N/A
13	General liability	Yes	6,77	Yes	5,70
14	Credit	Yes	5,46	Yes	5,49
15	Suretyship	Yes	39,72	Yes	18,69
16	Financial risks	Yes	7,27	Yes	5,81
17	Legal protection	No	N/A	No	N/A
18	Assistance	No	N/A	No	N/A
	All 18 classes[c]	Yes	6,21	Yes	5,27

[a] the OLS equation estimated is $LR_t = a_0 + a_1LR_{t-1} + a_2LR_{t-2} + \omega_t$
[b] the OLS equation estimated is $LR_t = a_0 + a_1LR_{t-1} + a_2LR_{t-2} + a_3Trend + \omega_t$
[c] simple period: 1991 – 2011
N/A – not available – a cycle does not exist

Also the existence of cycles was partly confirmed for disaggregated data. We find cycles for 11 classes (1-2, 4, 6-7, 10-11, 13-16) with the periods in majority of cases ranging between 4,1 and 6,8 years. Only for the class 15 (suretyship) results suggest extremely long periods – over 18 and 39 years – that raises concern if a cycle really exists. Hence, the empirical evidence only partially confirms cyclicality. The results demonstrate the presence of underwriting cycles in the Polish non-life insurance in over half of the cases (21 out of 38 cases: 2 out of 2 cases for aggregated LR and 19 out of 36 cases for disaggregated data).

Observed lengths of the cycles are comparable or a little bit shorter than in other countries and lines of insurance. In earlier research based on underwriting profits and loss ratios, underwriting cycle lengths in different lines of insurance and in different countries are usually in the range of about 5 to 10 years (the average is about 6-7 years), with only very few instances exceeding that range (Venezian, 1985; Cummins and Outreville, 1987; Lamm-Tennant and Weiss, 1997; and Chen et al., 1999). For example cycle length in motor insurance varies from 4-5 years in Australia, Canada, Denmark, Germany, France, Switzerland, the USA, and Taiwan; it ranges from 6-7 years in Italy, Japan, Singapore, and almost 10 years in Spain. For fire insurance the results are not very different: 4-5 years in Australia, the Netherlands, the USA and South Korea, 6-7 years in Canada, Denmark, Germany and Japan, as well as about 10 years in Malaysia.

5. CONCLUSION

Underwriting cycles are common in many lines of insurance and have been found to exist in many countries. Thus, the purpose of this research has been to investigate whether the non-life insurance market in Poland is volatile and/or cyclical over the period after the economic transformation, i.e. from 1991 to 2011.

The results indicate that the non-life insurance market in Poland appears to be both volatile and/or cyclical. More specifically, LR for the whole market looks to be cyclical, but the results for separate classes are different in almost each case. However, cyclicality for insurance classes was confirmed more often (19 out of 36 cases) than volatility (8 out of 18 cases). Moreover, volatility usually exists for classes with small premium volume. In contrast, cycles exist for the whole market and both for classes with big (for example class 10) and small (for example class 11) premium volume. Thus, the Polish non-life insurance market appears to be more cyclical than volatile.

Concluding the paper we can say that:

- some aspects of volatility and cyclicality was confirmed for Polish non-life insurance market: some classes are just cyclical (1-2, 6-7, 10, 13) and the other only volatile (5, 12, 17). On the other hand in some cases (classes: 4, 11, 14-16) both volatility and cyclicality was confirmed, but classes 3, 8-9, 18 demonstrate nor volatility nor cyclicality,

- cycles are confirmed more often for models with a time trend than without,
- observed lengths of the cycles are comparable with the results of earlier studies for different countries and lines of insurance, however in Poland the cycles length is usually a little bit shorter.

BIBLIOGRAPHY

Berry-Stölzle, Thomas and Patricia Born (2010), "Regulation, Competition and Cycles: Lessons from the Deregulation of the German Insurance Market", *Journal of Insurance Regulations*, Vol. 28, No. 2, pp.105-139.

Boyer, Martin (2006), "Underwriting Cycles and Underwriter Sentiment", *Proceedings from ARIA Annual Meeting 2006*, ARIA.

Chen, Renbao, Kie Ann Wong and Hong Chew Lee (1999), "Underwriting Cycles in Asia", *Journal of Risk and Insurance*, Vol. 66, No. 1, pp. 29-47.

Cummins, David and Francois Outreville (1987), "An International Analysis of Underwriting Cycles", *The Journal of Risk and Insurance*, Vol. 54, No. 2, pp.246-262.

Doherty, Neil and James Garven (1995), "Insurance Cycles: Interest Rates and the Capacity Constraint Model", *Journal of Business*, Vol. 68, No. 3, pp. 383-404.

Doherty, Neil and Han Bin Kang (1988), "Interest Rates and Insurance Price Cycles", *Journal of Banking and Finance*, Vol. 12, No. 2, pp. 199-214.

Fields, Joseph and Emilio Venezian (1989), "Interest Rates and Profit Cycles: A Disaggregated Approach", *The Journal of Risk and Insurance*, Vol. 56, No. 2, pp.312-319.

Grace, Martin and Julie Hotchkiss (1995), "External Impacts on the Property-Liability Insurance Cycle", *The Journal of Risk and Insurance*, Vol. 62, No. 4, pp.738-754.

Gron, Anne (1994), "Capacity Constraints and Cycles in Property-Casualty Insurance Markets", *RAND Journal of Economics*, Vol. 25, No. 1, pp. 110-127.

Haley, Joseph (1995), "A by-line cointegration analysis of underwriting margins and interest rates in the Property-Liability Insurance Industry", *Journal of Risk and Insurance*, Vol. 62, No. 4, pp. 755-63.

Harrington, Scott and Patricia Danzon (1994), "Price Cutting in Liability Insurance Markets", *Journal of Business*, Vol. 67, No. 4, pp.511-538.

Lamm-Tennant, Joan and Mary Weiss (1997), "International Insurance Cycles: Rational Expectations/Institutional Intervention", *The Journal of Risk and Insurance,* Vol. 64, No. 3, pp.415-439.

Manikowski, Piotr (2011), „Zmienność i cykliczność rynku ubezpieczeń satelitarnych", *Zeszyty Naukowe Uniwersytetu Ekonomicznego w Poznaniu*, No. 181, pp.124-131.

Niehaus, Greg and Andy Terry (1993), "Evidence on the Time Series Properties of Insurance Premiums and Causes of the Underwriting Cycle: New Support for the Capital Market Imperfection Hypothesis", *The Journal of Risk and Insurance,* Vol. 60, No. 3, pp. 466-479.

OECD (2010), Insurance activity indicators. OECD Insurance Statistics (database), http://www.oecd-ilibrary.org/content/datacollection/ins-data-en, DOI:10.1787/data-00333-en; [Accessed 24.03. 2012].

Stewart, Barbara (1987), "Profit cycles in property-liability insurance", (in: Everett Randall-Ed., *Issues in Insurance*, 4th ed., Vol. 2), Malvern, PA: AIPLU, pp.111-174.

Venezian, Emilio (1985), "Ratemaking Methods and Profit Cycles in Property and Liability Insurance", *The Journal of Risk and Insurance,* Vol. 52 (3), pp. 477-500.

Winter, Ralph (1994), "The Dynamics of Competitive Insurance Markets", *Journal of Financial Intermediation*, Vol. 3, No. 4, pp. 379-415.