The Reinsurance Price and the Insurance Cycle

By

Ursina B. Meier
J. François Outreville

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ABSTRACT:

The fluctuations in the price of reinsurance during the past ten years have been documented recently in the business literature. Reinsurance allows a primary insurer to increase its premium volume by more than would otherwise be possible with a given amount of capital. If the price of reinsurance decreases, reinsurance becomes more affordable for insurance companies and this will be reflected in more capacity, price competition and at the end an increase in the loss and combined ratio. This paper examines the existence of an underwriting cycle in property-liability insurance for France, Germany and Switzerland over the recent period 1982-2001 in connection with the price of reinsurance in Europe during the same period.

Correspondence:

Ursina B. Meier	J. Francois Outreville
Brunnmattstrasse 69,	UNOG - Palais des Nations
3007 Bern	CH 1211 Geneva 10
+41 31 371 57 18	+41 22 917 32 11
ursina.meier@bluewin.ch	joutreville@unog.ch

1. Introduction.

The underwriting cycle in the property-liability insurance business is a recurring pattern of increases and decreases in insurance prices and profits. A number of studies presenting empirical assessments of this cycle have appeared in the literature over the past 20 years. Many of these studies have shown that the underwriting cycle does exist in many countries but there are still numerous debates on the causes of this cycle.

Cummins and Outreville (1987) suggested that the cycle, as observed in the United States and in other developed countries, will also be present in other parts of the world through the proliferation of international reinsurance services. More recent research has demonstrated the presence and causes of this cycle in European countries and in Asian countries. However, there has been no study to determine the impact of reinsurance on insurance prices and profits.

The underlying causes of volatility have apparently diminished in importance during the 1980s and this has caused some observers to suggest that the underwriting cycles have become obsolete. The fluctuations in the price of reinsurance during the past twenty years seems to contradict these opinions. If the price of reinsurance decreases, reinsurance becomes more affordable for insurance companies and this will be reflected in more capacity, price competition and at the end an increase in the loss and combined ratio. This paper examines the existence of an underwriting cycle in property-liability insurance for France, Germany and Switzerland over the recent period 1982-2001 in connection with the price of reinsurance in Europe during the same period.

This paper is organized as follows. The next section reviews the previous studies on the presence and causes of property-liability underwriting cycles. Section 3 and 4 describe the data and methods employed for testing the hypotheses on the existence of cycles for reinsurance and for insurance results in the three countries. The following section examines the cointegration of cycles between the reinsurance price and the loss ratio for the three countries. The last section presents the summary and discussions on the results.

2. Causes of the Underwriting Cycle.

In a perfect market with rational expectations, insurers set pure premiums equal to the present value of expected future losses using all relevant information available to them. The price of insurance, i.e. premiums, is therefore the best predictor of future losses in the sense that it incorporates all information and measures expected losses with an error term uncorrelated with this information when the price is set.

Over the last decade or more, a substantial body of insurance literature has developed attempting to explain a cyclical pattern of increases and decreases in insurance prices and profits in Property-Liability insurance. There is no generally accepted view of what the causes are and we can summarize the work into three main schools of thought: 1) disequilibrium between supply and demand, 2) external shocks and 3) general business influences. These views are not necessarily mutually exclusive since the rational expectations hypothesis implies that premiums are influenced by many factors other than the present value of expected future losses. This is briefly discussed in the following paragraphs:

Disequilibrium between supply and demand:

- Competition-driven prices

Many authors have declared that the underwriting cycle was mainly caused by competition on prices due to the standardization of the property-liability business. This phenomenon has also been considered as an irrational behavior in order to maintain or gain market share. Insurers deviate in their pricing practices from the theoretical model by introducing an information on the behavior of competitors. They engage into excessive price competition followed by subsequent cutbacks in supply.[Wilson (1981), Stewart (1984), Radach (1988), Harrington and Danzon (1994)].

- Capacity constraints

Other researchers have been skeptical about the assumption that insurers decide to cut prices or raise rates. Research has assumed that underwriting cycles are probably due to capacity constraints in the ability to supply insurance at some time. Prices not only depend on expected future loss payments but also on present and past values of capital and surplus. When there is a reduction of surplus due, for example, to unexpected losses, it is difficult for insurers to increase external capital due to the costs of raising new capital. This implies that shocks to capital affect the price and quantity of insurance supplied in the short-run. [Winter (1988, 1991, 1994), Niehaus and Terry (1993), Gron (1990, 1994a, 1994b), Cummins and Danzon (1997), Froot and O'Connell (1997)].

- Naïve rate-making process

Cycles have also been attributed to the imperfection of the naïve rate-making processes used by insurers. There is a strong relationship between the premiums and lagged losses and extrapolative models always over or under-forecast the expected future losses. Losses paid are also related to the nature of the business written and with a long claim tail, losses paid variables include significant measurement errors. [Outreville (1981), Smith (1984), Venezian (1985), Berger (1988), Niehaus and Terry (1993)].

External shocks:

- Interest rates

As premiums are the outcome of discounted future losses, any changes in the interest rates would induce changes in premiums and interest rates could be a cause of cycles. Although there is no proof that interest rates themselves exhibit a cyclical behavior, an unexpected change in interest rate may create external shocks which could generate an underwriting cycle.[1] [Wilson (1981), Doherty and Kang (1988), Smith (1989), Fields and Venezian (1989), Doherty and Garven (1992), Haley (1993), Lamm-Tennant and Weiss (1997), Fung, Lai, Patterson and Witt (1998)].

- Regulatory and accounting lags

Some authors have argued that the underwriting cycle is not caused by an irrational behavior but rather generated by the influence of external factors such as data collection lags, regulatory lags and accounting rules. [Cummins and Outreville (1987), Lamm-Tennant and Weiss (1997), Chen, Wong and Lee (1999)]. As an example, prior authorization rules in the United States create an increased variability in the underwriting results by delaying the rapid adjustment of

[1] The major conclusion that can be drawn from Haley(1993) is that the underwriting results of P/L insurers and the risk-free interest rate were cointegrated over the period time 1930-1982 and that a shock to interest rates had a permanent and negative effect on the underwriting results.

prices to new information. [Witt and Miller (1981), Witt and Urrutia (1983), Harrington (1984), Outreville (1990), Tennyson (1991, 1993)].

- Catastrophic losses

Empirical evidence suggest that insurance premiums may increase by more than the discounted value of expected costs if large underwriting losses or investment losses are unexpectedly reported in a given market. A shock to capital in the form of unexpected claim payments on existing policies would deplete insurers' capital and shift back the short-run supply curve. If capital cannot be raised at relatively low cost, insurers have the choice of either increasing the probability of insolvency or reducing the amount of coverage at a given price. This situation is inherently temporary and adjustments create shocks that could generate an underwriting cycle. [Cummins, Harrington and Klein (1991), Harrington and Niehaus (1999)].

General business influences:

- General business cycle

There are a number of studies on the relationship between the underwriting cycle and the general condition of the economy. The property-liability insurance business is obviously linked to the general economic performance of the national economy and may be related to changes in real prices or real GDP. [Webb (1992), Grace and Hotchkiss (1995), Chen, Wong and Lee (1999), Meier (2001), Leng and Meier (2002)].

- Business practices

Greater risk management practices would be expected to reduce the effects of shocks and the shifts in demand and supply that may cause variability in the underwriting results. Possible evolution of the regulatory environment at national or international (global) level also has an impact on business, capital requirements and pricing policies. [Cummins, Harrington and Klein (1991), Winter (1991)].

3. The Price of Reinsurance

Reinsurance is either placed on a facultative basis, an obligatory basis or a combination of the two. In every type of proportional reinsurance, premium and claims are shared between the insurance company and the reinsurer in the proportion stipulated in the contractual agreement. The price the reinsurer pays for receiving the business is the "reinsurance commission." This commission, which the reinsurer pays to the ceding company, is normally expressed as a percentage of the original gross premium. In the market place, the nature of this price has become more commercial, it is determined by the nature and composition of the insurer's reinsured business and underwriting results form part of the criteria for agreeing on the actual percentage.

In non-proportional reinsurance, no proportional distribution of premium and claims is fixed between the ceding company and reinsurer in advance. Distribution of claims depends on the actual claims amount. In calculating the risk premium, i.e. the price, the reinsurer takes into account the claims experience made during the previous years or the future loss expectancy according to the kind of risks involved.

Since the technical reinsurance price varies according to the line of business and the type of contract, it is very difficult to get any price data in reinsurance and there is no price index for the reinsurance business overall. Swiss Re (2002) has proposed to use the price index for "proportional property" as a dummy for the price of reinsurance. The index is based on Swiss Re's global book of proportional facultative property business. Because facultative business looks at single risks, the notion of quota-share or surplus is not relevant. Because of data collection problems, US business is lacking in the data set and therefore the European business determines the index. Figure 1 replicated from Swiss Re (2002) shows this reinsurance price index over the period 1980-2002 versus the return on equity (ROE) of the US reinsurers and the changes in their equity (surplus).[2]

Insert Figure 1

Property reinsurance business is typically subject to price cycles. Periods of several years with high premium levels are followed by phases with low reinsurance rates. From a business perspective, fluctuations in the reinsurance price can originate from the supply side as well as the demand side. In years with equity growth, low claims and high investment income, the supply of reinsurance capacity expands and prices fall. Inversely, low returns on investment and catastrophic losses cause prices to rise.

As shown in Swiss Re (2002) ceding companies react to price increases by buying less cover and inversely, when reinsurance rates fall, buyers reduce retention, extend their ceded lines, and increase coverage for their clients. In principle, such a response to price fluctuations in reinsurance can lead to either an increase or a decrease in insurance prices and premium volume.

Obviously, prices always rose when the return on equity in the reinsurance industry was low or negative (1984/85) but also following record losses caused by Hurricane Andrew (1993/94). The question whether or not the price index is following a cycle is an interesting one.

We use the second-order autoregressive model proposed first by Venezian (1985) and developed by Cummins and Outreville (1987) to obtain the required parameters for testing the presence of a cycle under conditions of competitive markets and rational expectations. If all information were available concurrently, cycles would not exist under the rational expectations hypothesis.[3]

The model is as follows:

$Xt = a_0 + a_1 X_{t-1} + a_2 X_{t-2} + w_t$

Where Xt is the price index variable in period t and wt is a random error term.

A cycle will be present if a_1 is greater than 0, a_2 less than 0 and $a_1^2 + 4a_2$ less than 0.

The length of the cycle period can be expressed as follows:

$$\text{Period } (\Pi) = 2\pi/\cos^{-1}\left(a_1/2\sqrt{-a_2}\right)$$

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[2] The authors like to thank Mr. Rudolf Enz from Swiss Re for providing the data on the price index used in his study (Swiss Re, 2002). In this study, the price index is considered a perfect dummy variable for the world wide price development and compared with financial results available in the United States.

[3] For a comment of the AR(2) process in empirical work see Leng and Venezian (2000).

For the period 1982-2002 the results are as follows:

$$\text{Price}_t = 45.69 + 1.49[8.48]\,\text{Price}_{t-1} - 0.98[5.38]\text{Price}_{t-2} \qquad R^2 = 0.79 \qquad \text{Cycle} = 8.74$$

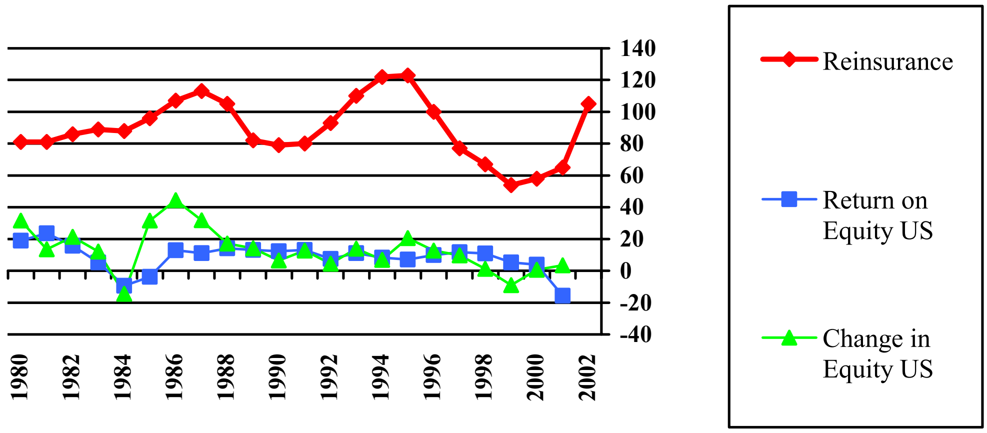
There is no significant trend over the period and a significant cycle of 8 years and 9 months is calculated according to the formula.

According to Swiss Re(2002), prices always rose when the return on equity in the reinsurance industry was low or negative. The model is extended by assuming that fluctuations in prices are also probably due to capacity constraints in the ability to supply reinsurance at some time. Prices not only depend on expected future loss payments but also on present and past values of the return on equity (ROE).
The model is as follows:
$Xt = a_0 + a_1 X_{t-1} + a_2 X_{t-2} + b_1\Sigma\, ROE_{t-i} + w_t$

Estimation over the period 1982-2001 shows that none of the lagged value of ROE are significant. The results are summarized in the following equation:

$$\underset{}{\text{Price}_t} = 41.97 + \underset{[8.64]}{1.44\,\text{Price}_{t-1}} - \underset{[4.63]}{0.85\,\text{Price}_{t-2}} - \underset{[2.05]}{0.54\,\text{ROE}_t} \qquad R^2 = 0.82 \quad \text{Cycle} = 9.30$$

Figure 1: Reinsurance Price Index and Equity
(Source: Swiss Re, 2002)



4. The Insurance cycle in France, Germany and Switzerland

Underwriting results from three countries, Germany, France and Switzerland are studied in this paper. The three markets are organized in a similar way, are close to each other and are probably affected by the same economic environment.

Figure 2 shows the loss ratio of the three countries. We can see that the cyclical patterns are very similar over the period under study although fluctuations are more exacerbate in the French market since 1990. Since 1972, Germany and Switzerland exhibit very similar cyclical patterns. However, the loss ratio of Germany is about 8 to 10 percentage points higher than that of Switzerland. Leng and Meier (2002) found that a structural change happened in Germany and Switzerland in the beginning of the 70s and culminated in 1975. The loss ratio in Germany and Switzerland was consistently higher after 1975. Outreville (2002) found a similar pattern for France.

Insert Figure 2

Table 1 shows the correlation coefficients of the loss ratios among the countries. The underwriting results of insurance markets in these countries are closely tied. Contrary to what was expected, over different sub-periods, the correlation coefficients are higher between France and Switzerland than between these countries and Germany.

Insert Table 1

Figure 2: Loss ratios in the Three Countries

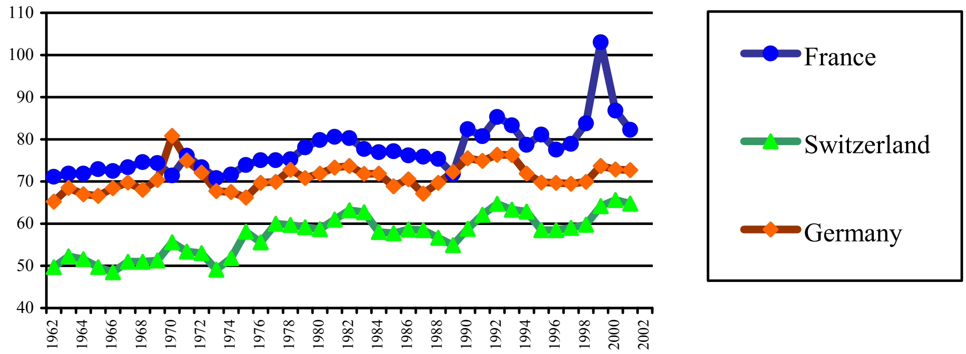


Table 1: Correlation Coefficients of Loss Ratios among the Countries

	1982-2001	1975-2001	1965-2001
France/Germany	0.44	0.48	0.37
France/Switzerland	0.64	0.66	0.71
Germany/Switzerland	0.59	0.60	0.47

Similarly to the previous section, we use the second-order autoregressive model to obtain the required parameters for testing the presence of a cycle under conditions of competitive markets and rational expectations. If the underwriting results of insurance markets in these countries are closely tied we should find similar results for the three countries.

The coefficients of the simple AR(2) process have been estimated over several sub-periods with and without a trend variable. The results presented in Table 2 are very different according to the countries concerned. In France the cycle period is shorter and could only be calculated with the existence of a significant trend variable. In Switzerland, the trend variable is significant and affects the results for the longer periods of time. In Germany, the trend variable in never significant.

Table 2: Cycle period for Loss Ratio Following an AR(2) Process
The cycle period is calculated with and without a trend

Without a trend

	1982-2001	1975-2001	1965-2001
France	NS / NC	NS / NC	NS / NC
Germany	9.93	NS / NC	8.88
Switzerland	7.72	9.57	NS / NC

With a trend

	1982-2001	1975-2001	1965-2001
France	4.88	5.15	5.36
Germany	NS / NC	NS / NC	NS / 7.95
Switzerland	7.32	7.15	8.78

NS = Coefficients are non-significant
NC = Cycle cannot be calculated

One of the main argument for extending the Cummins-Outreville-type model is the assumption that all relevant information is included in the past loss experience. The analysis of the residuals from regressions analogous to the model of Cummins-Outreville shows that the residuals are not uncorrelated and still include cyclical oscillations [Meier, 2001]. This supports the hypothesis of missing variables and from an insurance pricing theory point of view, the interest rate and the loss ratio should be cointegrated as shown in Haley(1993).[4]

The model is tested over the most recent period 1982-2001, with and without a trend, and with the money market rate (MM) at time t. This variable is never significant for France and Switzerland and always significant for Germany. When this variable is introduced in the equation the calculated cycle for France is no more significant, the cycle period for Switzerland remains significant and similar to the one calculated before.
The results of the estimation are presented in Table 3 below. The results without a trend variable for France and Switzerland are not significant and therefore not included in the table.

Table 3: Estimation of the Extended Model with Money Market Rate: 1982-2001

Variables	LR_{t-1}	LR_{t-2}	Trend	MM	R^2	Cycle
France	0.18	-0.27	1.08	0.89	0.24	NS/4.50
	[0.69]	[1.08]	[1.90]	[1.05]		
Switzerland	1.03	-0.61	0.12	0.05	0.61	7.38
	[5.17]	[2.74]	[1.46]	[0.23]		
Germany	0.13	-0.07	-0.20	1.09	0.68	NS/4.75
	[0.57]	[0.42]	[0.84]	[4.19]		
	0.40	-0.15	-	0.67	0.54	NS/6.11
	[1.58]	[0.71]		[2.61]		

Note: For all equations, the estimation is done with a constant term.

In a recent paper, Venezian (2002), explains the problems encountered with the mis-specification of the model when it is over-simplified. He shows that attempt to relate underwriting income to interest rates is misspecified unless the ratio of premiums to surplus and changes in tax rates are introduced in the model. Unfortunately data restrictions in European countries do not permit any validation of this hypothesis. A tentative graphical analysis is provided for France in Appendix 2.

5. Relationship Between the Insurance Cycle and the Reinsurance Price Index

Another argument to extend the Cummins-Outreville-type model is the approach used in capacity-constraint models where the internal capital of the insurance firm is an essential variable. A negative relationship between capacity and insurance result is expected. Real frictions (adjustment costs) which prevent a fast adjustment to the long-run equilibrium, as well as market imperfections lead to temporary capacity constraints and therefore to insurance

[4] Cointegration models for insurance cycles have captured the long-term dynamics of the economic environment but have been unable to investigate the length of insurance cycles. Recent work by Meier (2001) for Germany and Switzerland or Outreville (2002) for France did not found significant or consistent results in the countries considered.

cycles. Usually competitive markets are assumed in capacity constraint models and the fluctuations in price and quantity are only caused by supply fluctuations.

Surplus cannot be adjusted in the short-run without incurring transactions and/or agency costs. The insurance market provides a simpler and more efficient method of capital allocation, namely reinsurance. Proportional reinsurance involves the sharing of risk proportionally between the insurer and the reinsurer. Reinsurance demand is influenced among other factors by regulatory constraints in capital and surplus and provides a tool to rapidly expand the amount of insurance written.[5] To limit insurer underwriting risk and the potential for insolvency, either industry practice, regulation or both place limits on the amount of leverage permitted. This is typically measured by the ratio of net premiums written to surplus and, by purchasing reinsurance, an insurer reduces its leverage.

Reinsurance allows a primary insurer to increase its premium volume by more than would otherwise be possible with a given amount of capital. Reinsurance also enables insurers to circumvent the effect of tax considerations and international insurance trade barriers [Garven and Loubergé, 1996]. If the price of reinsurance decreases, reinsurance becomes more affordable for insurance companies and this will be reflected in more capacity, price competition and at the end an increase in the loss and combined ratio.

If reinsurance is a significant factor in the behavior of primary insurance companies, the price of reinsurance should have an immediate and negative impact. The lagged values of the price index should not impact on the decision of insurance companies.

Therefore, following the capacity-constraint model ideas, the same logic applies to the price of reinsurance RE which should be considered as an additional variable in the model and the series must be stationary. In other words the coefficient λ in $X_t = \lambda X_{t-1} + \psi_t$ must be significantly less than 1.[6] This being validated for the loss ratio variables and the reinsurance price (Appendix 3), we can use the following model:

$$LR_t = a_0 + a_1 LR_{t-1} + a_2 LR_{t-2} + b_i \Sigma RE_{t-i} + \varepsilon_t$$

where LR_t is the loss ratio and RE_{t-i} is the reinsurance price index over the period 1982-2001. Although a trend variable is not necessarily compatible with the idea of the model, it is estimated with and without a trend and with and without the money market rate. The estimations are presented in Table 4 with concurrent and lagged variables.

As shown in Table 4, the estimation for the reinsurance variable is negative and significant in all the three countries and the lagged value is never significant as expected.

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[5] The problem of optimal reinsurance has only received limited attention in financial economics and insurance literature [Doherty and Tinic (1981), Mayers and Smith (1982), Blazenco (1986), Garven (1987), Outreville (1995), Garven and Loubergé (1996)]. Mayers and Smith (1990) documents that factors such as ownership structure, firm size, geographic concentration and line-of-business concentration influence the demand for reinsurance.

[6] See Dickey and Fuller (1979). The process that generates the series should also has time-invariant coefficients. This may not be the case as shown by Leng (2000) for the combined ratio in the United States.

For France, the cycle is no more significant, nor the trend varaible or the money market rate. Only the reinsurance price index is a significant variable explaining the fluctuations in the loss ratio over the period under study.[7]

For Switzerland, the length of the cycle remains significant and similar to previous estimations. The trend variable and the money market rate are not significant and the reinsurance price index is negative and significant as expected.

For Germany, there is no cycle and the reinsurance price index explains significantly the fluctuations of the loss ratio. As shown before, there is no trend variable and the money market rate is a significant variable.

Insert Table 4

Table 4: Unconstrained Estimation of the Extended Model: 1982-2001

Variables	LR_{t-1}	LR_{t-2}	RE_t	RE_{t-1}	Trend	MM
France	0.29	-0.04	-0.14	-	-	-
	[1.21]	[0.18]	[2.04]			
	$R^2 = 0.24$					
	Cycle = NS / 8.27					
	0.22	-0.08	-0.07	-0.10	-	-
	[0.85]	[0.33]	[0.66]	[0.75]		
	$R^2 = 0.22$					
	Cycle = NS / 5.36					
	0.16	-0.16	-0.11	-	0.43	-
	[0.68]	[0.70]	[1.60]		[1.61]	
	$R^2 = 0.31$					
	Cycle = NS / 4.59					
	0.12	-0.21	-0.10	-	0.84	0.66
	[0.47]	[0.88]	[1.86]		[1.44]	[0.78]
	$R^2 = 0.30$					
	Cycle = NS / 4.36					

[7] For the first equation for the 3 countries the results are identical if the period is extended over 1980-2001.

Table 4: Unconstrained Estimation of the Extended Model: 1982-2001

Variables	LR_{t-1}	LR_{t-2}	RE_t	RE_{t-1}	Trend	MM
Switzerland	1.01	-0.48	-0.04	-	-	
	[5.38]	[2.21]	[1.80]			
	R^2 = 0.65					
	Cycle = 8.33					
	0.72	-0.31	0.02	-0.09	-	-
	[3.21]	[1.42]	[0.60]	[0.20]		
	R^2 = 0.61					
	Cycle = 7.24					
	0.99	-0.51	-0.03	-	0.07	-
	[5.19]	[2.29]	[1.21]		[0.77]	
	R^2 = 0.65					
	Cycle = 7.80					
	1.01	-0.44	-0.04	-	-	0.10
	[5.24]	[1.90]	[1.81]			[0.48]
	R^2 = 0.64					
	Cycle = 8.90					
Germany	0.64	0.06	-0.05	-	-	-
	[2.81]	[0.22]	[1.92]			
	R^2 = 0.46					
	Cycle = NS / NC					
	0.65	0.06	-0.05	0.003	-	-
	[2.42]	[0.21]	[0.99]	[0.05]		
	R^2 = 0.43					
	Cycle = NS / NC					
	0.63	0.10	-0.06	-	0.05	-
	[2.65]	[0.35]	[1.90]		[0.54]	
	R^2 = 0.44					
	Cycle = NS / NC					
	0.15	0.24	-0.06	-	-	0.79
	[0.69]	[1.19]	[3.23]			[3.80]
	R^2 = 0.71					
	Cycle = NS / NC					

Note: For all equations, the estimation is done with a constant term.
R^2 is the adjusted value, NS = not significant, NC = not cyclical.

6. Summary and Concluding Remarks

In this study, the cyclical pattern of the reinsurance price index and loss ratios for France, Germany and Switzerland are investigated over the recent period 1982-2001. This article provides new evidence on the determinants of underwriting results. The reinsurance price index is a significant variable explaining the fluctuations of the loss ratio in the three countries.

Through several model specification we can show empirical evidence for cycles in property-liability insurance business in the three countries. However, the results seem not very robust over time and among the countries. The money market rate is a significant variable in the model for Germany but not for the two other countries.

When dealing with reinsurance, an important caveat must be emphazized. Ideally, it would be best to conduct the tests using policy year loss data rather than calendar year data. Unfortunately, these data are not publicly available, and so calendar year loss data are used which probably creates a biais in the results.

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Appendix 1: Description of the Data

Our study is based on yearly data. For France, Germany and Switzerland, premiums and losses for the domestic business from 1960 to 2001 are used to calculate the loss ratio. For Germany, the loss ratio is only available for West Germany until 1991, after which data are available for Germany as a whole.

Data for the combined ratio are not used due to the lack of homogeneity in the data for Germany over the period under study.

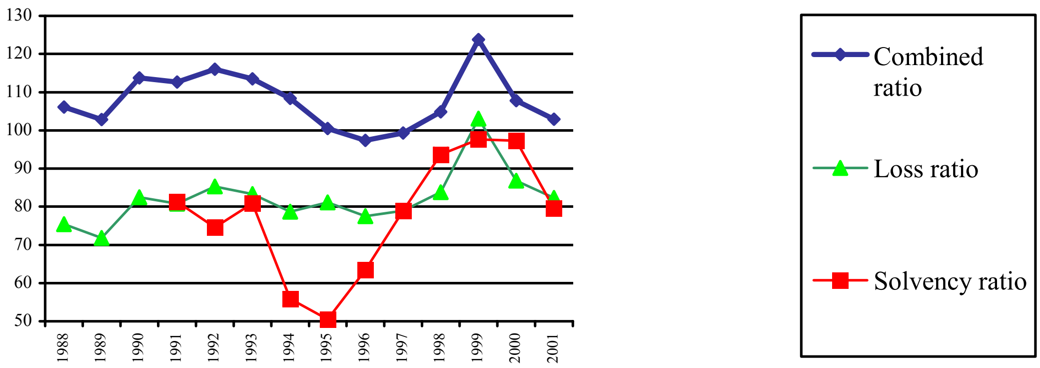
Yearly data for the reinsurance price index are only available from 1980 onwards.

Appendix 2: Loss ratio, Combined ratio and Solvency ratio in France

The empirical use of a second order autoregressive model may lead to serious misspecification problems if we ignore multiplicative variables such as the ratio of premiums to surplus. Unfortunately, due to data availability problems, some variables are often not included in empirical models.

In France, the solvency ratio (Capital and Surplus / Premiums) is only available since 1991.

The following graph presents the series for France over the period 1988-2001 for the loss ratio, the combined ratio and the solvency margin.



Appendix 3: Stationarity of the Series

$X_t = \lambda X_{t-1} + \psi_t$ with $|\lambda| < 1.0$ λ

Loss ratio	France	0.43 [2.04]
	Germany	0.64 [3.53]
	Switzerland	0.72 [4.01]
Reinsurance price Index		0.72 [4.34]