Business Cycles in Insurance and Reinsurance: Is the US insurance market setting the price?

By

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Abstract

This paper examines the existence of a cyclical pattern in property-liability insurance for the US over the recent period 1982-2001 in connection with the international price of reinsurance during the same period. The fluctuations in the price of reinsurance during the past twenty years have been documented recently in the business literature. If the price of reinsurance decreases, reinsurance becomes more affordable for insurance companies and this will be reflected in more capacity, price competition and finally an increase in the loss and combined ratio. Our study is using a price index developed recently for this period of time and based on Swiss Re's global book of business. We show that the reinsurance price index exhibits a significant cycle of almost 9 years.

The beginning of our observation period starting in 1982 coincides with previously found structural breaks in the loss ratio series. We find that inclusions of the reinsurance price and/or the money market rate do not contribute much to the explanation of the loss ratio in property-liability insurance, whereas the loss ratio does help to explain the fluctuations in the reinsurance price index. This supports our hypothesis of the international diversification effects of reinsurance operation and a proliferation of cycles or large insurance shocks through international reinsurance services.

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1. Introduction

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. the premium (for each insured unit), is therefore the best predictor of future losses in the sense that it incorporates all available information and measures expected losses with an error term uncorrelated with this information when the price is set. Premiums in year t are therefore not independent of past loss experience and Witt (1978, 1981) noticed a cyclical pattern in loss ratio over time which could be due to the fact that insurers would set rates by using regression results derived from past losses.

In the early literature, this cyclical behavior was attributed to the imperfection of naïve ratemaking processes (Outreville, 1981). Brockett and Witt (1982) were the first to show that an autoregressive process arises as a first order Taylor approximation to the loss ratio independently of the number of policy owners and companies (and therefore type of company) when premiums are set applying an empirical Bayes approach to the underwriting rate-setting. The premium set by this method would create a quasi-cyclical pattern of the underwriting profit margin.

A number of studies presenting an empirical assessment of the cyclical pattern of underwriting profits (or other operational measures strongly associated with underwriting profits, such as loss ratio or combined ratio) have since incorporated additional variables to take into account and relax some of the strong assumptions (e.g. that the values can be explained simply by their own two lags through an autoregressive process of second order) formulated earlier. Proposals include the "fluctuations in interest-rates" hypothesis to take into account the fact that interest rates cannot be assumed to be constant over time, and the capacity-constraint hypothesis to take into account the fact that capital does not flow freely into and out of the insurance market.

This paper examines another hypothesis, i.e. the role of reinsurance, which may be taken into account to explain the fluctuations in the underwriting results. Fluctuations in the price of reinsurance during the past ten years have been documented in the insurance 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, finally, a higher loss and combined ratio.

The existence of cyclical patterns in underwriting results in property-liability insurance for the US over the recent period 1982-2001 is examined in connection with the price of reinsurance during the same period. The reinsurance price exhibits a significant cycle of almost 9 years for this time period. Inclusions of the reinsurance price and/or the money market rate do not contribute much to the explanation of the loss and combined ratios, whereas loss and combined ratios can apparently help to explain the reinsurance price index.

The paper is organized as follows: The next section briefly reviews the arguments of previous studies on the presence and causes of property-liability underwriting cycles. Then we describe the data and methods employed for testing the hypotheses and explore cyclical fluctuations in the loss ratio and the combined ratio. The following section examines the cyclicality of the reinsurance price, followed by an analysis of the cyclical relationship between the reinsurance price (and money market rate) and the loss ratio. In the next section we test for other representations of the cyclical pattern, namely autoregressive processes of different lag length. The following section deals with the direction of causality between the variables. The last section presents the summary and concluding remarks.

2. The hypotheses explaining the cyclical behavior of underwriting results

Over the last decade or more, a substantial body of insurance literature has developed that attempts 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 group the work into three main strands of argumentation: 1) disequilibrium between supply and demand, 2) external shocks and 3) general business influences. A detailed description of these three strands is presented in Meier and Outreville (2006).

Cummins and Outreville (1987) suggested that the cycle, as observed in the United States and in other developed countries, would also be present in other parts of the world through the proliferation of international reinsurance services.[1] According to Cummins and Danzon (1997), shocks drive insurers away from an optimal capital structure (risky debt hypothesis), leading to supply shifts until capital is restored through retained earnings and/or until external capital is raised after price increases signal that reserves are not understated.[2] Insurers are reluctant to raise external capital following a loss shock, preferring instead to rely on retained earnings to restore capacity.

Therefore, reinsurance allows a primary insurer to increase his premium volume by more than would otherwise be possible with a given amount of capital. Cummins and Weiss (2000) provide a statistical analysis of the economic impact of the role of the reinsurance market on the primary market capacity and efficiency. If reinsurance were available at a reasonable price, insurers would use it in a competitive market as a buffer for adverse changes in insurance loss distributions. Weiss and Chung (2004) hypothesized that reinsurance is a potential factor in observed cycles in the primary market and their results show that reinsurance prices are significantly related to capacity and financial quality. Reinsurance also enables insurers to circumvent the effect of tax considerations and international insurance trade barriers (Garven and Loubergé 1996).

Meier and Outreville (2006) have demonstrated that a relationship exists between the reinsurance price and the insurance cycle in some European countries. As a large portion of the losses covered by reinsurance occurred in the US, but most large reinsurers are based in Europe, our hypothesis is that the reinsurance cycle can be partly explained by the developments on the primary market in the US. Meier and Outreville (2006) have observed that the reinsurance price index has a significant influence on the primary markets in three European countries. In this paper we investigate the US market to test whether our hypothesis of an opposite causality between reinsurance and primary market is true.

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[1] Berger, Cummins and Tennyson (1992) also argue that the role of reinsurance may be of greater importance in commercial liability than in other lines of business.

[2] Literature on the capital constraint hypothesis is also relevant (Niehaus and Terry 1993, Gron 1994, Winter 1994). Cummins and Danzon (1997) provide this alternative explanation. They hypothesize that price increases as well as the strengthening of reserves acted as signals to the securities market. They signaled that insurance was being written at profitable rates and that new equity would not be used to discharge liabilities on old policies. The original draft of their paper was published as a working paper in 1991 and has been quoted in Berger, Cummins and Tennyson (1992).

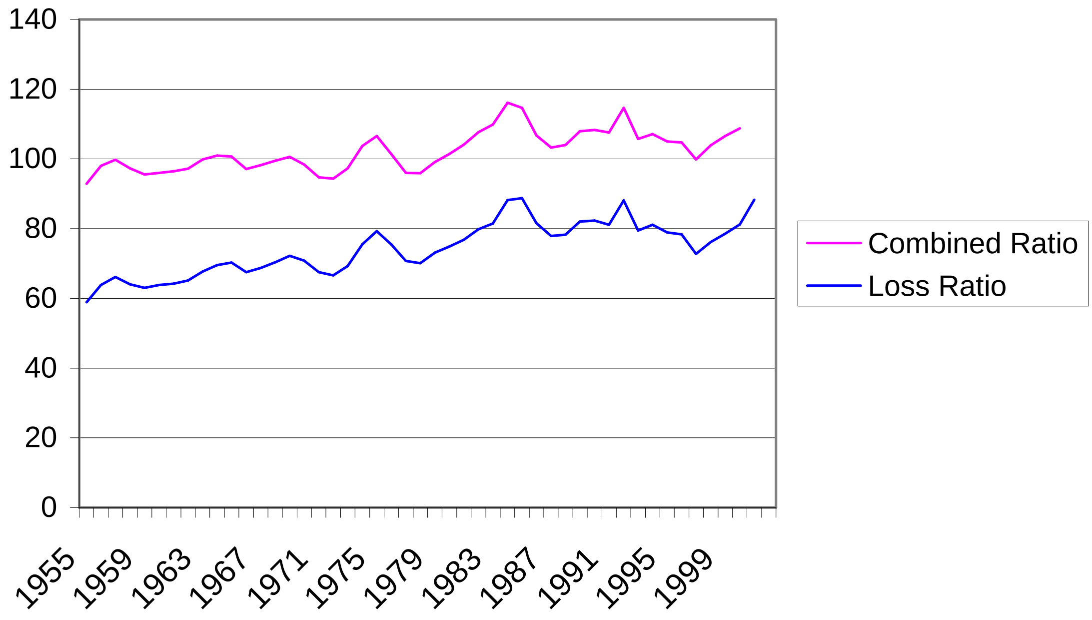
3. The cyclical behavior of insurance and reinsurance data

Loss and combined ratio for property-liability business

Data are available for global property-liability business in the United States starting from 1955.[3] As can be seen from figure 1, the loss ratio and combined ratio for the US fluctuate over time and we can imagine that there exist cycles of around eight to ten years length. We also recognize a slight upwards-trend (which reflects the increasing competition between the insurers) with a possible break in the late seventies or the early eighties (as has been found previously). Unit root tests (Appendix 1) reject the null hypothesis of unit roots. Because of the increasing competition as well as improving efficiency, the difference between the ratios (which is due to the decreasing expenses included in the combined ratio) is diminishing too.

Insert figure 1

Figure 1: US Loss Ratio and Combined Ratio (1955-2001)



[3] The data for the loss ratio and combined ratio are from Best's Aggregates and Averages, Property-Casualty (several years).

The Reinsurance Price Index and the Money Market Rate

Since the technical reinsurance price (i.e. the price or premium per unit of insured losses) varies according to the line of business and the type of contract and is often set individually (especially for non-proportional insurance), it is very difficult to get any price data on reinsurance and there is no price index for the reinsurance business overall. Enz (2002) has proposed to use the price index for "proportional property" as a proxy for the price of reinsurance. The index is based on Swiss Re's global book of proportional facultative property business[4] and is available for the period 1980 to 2002. Because facultative business looks at single risks, the notion of quota-share or surplus is not relevant. Due to data collection problems, US business is lacking in the data set so that mainly European business determines the index.

A similar variable for the US is the rate-on-line (ROL) index[5] for the US catastrophe property, but the series starts as late as 1990 and therefore is too short for our regressions. However, the correlation between the reinsurance price index and the ROL index for the concurrently available years (1990-2002) is very high: 0.86. Therefore we use the more general/global reinsurance price index as proxy variable for the US business in our regressions.

To represent the changing costs to raise money and the gains from investing money at the capital market, we use the money market rate for the US as a proxy variable[6]. Figure 2 shows the reinsurance price index [7] over the period 1980-2002 versus the ROL USA and the US money market rate (MM) for as long as the series are available.

Insert figure 2

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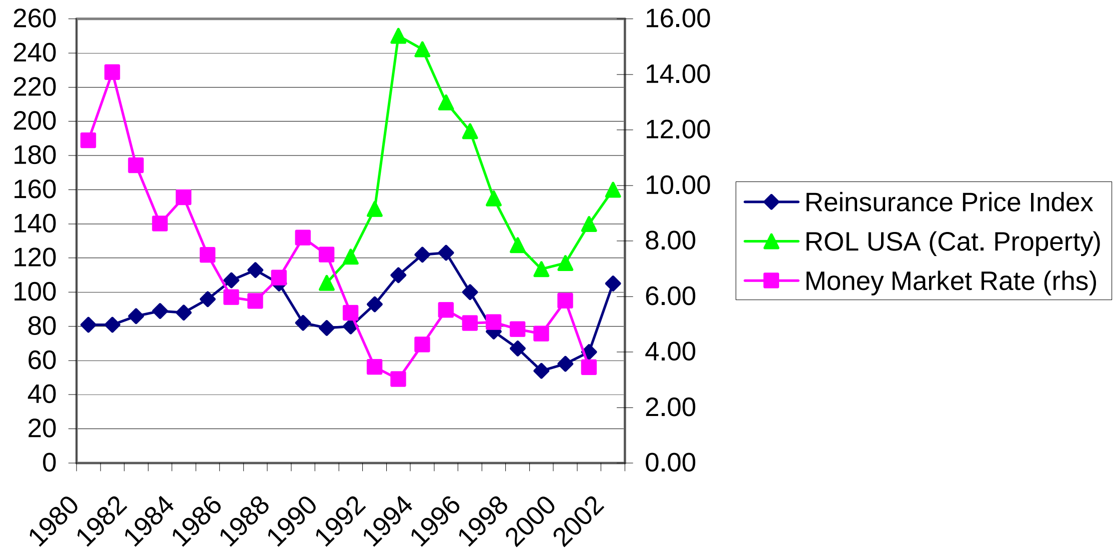
[4] It is calculated as net premiums (premiums minus commissions) in relation to the risk premium for Swiss Re's facultative business.

[5] The rates-on-line (ROL) is defined as the price of reinsurance divided by the maximum possible loss under the reinsurance contract, averaged over contracts (definition from Cummins and Weiss 2000, p. 184).

[6] The US money market rate from 1980-2001 is from IMF, International Financial Statistics.

[7] The authors like to thank Mr. Rudolf Enz from Swiss Re for providing us with the data used in his study (Enz 2002). There, the reinsurance price index is considered a perfect proxy variable for the worldwide price development and compared with financial results available in the US.

Figure 2: Reinsurance Price Index, Money Market Rate and ROL (1980-2002)



(Sources: Enz, 2002; IMF, several years; and Guy Carpenter, 2003)

As can be seen in figure 2, property reinsurance business is typically subject to cyclical fluctuations. 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 from 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 Enz (2002), ceding companies react to price increases by buying less coverage 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. Prices always rose when the return on equity in the reinsurance industry was low or negative (1984/85) but also following the huge losses caused by hurricane Andrew (1993/94) as well as after the Northridge earthquake 1994. The same pattern was observed by Cummins and Weiss (2000) by looking at the Guy

Carpenter rates-on-line and price index [8] for the United States and can also be seen in figure 2.

Table 1 shows the correlation coefficients for the reinsurance price index, the money market rate, return on equity, changes in US equity and inner capital of insurance firms in the US from 1982-2001.[9] The correlation between the reinsurance price index and return on equity is positive but very low. The reinsurance price is negatively correlated with the money market rate, and the inner capital negatively correlated with most other variables. The variables representing the situation at the capital market (money market rate, return on equity and change in US equity) are positively correlated with each other.

Insert table 1

Table 1. Correlation Coefficients (1980-2001)

	RE	MM	ROE	CHEQ	IC
RE	1	-0.12	0.16	0.51	0.24
MM		1	0.38	0.20	-0.71
ROE			1	0.41	-0.01
CHEQ				1	-0.22
IC					1

Note: RE = reinsurance price index, MM = money market rate, ROE = return on US equity, CHEQ = change in US equity, IC = inner capital of the US insurance firms (until 1997)

4. Is there a cycle?

In this paper we use the autoregressive model proposed first by Venezian (1985) and developed by Cummins and Outreville (1987) to calculate the existence of a cyclical pattern. We apply it also to the reinsurance industry and develop it further.

[8] As the price index takes into account changes in retentions (the quantity of coverage) as well as rates-on-line (definition given in Cummins and Weiss 2000, p. 184), the reaction of the price index on hurricane Andrew was even stronger than the one of the ROL.

[9] ROL is not included in the table as this series is too short.

The formula derived in the literature is:

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

where X_t is the observed variable (in this study the price of reinsurance) in period t, and w_t is a random error term. With this model we can test for the presence of cycles under conditions of competitive markets and rational expectations: a cycle is 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:

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

Looking at the price of reinsurance for the period 1982-2001, table 2 shows that the reinsurance price index is represented well by an AR(2)-process and all coefficients are significant at the 1% significance level. The reinsurance price index is characterized by cycles of 8 years and 9 months length. As shown in figure 2, there is no significant trend in this variable. [10] Table 2 also shows the AR(2)-processes for the money market rate, but the apparent cycle cannot be calculated.

Insert table 2

Table 2. The Reinsurance Price Index and Money Market Rate Following an AR(2) Process (1982-2001)

	C		AR(1)		AR(2)			
	Coeff	t	Coeff	t	Coeff	t	Adj. R^2	cycle
Reinsurance Price Index	45.70**	4.53	1.49**	8.48	-0.98**	-5.38	0.79	8.73
Money market rate	1.45#	1.92	0.83**	4.31	-0.14	-0.77	0.69	NC

Asterisks indicate: **) 1 %; *) 5 %; #) 10 % significance level.

Many insurance practitioners confirm that the (re)insurance industry in the US has undergone many changes in the last twenty years, but there is also a wide consensus that the insurance cycle still exists. E.g. Keeling said at a reinsurance symposium in

2004: “Perhaps the shape of the cycle has changed, but the cycle is very real indeed” (cited in O’Connor 2004). With the general introduction of information technology, the information on incurred and paid losses became available much faster than before. Risk-based capital requirements were introduced in 1993 and risk management was introduced on a more professional basis. This also had a clear influence on the relevant length of administration and regulatory lags.

Whereas the reinsurance market can still be explained by an AR(2)-process, changes in the primary insurance market influenced the insurance cycle such that it is now better represented by an autoregressive process of first-order. Leng (2000) and Leng, Powers and Venezian (2004) came to a similar conclusion when they investigated data for the period 1958-1999. They found that the underwriting profit margins are represented by an AR(2)-process for 1958 to 1981 and by an AR(1)-process for 1983 to 1999. It should be noted that the fact that the series are no longer well represented by AR(2)-processes does not necessarily mean that the series are not cyclical anymore (see Appendix 2).

5. How do reinsurance and the money market rate influence the primary insurance market?

If reinsurance is a significant factor in the behavior of primary insurance companies, there is an expected significant relationship between the price of reinsurance and the technical results of primary insurers. As much of the pricing strategies have to be done before the price and amount of reinsurance ceded are known, past experience plays an important role. Therefore also lagged values of the reinsurance price index have an impact on the decision of insurance companies.

We can estimate the following model:

$$LR_t = a_0 + a_1 LR_{t-1} + a_2 LR_{t-2} + b_i \Sigma RE_{t-i} + a_3 MM_t + \varepsilon_t ,$$

[10] Regressions with a time trend show that the trend is zero and not significant; it does hardly change the other coefficients in these regressions.

where LR_t is the loss ratio, RE_{t-i} is the reinsurance price index over the period 1982-2001 and MM_t is the US money market rate. These variables are stationary as validated by testing for unit roots (Augmented Dickey-Fuller tests).[11]

Several specifications of the estimations for the loss ratio are presented in table 3 with concurrent and lagged variables for the reinsurance price index as well as with and without the (simultaneous) money market rate.

Insert table 3

The second lag estimates of the loss ratio are not significant when we include the reinsurance price index and/or the money market rate in the regressions (at least not for the period for which these variables are available).

In the regressions with the reinsurance price index, the results are usually better if the lagged reinsurance price index variable is included than if we use the concurrent variable. At the time insurers sell their policies, they usually only know past but not current reinsurance prices, because reinsurance contracts are often only offered and signed after the insurance contracts on the primary market are signed. However, this is more important for non-proportional than for proportional insurance business. In addition, reinsurance prices are highly autoregressive, so that much of the information in current prices is already contained in the lagged value. Thus, the lagged variable is apparently more important (and often significant at the 10% level) than the concurrent reinsurance variable. In addition, this variable has always the expected negative sign (whereas the insignificant concurrent reinsurance variable sometimes exhibits a positive sign if included together with the lagged variable).

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

Table 3. Loss Ratio Following an AR(2) Process with/without Money Market rate (1982-2000)

	Constant	LR(-1)	LR(-2)	RE	RE(-1)	MM	Adj. R^2
Loss Ratio	30.18	0.65*	0.07	-0.08	-	-	0.25
	[1.67]	[2.66]	[0.25]	[-1.32]	-	-	
Loss Ratio	43.14*	0.51*	0.06	-	-0.09	-	0.27
	[2.44]	[2.11]	[0.24]	-	[-1.84]	-	
Loss Ratio	50.44*	0.46	0.01	0.05	-0.13	-	0.23
	[2.14]	[1.68]	[0.03]	[0.48]	[-1.47]	-	
Loss Ratio	31.04	0.58*	0.02	-	-	0.27	0.21
	[1.51]	[2.37]	[0.06]	-	-	[0.72]	
Loss Ratio	34.37	0.50*	0.14	-	-0.08	0.33	0.19
	[1.60]	[2.00]	[0.48]	-	[-1.22]	[0.90]	
Loss Ratio	40.33	0.46	0.09	0.03	-0.10	0.30	0.13
	[1.37]	[1.62]	[0.28]	[0.31]	[-1.04]	[0.76]	
Loss Ratio	21.10	0.61*	0.17	-0.06	-	0.35	0.20
	[0.88]	[2.45]	[0.54]	[-0.83]	-	[0.90]	

Asterisks indicate: **) 1 %; *) 5 % significance level

[ ]: t-values

Vector autoregressive models are able to capture the dynamic adjustment in the model. This is not done by estimating univariate time-series models separately but by estimating a multivariate system and explains several variables simultaneously and thus takes into account their common past. That also means that we can capture short- and long-term relationships. Even more, VAR-models are a tool often used for forecasting. Impulse-response functions allow to follow a shock over time and to observe the dynamic interdependencies in the system. The VAR method is only applicable to stationary variables; for non-stationary variables cointegration or vector error correction models should be used. The power of the VAR-system also depends on the VAR order. Often the order is decided on the basis of economic theory assumptions.

Results are presented in tables 4 and 5 below:

Insert tables 4 & 5

Table 4. Vector Autoregressive Process with two lags (1982-2000)

	Loss Ratio		Reins. Price Index		money market rate	
	Coeff	t-value	Coeff	t-value	Coeff	t-value
Loss Ratio (-1)	0.36	1.25	0.66	1.39	-0.05	-0.65
Loss Ratio (-2)	0.04	0.11	1.01	1.85	-0.06	-0.71
Reinsurance Price Index (-1)	-0.00	-0.00	1.17**	6.82	0.03	1.30
Reinsurance Price Index (-2)	-0.09	-0.83	-0.75**	-4.03	0.01	0.35
Money market rate (-1)	0.47	0.60	1.26	0.96	0.64**	3.14
Money market rate (-2)	-0.14	-0.18	-1.28	-0.97	0.09	0.44
constant	55.46*	2.00	-81.29	-1.75	5.75	0.79
Adj. R^2	0.08		0.87		0.75	

Asterisks indicate: **) 1 %; *) 5 % significance level

Table 5. Vector Autoregressive Process with three lags (1983-2000)

	Loss Ratio		Reins. Price Index		money market rate	
	Coeff	t-value	Coeff	t-value	Coeff	t-value
Loss Ratio (-1)	-0.04	-0.15	0.60	1.02	-0.08	-1.04
Loss Ratio (-2)	0.23	0.89	1.22	1.95	-0.07	-0.94
Loss Ratio (-3)	-0.21	-0.76	0.45	0.67	-0.03	-0.34
Reinsurance Price Index (-1)	-0.23	-1.29	0.55	1.32	0.04	0.67
Reinsurance Price Index (-2)	0.20	0.94	0.03	0.06	0.01	0.21
Reinsurance Price Index (-3)	-0.36	-1.92	-0.64	-1.41	0.00	0.05
Money market rate (-1)	2.19*	2.36	0.36	0.16	0.82	2.80
Money market rate (-2)	-1.82*	-2.20	-0.14	-0.07	-0.36	-1.38
Money market rate (-3)	0.28	0.41	-1.11	-0.69	0.41	1.92
constant	116.20*	3.84	-78.20	-1.08	10.49	1.09
Adj. R^2	0.54		0.87		0.74	

Asterisks indicate: **) 1 %; *) 5 % significance level

The VAR most similar to some of our univariate estimations of autoregressive processes is the one with the three variables loss ratio, reinsurance price index and the money market rate, each with two lags. It confirms our earlier findings: the lagged reinsurance price index does not significantly contribute to the explanation of the loss ratio, but the two lags of the loss ratio significantly contribute (at the 10% significance level) to the explanation of the reinsurance price index. Also the variance explained (adjusted R^2) is much higher for the reinsurance price index. The lags of the money market rate do not add much additional explanatory power. The constant is significant at the five and ten percent level for the loss ratio and the reinsurance price index ratio. Including a third lag improves especially the loss ratio regression: the third lag of the reinsurance price index is significant at the ten percent level, and the two lags of the money market rate are significant at the five percent level. Also, the adjusted R^2 (which was very low in the two-lag specification) improves significantly to 0.54, whereas the adj. R^2 of the equations for the reinsurance price index and the money market rate remain about the same as before (RE: 0.87 from 0.87, MM: 0.74 from 0.75).

The results also confirm that especially the loss ratio is not well explained by its two first lags, but the first two lags of the reinsurance price index seem to contribute very well to its own explanation. To explain the development of loss ratio and reinsurance price index by VAR models it would be appropriate to apply structural VAR models and exclude the insignificant lags. Since the loss ratio seems to be better explained by an AR(1) than an AR(2) for the time period since the eighties, which is confirmed here, there is no need to continue with this procedure.

6. Causality between the loss ratio and the reinsurance price index

The price of reinsurance is determined by the reinsurer and is based on the nature and composition of the insurer's reinsured business; past underwriting results form part of the criteria for agreeing on the actual percentage paid as reinsurance commission in proportional reinsurance business. Therefore it is not obvious whether the conditions on the market for reinsurance do influence more the primary insurance market or whether the causality is rather opposite. In table 6 are the results summarized for AR(2)-processes on the reinsurance market with the loss ratio as additional regressors.

Insert table 6

Table 6. Reinsurance Price Index Following an AR(2) Process with Loss Ratio (1982-2001)

	C	RE(-1)	RE(-2)	LR(-1)	LR(-2)	Adj. R^2	cycle
Reinsurance Price Index	-69.12	1.29**	-0.71**	1.34*	-	0.85	8.91
	[-1.70]	[7.87]	[-3.99]	[2.89]	-		
Reinsurance Price Index	-103.70*	1.16**	-0.65**	1.06*	0.78	0.86	8.18
	[-2.22]	[6.31]	[-3.60]	[2.15]	[1.39]		

Asterisks indicate: **) 1 %; *) 5 % significance level

From the comparison of the tables 2 and 6, we see that the inclusion of lagged loss ratios improves the regressions of the reinsurance price index whereas it cannot be clearly said that the reinsurance price also explains the changes of the loss ratio. This supports well our hypothesis, that reinsurance markets react strongly to the huge losses in the US and that this effect is then mitigated through the proliferation of international reinsurance services.

7. Summary and concluding remarks

In this article, we investigate the cyclical nature of a reinsurance price index used as proxy for the reinsurance market for the US. We also investigate the patterns of the US money market rate and their relationship with the loss ratio for property-liability insurance business over the time period 1982-2001. Since the reinsurance price exhibits a significant cycle of almost 9 years, we also examine the relationship between the price of reinsurance and the variables loss ratio and money market rate.

Our conclusion is that in the eighties and nineties a simple AR(2) process, even with additional regressors, was no longer able to well explain the US loss ratio (whereas it still serves well for other countries) and additional variables or different models need to be chosen to explain the US loss ratio over this time period. Our findings - that the loss ratio helps to explain the reinsurance price index, but the reinsurance price index is less helpful in explaining the loss ratio - are confirmed by vector autoregressive processes of two and three lags. Most of the huge insured losses in the last years occurred in the US, meaning that reinsurance was used in the US more than average. Reinsurance prices were driven heavily by high losses (and therefore high loss ratios on the primary market) in the US. However, the following premium rises for reinsurance occurred also in Europe and other countries, leading to premium increases in Europe as well. So our findings support well the hypothesis of the international diversification effects of reinsurance operation and a proliferation of cycles or large insurance shocks through international reinsurance services.

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Appendix 1: Unit Root Tests

We test the series for unit roots with Dickey-Fuller- and Augmented Dickey-Fuller-tests (0 to 2 lags). The coefficient λ in $X_t = \lambda X_{t-1} + \psi_t$ must be significantly less than 1, what is tested by $\Delta X_t = (\lambda - 1) X_{t-1} + \psi_t$. The null hypothesis tested is that the coefficient of X_{t-1}, $\lambda - 1$, is zero (i.e., the series has a unit root) against the alternative hypothesis that it is negative (when the series is stationary). We run the test regression including a constant term, but also with and without a trend. We find that inclusion of a trend variable does not change the test results. As is often done, we also apply ADF-tests, i.e. tests including AR (autoregressive) polynomials. From the unit root tests in table A1 we conclude that the series contain no unit roots and thus are stationary. For the reinsurance price index and money market rate we test the series for the whole time period available, for the Combined Ratio and Loss Ratio for the periods used in the regressions including reinsurance and money market rate (i.e. because of two lags of the AR(2)-process starting in 1978). For almost all tests, the null hypothesis of unit roots can be rejected at the 1% significance level.

Table A1. Unit Root Tests (1978-2001)

	Lags	Combined Ratio	Loss Ratio	Reinsurance Price Index	Money Market Rate
without trend	0	-9.77	-9.58	-6.02	-3.76
“	1	-13.33	-12.63	-460.51	-7.37
“	2	-31.74	-30.31	48.04*	-3.62**
with trend	0	-9.56	-9.65	-6.33	-7.74
“	1	-12.91	-12.68	-465.36	-16.21
“	2	-28.74	-30.34	48.69*	-9.19

*: unit roots cannot be rejected. However, as these series are stationary with zero and 1 Lags, we nevertheless assume that also this series is stationary.

**: unit roots can be rejected at the 5 % significance level

critical values:

without trend: -3.75 (1%), -3.00 (5%), -2.63 (10%)

with trend: -4.38 (1%), -3.60 (5%), -3.24 (10%)

These results are also confirmed by the findings of Harrington and Yu (2003) who have run a battery of unit root tests including simulations and also came to the conclusion that the loss ratio series are stationary or stationary with a linear trend. They also show that non-rejection of the null hypothesis of a unit root could easily reflect low power of the test. Macroeconomic series such as the money market rate must always be stationary in the long run.

Appendix 2: Validation of the loss ratio characteristics for the period 1982-2001

As suggested by the fluctuations of the series in figure 1 and also by earlier studies (e.g. Leng 2000, Meier 2006a and 2006b and Leng and Meier 2006), the series for US combined ratio and loss ratio have a break in the late seventies or early eighties. Papers by Malliaropulos (2000) and Leng, Powers and Venezian (2002), also indicate that the series for interest rate and underwriting margins (combined ratio) changed in 1981. Therefore it seems also reasonable to consider the time period 1982 to 2001 separately. Statistical tests confirm that loss ratio series from 1982 to 2001 do not indicate breaks, neither when assuming an underlying AR(2) process nor for an AR(1) process.

We run an AR(2)-process for this time period (table A2) and calculate the length of cycles for this time span.

Table A2. Loss Ratio and Combined Ratio Following an AR(2) Process with/without Time Trend (1982-2001)

	C		AR(-1)		AR(-2)		Trend		Adj. R^2
	Coeff	t-value	Coeff	t-value	Coeff	t-value	Coeff	t-value	
Loss Ratio	40.70*	2.46	0.63*	2.52	-0.13	-0.57	-	-	0.22
Loss Ratio	40.60*	2.38	0.63*	2.44	-0.13	-0.56	0.01	0.07	0.18
Combined Ratio	57.87*	2.85	0.61*	2.64	-0.15	-0.73	-	-	0.24
Combined Ratio	58.80*	2.83	0.59*	2.45	-0.12	-0.58	-0.08	-0.60	0.21

Asterisks indicate: **) 1 %; *) 5 % significance level

Cycle length LR: 12.22 years, CR: 10.63 years (with time trend)

Cycle length LR: 12.50 years, CR: 9.46 years (without time trend)

The trend for the period 1982-2001 is very small and insignificant, supporting the indication from figure 1 that from 1982 onwards there is no longer a clear trend. The constant and the first lag of the ratios are significant as before, but the second lag is no longer significant.

We can calculate cycles of 12 years and 2 months for the loss ratio, and of nine and a half years for the combined ratio. However, as the second lags of the combined and loss ratios are not significant, the cycles are not significant either. It could well be that the series do no longer follow an AR(2)-process but may be explained by another representation. As we can see from the data and the graph, the margin between premiums and losses decreases over time, and since the seventies the combined ratio (which also includes expenses) has been greater than 100, suggesting that investment income has become a major underwriting factor. As the insurance companies began to “manage" the insurance cycle (cf. e.g. Schiro 2004) the companies are aware of the mechanisms of the cycle and try to reduce the volatility and react much faster to downwards movements of the cycle than in earlier years. This may also be a reason that the second lag of the AR(2)-process is often not too significant anymore. The active cycle management may have changed the cyclicality of the cycle significantly.

The United States led the world in total insurance premiums, as shown in Table 8.1 "Top Ten Countries by Life and Nonlife Direct Premiums Written, 2007 (Millions of U.S.$)*". Table 8.1 Top Ten Countries by Life and Nonlife Direct Premiums Written, 2007 (Millions of U.S.$)* Total Premiums.Â Markets conditions: underwriting cycles, availability and affordability, insurance and reinsurance markets. Regulation of insurance. Links. As we have done in the prior chapters, we begin with connecting the importance of this chapter to the complete picture of holistic risk management. We will become savvy consumers only when we understand the insurance marketplace and the conditions under which insurance institutions operate. This article is part of series on the. United States portal. v. t. e. Insurance in the United States refers to the market for risk in the United States, the world's largest insurance market by premium volume. Of the $4.640 trillion of gross premiums written worldwide in 2013, $1.274 trillion (27%) were written in the United States. Insurance, generally, is a contract in which the insurer agrees to compensate or indemnify another party (the insured, the policyholder or a beneficiary) for specified loss An overview of insurance markets, how insurance companies compete on price and quality of services, and how the insurance market goes through cycles, from a soft market of looser underwriting standards and lower premiums to a hard market of stricter underwriting standards and higher premiums.Â Many large businesses and organizations also self-insure for many of their employee benefits, such as health coverage, which increases competition for insurance companies. However, many self-insurers use the services of insurance companies to manage insurance program, including the filing of claims.Â The price of insurance, like most other things offered for sale, is determined by the cost of production and the amount of competition within the industry. As we know insured people and insurance companies meet each other in the insurance market. The activities in insurance market which occur every day effect economic growth positively. Insurance activities also help increasing country GDP.Â Reinsurance also known as insurance for insurers or stop-loss insurance, is the practice of insurers transfering portions of risk protfolios to other parties by some form of agreement to reduce the likelihood of having to pay a large obligation resulting from an insurance claim [10]. Reinsurance lets insurers cover their risks by recovering some or all of the amounts they pay to claimants.Â The insurance sector safeguards the assets of its policyholders by transferring risk from an individual or business to an insurance company.