AN INTRODUCTION TO PREMIUM TREND

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* The methods described in this paper are not necessarily those used by any particular organization to account for premium trend. Instead, these methods are intended to illustrate the general theoretical concepts of premium trending.

AN INTRODUCTION TO PREMIUM TREND

Introduction

A fundamental aspect of insurance ratemaking is the calculation of the indicated rate level change for a segment of an insurer's book of business. The indicated rate level change is simply the difference between the current rate level and the indicated rate level. So how do we determine the indicated rate level? Since ratemaking is prospective, the indicated rate level is the rate level that achieves a balance between the expected premium income and the expected losses and expenses (including a profit provision that considers investment income) for a future policy period. While it may be clear that losses and expenses are subject to continuous change from economic forces such as inflation, the average premium per exposure can also change significantly over time, even in the absence of rate changes. In the calculation of the indicated rate level change, we recognize the continuous change in the frequency and severity of claims when projecting a future loss level. Similarly, our projection of the future average premium level may be quite different from the historical or current level. There are several factors that can influence the average premium level and two main methods of properly accounting for the effect on the indicated rate level change.

The Indicated Change

One of the traditional approaches to calculating the indicated rate level change is to determine the expected future loss ratio that would result if the current rates were left in effect, and then compare that to the permissible loss ratio, which is simply the complement of the projected expense ratio. In other words, the permissible loss ratio is the highest that the expected future loss ratio can be and still be in the desired profit range. If the expected future loss ratio is higher than the permissible, a rate increase will be indicated. If the expected future loss ratio is lower than the permissible, a rate decrease will be indicated.

But how do we estimate the expected loss ratio for a future period? In most cases, the recent historical loss ratio for the same book of business makes a good starting point. Since many of the risks in the historical book of business will continue their coverage through the future policy period, the recent experience contains powerful predictive information about the claim experience we can expect in the future. However, we cannot simply assume that the best estimate of the expected future loss ratio is the past loss ratio. The reason that this would be a bad idea is that the economic and legal environments of insurance are constantly changing, as are individual insurer's rate levels and the characteristics of their policyholders. These types of changes can significantly reduce the historical loss ratio's usefulness as a predictor of the future loss ratio. Our task is to identify these changes and adjust for them, so that we can take the historical loss ratio and shape it into a more accurate estimate of the expected future loss ratio.

The changes that we need to adjust for are those that create differences between the historical loss ratio and the expected future loss ratio. These are generally changes that have a direct influence on loss frequency, loss severity, or average premium. Historical losses should be adjusted to reflect the frequency and severity levels that can be expected in the future policy period. Likewise, historical premiums should be adjusted to reflect the average premium level that can be expected in the future policy period.

Basis of Calculations

As the analysis begins, we should be clear about the basis of the calculations and the different choices available to us. The starting point for determining the indicated rate level change is typically a collection of historical data showing dollar amounts of premiums and losses, as well as a summary of expense provisions. Note, however, that the premium and loss amounts are based on historical exposure levels that are likely to have changed throughout the experience period and will probably continue to change in the future policy period. The result is that we cannot predict future dollar amounts for these figures without projecting a future exposure level.

In many cases, we can simplify the calculation by recognizing that exposure growth will tend to affect premiums and losses (and expenses) proportionally. The simplification is to look at ratios (loss ratio, expense ratio) instead of dollar amounts. Projected ratios provide estimates of expected future quantities without having to consider exposure growth. This approach works well for lines of business with an exposure basis that is fixed in real terms, such as car-years for auto insurance. For other lines of business, such as Workers Compensation, which has an exposure base of $100 of payroll, we will need to monitor changes in the exposure level as part of the analysis. The ratio approach can still be used to derive the indicated rate level change for either of these lines of business. The additional analysis required for Workers Compensation and other lines of business with inflation-sensitive exposure bases will be discussed at the end of this paper.

There are two main approaches to making adjustments to historical experience in order to derive an estimate of expected future experience. As we will see later, the expense ratio is handled the same way in both approaches. Therefore, the discussion below relates only to the loss ratio.

Option 1

- Start with historical dollar amounts of premium and losses.
- Adjust premium and loss figures for the various changes that have influenced their respective average values. The result is projected dollar amounts for premium and losses.
- Calculate the projected loss ratio for each year in the experience period by dividing the projected losses by the projected premium.
- Calculate an overall projected loss ratio based on some average of the different years.
- Compare the projected loss ratio to the permissible loss ratio (1 – expense ratio).

Option 2

- Immediately convert historical dollar figures for premium and losses into loss ratios.
- Adjust the loss ratios for the various changes that have influenced either premium or losses. The result is a projected loss ratio for each year in the experience period.
- Calculate an overall projected loss ratio based on some average of the different years.
- Compare the projected loss ratio to the permissible loss ratio (1 – expense ratio).

These two alternatives are mathematically equivalent. The only difference between the two is the point at which ratios of the dollar amounts are taken. Most of the procedures used throughout the industry for calculating an indicated rate level change use a blended approach, where some adjustments are made to the historical dollar figures, ratios are calculated, and the remaining adjustments are made to the ratios.

Projecting Expenses

The expenses of an insurance operation (in dollars) will tend to increase over time as salaries and other operating expenses rise. To estimate future expenses, a common approach is to use the average expense ratio from the experience period as the prediction for the future expense ratio. This approach assumes that expenses will maintain a relatively constant relationship to premium as both increase over time.

Expense estimates can also be entirely prospective, relying on new information rather than on historical figures. For example, if a company's commission contracts had been revised so that agents now receive a 12 percent commission rather than a 10 percent commission, the 12 percent figure would probably make a better estimate than would the historical average ratio of 10 percent.

Once the expense provisions are selected, a total expense ratio is determined and it is ready to be used in the calculation of the indicated change. The total expense ratio, in this context, should include a provision for profit. The complement of the expense ratio is the permissible loss ratio. Once we know the permissible loss ratio, our only remaining task in determining the indicated change is to calculate the expected future loss ratio. The remainder of this paper focuses on the adjustments to the historical loss ratio that are needed to make it a better estimate of the expected future loss ratio.

Changes Affecting the Loss Ratio

The underlying components of the loss ratio (frequency, severity, and average premium) are subject to different influences. Therefore, the preferred approach to calculating the expected future loss ratio is to examine each component of the historical loss ratio separately and adjust for any changes that have occurred.

The most intuitive examples of changes that would require an adjustment to historical loss ratios involve the frequency and severity components of the loss ratio. A shift in the mix of business toward a higher-frequency segment of the population will tend to increase the overall claim frequency of the book of business. Claim amounts can increase as homes, cars, and other insured items become more expensive to repair and replace. Liability settlements and jury awards may jump suddenly due to changes in legislation or prevailing social attitudes. Each of these changes would tend to cause the losses to increase, which would cause the loss ratio to increase, assuming that the premium did not increase as quickly as the losses. Under any of the above scenarios, if we use an average of the unadjusted loss ratios from the experience period as our estimate of the expected future loss ratio, the estimate would be too low. Instead, the historical loss ratios need to be adjusted with a loss trend to reflect the higher incidence of loss that is expected in the future policy period.

Changes Affecting the Average Premium Level

It may be clear that we need to adjust the numerator of the loss ratio for changes that have occurred to losses. What may not be as clear is that there are also many types of changes that can affect the average premium level from one year to the next. These changes are accounted for with an adjustment to the denominator of the loss ratio. Omitting this adjustment would incorrectly assume that the average premium level from the experience period provides an accurate estimate of the average premium level for the future policy period.

Some of the changes that can cause the future average premium level to differ from the past average premium level are:

1) Past rate changes
2) Past rating plan changes
3) The existence of rating plans which change the premium level over time
4) Past and expected future shifts in the mix of business

These changes can have different types of effects on the average premium level:

1) One-time vs. continuous effects
2) Measurable effects vs. effects that can only be estimated
3) Abrupt effects vs. gradual shifts

Effect on the Premium Level

Each type of change is addressed in greater detail below and the nature of its effect on the average premium level is described. In a later section, we will determine how best to adjust for each type of change when calculating our estimate of the expected future loss ratio.

1. Past Rate Changes – Rate changes have a one-time and measurable impact on the average premium level. The experience period premium is likely to have been generated from several different rate levels, but the object of the indicated change measure is to quantify the needed revision to the current rates. Therefore, only the current rate level is of interest in the analysis and our estimate of the expected future loss ratio must be based on a premium component that assumes the current rate level. To understand why this is true, imagine that a company had taken a large rate increase a few months ago to restore rate adequacy. A current analysis of the historical experience would show a consistently high loss ratio throughout the experience period. However, the needed increase has already been taken. We would need to recognize the recent rate increase to avoid hitting the book of business with another large increase.

2. Past Rating Plan Changes – Rating plan changes can include the introduction of a new rating plan, the elimination of an old rating plan, or a revision to an existing rating plan. These changes usually have one-time and measurable effects on the average premium level, much like rate changes. It might be helpful to make a distinction between two types of rating plan changes:

    a. Rate Level Changes – Rating plan changes that affect the average premium level without affecting the level of coverage are essentially the same as rate changes. For example, a new discount could be implemented that provides a 5 percent premium reduction for certain risks. If roughly half of the policyholders qualify for the discount, the overall effect would be approximately a 2.5 percent reduction of the premium level. The effect on the premium level is practically identical to a 2.5 percent overall decrease to the base rates.

    b. Premium Level Changes – Rating plan changes that affect the average premium level but also include a corresponding change in the level of coverage are not really rate changes. They may increase the premium level, but there is often no change to the rates or rating

factors. For example, in auto insurance, there may be a state-mandated increase in the minimum limit of bodily injury liability from 15/30 to 25/50. Policyholders will pay a higher premium, but they also receive more coverage.

Both of the above types of rating plan changes have a direct effect on the future premium level and this effect must be reflected in calculation of the expected future loss ratio. The first type of change affects only the premium. The second type of change affects the premium and the losses, since it also provides a higher level of coverage. [1]

3. The Use of Rating Plans that Change the Average Premium Level Over Time – Many companies have adopted rating plans that exert a persistent influence on the average premium level from year to year. The more common examples of these types of rating plans tend to have measurable effects on the average premium level, but the effects are usually gradual and continuous, and are often expected to continue into the future policy period. A good example is the model year and vehicle symbol plans for the automobile physical damage coverages. These rating plans apply a continuous upward force on the Collision and Comprehensive average premium levels over time.

   The model year plans assign larger rating factors to the more recently manufactured vehicles to address the increasing cost of repairing and replacing vehicles. As policyholders trade in old vehicles for new ones, a higher model year factor is applied, which results in a premium increase. This type of rating plan creates an "automatic" positive premium trend that reduces the need to increase rates in Collision and Comprehensive. In fact, if losses in these coverages fail to keep pace with the upward premium trend, regular rate decreases would be needed to maintain a proper rate level. [2]

   When people buy new cars, a shift in the mix of business (described in the next section) occurs, but only as it relates to the model year. If the rating factors were based on age of vehicle, there would be little, if any, premium trend. This is because the average age of vehicle is generally quite stable from year to year.

   As with model year programs, there is also a positive trend in the vehicle symbol factors used in many vehicle-rating programs. The symbol is initially based on new vehicle cost and the factors are higher for the more expensive vehicles. The result of this relationship is that the average symbol factor gradually increases as policyholders replace old vehicles with ones that carry a higher new price. For example, if a policyholder replaces a 1989 Ford Taurus with a 2002 Ford Taurus, the symbol is very likely to have increased because the

[1] If the increased limit factors are priced correctly, moving to a higher minimum limit will have the same effect on losses and premiums and there will be no overall effect on the loss ratio. However, if we allow the additional losses to be reflected in the loss trend, our projection of the expected future loss ratio would be higher than the current loss ratio. If the effect on losses and premiums were the same, the projection of a higher loss ratio would be inappropriate. We would also need to reflect the additional premium that would be expected as a result of the change. Remember, we want the loss ratio to be predictive of the future. It would be incorrect to reflect a change to the losses without reflecting the corresponding change to the premium, or vice versa.

[2] Notice that Property Damage coverage is similar to Collision coverage in that both cover the costs of repairing vehicles. However, Property Damage lacks the premium trend that model year factors provide. As a result, indications in Property Damage tend to be higher each year since there is no automatic mechanism to keep up with the increasing claim costs.

1989 model received a symbol based on a cost of approximately $15,000, while the 2002 model's symbol was based on a cost of approximately $25,000.

Many companies employ both model year and vehicle symbol plans. In these cases, the upward trend in symbol factors occurs in addition to the upward trend in model year factors, and there are two separate sources of positive premium trend.

Another way for a rating plan to influence the premium trend involves the combined effect of exposure growth, or lack thereof, and a discount offered to long-term customers. Assume that the discount is 10 percent and applies to any policyholder that has been insured with the company for three years or more. Now consider the case of a company that offers this discount but suddenly stops adding new business. Assume that the company stops writing new business when half the book of business is already earning the discount. At that point in time, the average discount for the entire book would be about 5 percent. Over the next three years, though, as the other half of the insureds reached the point where they earned the discount, the average premium would gradually fall another 5 percent. This situation is more appropriately classified as a shift in the mix of business, since a population characteristic (the average number of years insured) would have changed.

4. Shifts in the Mix of Business – In some cases, such as an acquisition of another carrier's book of business, shifts in the mix of business can be abrupt. However, for most companies in a normal operating environment, the shifts are generally gradual and continuous. In some cases, though, shifts will reach a point where the shift is complete and cannot continue.

   As far as measuring the effect of a shift in the mix of business, the difficulty will vary from one company to another, depending on the quality of company's data management and technology resources. The shift in the mix of business over one variable may be fairly easy to measure. For example, a distribution of exposures by limit of liability may show a steady 3 percent annual increase in the average increased limit factor. Unfortunately, this process becomes more complex and difficult when we try to coordinate and measure the shifts over all possible rating variables.

   Shifts in the mix of business can raise or lower the average premium level significantly, and they can be caused by changes in policyholder choices or changes in the types of risks an insurer writes. There could be a shift, for example, such that more workers compensation insureds were selecting higher deductibles to reduce their premiums. This could produce a significant negative premium trend. In other lines of business, when rates vary by territory, a shift in the mix of business could also occur at the territory level. For example, in property insurance, establishing a new agency in a high-cost county along the Atlantic coast would tend to increase the average premium for the state, and a positive premium trend would appear.

   An example of a shift in the mix of business that will eventually slow down and stop is an air bag discount for Medical Payments coverage in auto insurance. As older vehicles without air bags are replaced with new vehicles, most of which have air bags, there will be a downward influence on the premium for Medical Payments coverage. This shift will slow and eventually stop once the vast majority of insured vehicles have air bags.

Other rating plans cause the premium trend to be sensitive to the rate of new business growth. In addition to the situation described in the previous section, a driver classification plan can reduce the overall premium level when a company's growth slows. Drivers earn lower class factors as they age, marry, and become more experienced. The lack of growth would gradually phase out the high-premium, young driver segment as the existing book ages, and the average premium would fall. Accelerating growth, on the other hand, could raise or lower the average class factor, depending on the nature of the growth and the rating plans in effect.

Because of these shifts in the mix of business, the average experience period premium is likely to be quite different from the current average premium, even after premiums have been adjusted to the current rate level. An adjustment is needed in order to take the historical premiums at current rate level and restate them at a level that reflects the mix of business that is expected in the future policy period.

It is important to be sufficiently familiar with the book of business to be able to determine whether the historical shifts in the mix of business can be expected to continue. If the shifts have stopped, a smaller adjustment to the historical experience is needed as compared to the case when the shift is expected to continue.

Adjustment Methods

Now that we have discussed the various types of changes that can affect the premium level, as well as the measurability and duration of the resulting effect, we must now determine how best to make the appropriate adjustments to the historical loss ratio. Just as we adjusted the historical loss ratios to reflect the changes in loss frequency and severity, we must also adjust them for any changes in the average premium level. (*Note: Generally, the first adjustment for the historical premium is to bring it to the current rate level. The technique of deriving the percentage adjustments to be applied to each year's historical premium is quite complex and is dealt with in several other readings. Therefore, it will not be covered here. However, once the percentage adjustments are known, the following discussion is applicable to their proper handling in the indicated change calculation.*) Traditionally, there have been two methods of adjusting historical experience for changes that have affected the average premium level:

1. Recalculate the total historical premium to what it would be under current conditions, making exact adjustments to recognize the historical changes that have occurred to the average premium level. This method is generally used only when the effect of the change is one-time and measurable. This approach implies that the effect of the change has stopped and that we want to fully adjust for it without projecting a continuation of the change into the future policy period. An example of this type of change is a rate change.

2. Observe the overall trend in the average premium throughout the experience period and select an average annual change that can be applied to the denominator of the historical loss ratio for each year. The number of years of premium trend to be applied will vary according to the age of the year, but each year is trended to the average premium level that is expected in the future. This method is generally used when the effect of the change is continuous and difficult to measure precisely. It implies that we anticipate the change in average premium to continue completely through the future policy period. An example of this type of change is a gradual shift in the mix of business toward higher liability limits.

Notice that we must be careful to use only one of these adjustment methods. Otherwise, we will double count the effect of the change. For example, if we account for a rate increase using both methods, we would first increase the historical premium as we restate it at the current rate level. However, we would increase the premium again if we allowed the rate change to be observed and captured in the analysis of the trend in average earned premium. Applying a rate change trend factor to premium that is already at the current rate level would cause us to overestimate the future premium level, and underestimate the needed rate increase.

The task of adjusting for the changes affecting the average premium level is, therefore, reduced to two challenges. First, we must choose an adjustment method for each type of change that has had an impact on the average premium level. Second, if we choose the first method to adjust for a change, we must make sure not to capture the effect of that change a second time while measuring the premium trend.

Challenge 1: Choosing an Adjustment Method

We have already discussed the basis of choosing an adjustment method. Good candidates for making a direct adjustment to the historical premium are those changes to the average premium level that are one-time, especially those whose effects are measurable and abrupt. Changes that are continuous, especially those whose effects are gradual and difficult to measure, are usually best captured in an observation of the average premium trend.

Note that it is possible to adjust for all changes using the second method, but there are problems with that approach. First, historical rate changes will cause abrupt shifts in the average premium, making trend selection more difficult and obscuring the effects of the other, often more subtle, influences on the premium. Second, a trend selected in this way would assume that the average historical rate change would continue to occur in the future policy period. This is not likely to be a valid assumption.

Challenge 2: Making Sure Not to Double Count

The first adjustment method (making direct adjustments to the historical premium) accounts for changes having one-time, measurable effects. The second adjustment method (observation of premium trend and adjustment of the denominator of the projected loss ratios) accounts for all other changes.

So how do we avoid double counting? First, let's determine what the unadjusted series of historical average premiums would capture in the premium trend. The answer is – everything: rate changes, rating plan changes, rating plans that change the average premium level over time, and shifts in the mix of business. But we have already made direct adjustments to the historical premium dollar amounts for the rate changes and rating plan changes. If we use an unadjusted series of average premiums to determine the premium trend, we would double count the effects of any change already accounted for through a direct adjustment to the historical premium.

Exhibit 1 shows the 12-month moving average written premium for the last 24 quarters. Notice the jump from quarter 12 to quarter 16. This is due to a 20 percent rate increase taken in the middle of the experience period. The average annual change across the entire period, using an exponential fit, is 8.5 percent. But is that really the premium trend? Aside from the rate change, the annual trend appears to be much lower than 8.5 percent.

Exhibit 1

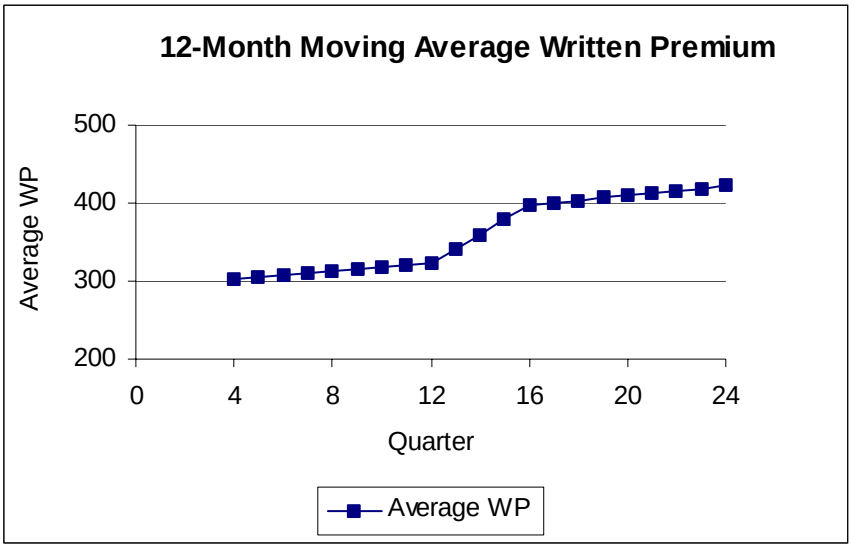
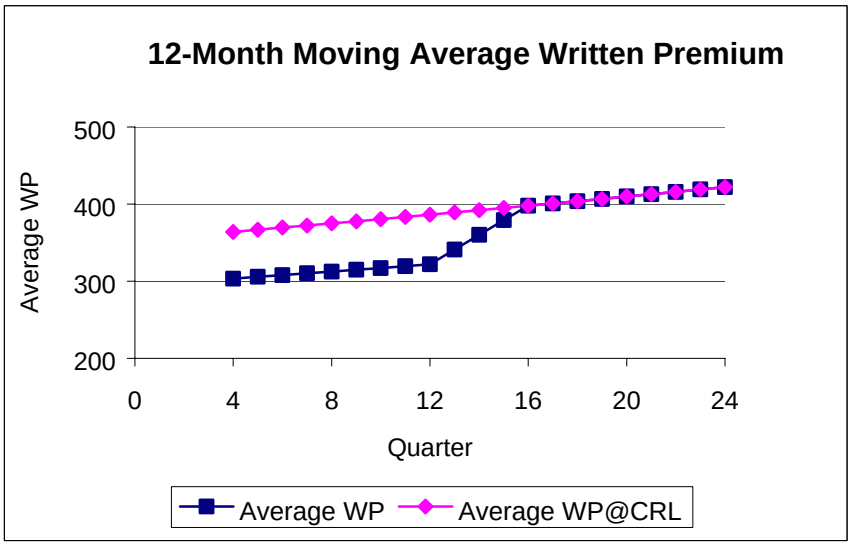


Exhibit 2 retains the series of historical average premiums from Exhibit 1, but adds a second set of points representing the historical average premiums at current rate level. On this basis, the effect of the rate change is no longer visible in the series of average premiums, and the stable underlying premium trend of 3 percent is much more readily apparent.

Exhibit 2



Since we will adjust the historical earned premium in the experience period loss ratios to the current rate level, we do not need to adjust for the rate change again by selecting a higher premium trend. The proper choice in this case is the 3 percent trend. Table 1 shows the numbers underlying these exhibits. The second to last column is the series in Exhibit 1, and the last column is the series that is added in Exhibit 2.

Table 1

Derivation of Average Premium Series for Trend Analysis

Quarter	Written Exposures	Quarterly Avg WP	Rate Change	Rate Level Index	Factor to CRL	Written Premium	WP@CRL	12-Month Moving Total WP	12-Month Moving Total WP@CRL	12-Month Moving Avg WP	12-Month Moving Avg WP @CRL
1	1,000	300.00		1.000	1.200	$300,000	$360,000	--	--	--	--
2	1,020	302.23		1.000	1.200	308,270	369,924	--	--	--	--
3	1,040	304.47		1.000	1.200	316,645	379,975	--	--	--	--
4	1,061	306.72		1.000	1.200	325,435	390,522	1,250,350	1,500,421	303.41	364.09
5	1,082	309.00		1.000	1.200	334,338	401,206	1,284,688	1,541,627	305.66	366.79
6	1,104	311.29		1.000	1.200	343,666	412,399	1,320,085	1,584,102	307.93	369.51
7	1,126	313.60		1.000	1.200	353,114	423,737	1,356,554	1,627,864	310.21	372.25
8	1,149	315.93		1.000	1.200	363,000	435,600	1,394,119	1,672,942	312.51	375.02
9	1,172	318.27		1.000	1.200	373,012	447,615	1,432,793	1,719,351	314.83	377.80
10	1,195	320.63		1.000	1.200	383,154	459,784	1,472,280	1,766,736	317.17	380.60
11	1,219	323.01		1.000	1.200	393,748	472,497	1,512,914	1,815,496	319.52	383.42
12	1,243	325.40		1.000	1.200	404,478	485,373	1,554,392	1,865,269	321.89	386.26
13	1,268	327.82	20.0%	1.200	1.000	498,808	498,808	1,680,187	1,916,462	341.15	389.13
14	1,293	330.25		1.200	1.000	512,415	512,415	1,809,449	1,969,093	360.23	392.02
15	1,319	332.70		1.200	1.000	526,596	526,596	1,942,297	2,023,192	379.13	394.92
16	1,345	335.17		1.200	1.000	540,959	540,959	2,078,778	2,078,778	397.85	397.85
17	1,372	337.65		1.200	1.000	555,911	555,911	2,135,882	2,135,881	400.80	400.80
18	1,399	340.16		1.200	1.000	571,056	571,056	2,194,522	2,194,522	403.78	403.78
19	1,427	342.68		1.200	1.000	586,805	586,805	2,254,731	2,254,731	406.77	406.77
20	1,456	345.22		1.200	1.000	603,171	603,171	2,316,944	2,316,943	409.79	409.79
21	1,485	347.78		1.200	1.000	619,748	619,748	2,380,780	2,380,780	412.83	412.83
22	1,515	350.36		1.200	1.000	636,958	636,958	2,446,682	2,446,682	415.89	415.89
23	1,545	352.96		1.200	1.000	654,389	654,389	2,514,266	2,514,266	418.97	418.97
24	1,576	355.58		1.200	1.000	672,470	672,470	2,583,564	2,583,565	422.08	422.08

The general rule for the trend analysis is to express the series of average premiums on the same basis as the adjusted historical earned premium to which the trend will be applied. That way, the historical loss ratio will be adjusted only once for each type of change to the average premium level. For example, if you have recalculated the historical earned premium to express it at the current rate level, then you must also recalculate the average premiums to express them at the current rate level before performing the trend analysis.

Now we must determine the most appropriate treatment method for each specific type of change to the premium level.

1. Past Rate Changes – We described the effect of historical rate changes on the premium level as one-time and measurable. Therefore, we should make a direct adjustment to the historical premium and restate it at the current rate level. If loss ratios are taken early in the process, the correct adjustment would be to apply a current rate level factor to the denominator of each loss ratio in the experience period.

   The other reason not to account for past rate changes with a premium trend is that the indication seeks to determine the needed revision to the current rate level. It would be inappropriate to project some type of annual expected rate level change as part of the calculation of the indicated change. The rate level we want to assume for the future is the current rate level.

   When observing the trend in average premiums, we need to make the same adjustment to the average premium figures as we did to the total premium figures so that we do not double

count the effect of the rate changes. An advantage of the direct adjustment approach is that the series of average premiums is cleaned up of sudden jumps so that the other influences on the average premium can be more easily identified.

2. Past Rating Plan Changes – We described the effect of most rating plan changes as one-time and measurable. Therefore, they can be treated just like rate changes. That is, we should make a direct adjustment to the historical premium and restate it at the current rating plan level. Also, as with rate changes, we do not want to project historical rating plan changes into the future with a premium trend since rating plans are part of the overall rate level and the basis of the indicated change is the current rate level.

   Let's look at an example of a rating plan change with a one-time, measurable effect on the average premium level. The example in the previous section relating to rating plan changes was a new 10 percent discount for which half the policyholders would qualify. The effect of this change is so similar to that of a 5 percent base rate reduction, we can treat it as a rate change and make a direct adjustment to the historical premium figures to account for it.

   As with rate changes, we would also need to remove its effect from the average premium series that we observe in the trend analysis so as not to double count the effect of the change.

3. The Use of Rating Plans that Change the Premium Level Over Time – We determined that these kinds of rating plans have measurable effects on the premium level, but the effects are normally continuous and gradual. There will be some judgment involved in choosing an adjustment method, with the key issue being the trend's likelihood of continuation. If the changes in the average premium level are expected to continue, capturing and projecting these changes with the premium trend may be the most appropriate method. On the other hand, if the changes were not expected to continue, making a direct adjustment the historical premium figures may be a better approach.

4. Shifts in the Mix of Business – The same is true of shifts in the mix of business. There are many types of shifts and judgment will be involved in choosing an adjustment method. It is important to be sufficiently familiar with the book of business to be able to judge whether the shifts in the various distributions have stopped or if they can be expected to continue. If the shifts have stopped, it may be more appropriate to make a current-rate-level type adjustment to the historical total premiums than to project a continuation of the premium trend into the future policy period. If the shifts are expected to continue into the future policy period, then the best approach may be to project this expectation with a premium trend.

   The direct approach is possible if a complete set of distribution data is available for each rating variable that applies to the coverage or line of business being studied. It is possible to determine the actual change in the average factor for each rating plan and then apply an adjustment to each year's earned premium in order to restate it at the current mix of business.

   Any shift that is expected to continue should also be projected into the future policy period. This determination can be made for each individual rating plan. The combined annual premium trend for those rating plans that are expected to continue shifting can be used to

project for the anticipated future shifts between the current distribution and the distribution in the future policy period.

What Data to Use?

As a reminder, the advantage of using average premium rather than total premium is that the trend series will not be distorted by exposure growth. Companies often choose to evaluate 12-month moving averages of the premiums instead of just using the averages for individual months or quarters. This technique helps to smooth out random fluctuations. Unlike with loss trends, seasonality should not be a significant concern when tracking the average premium for most lines of business. The use of 12-month moving average premiums in Exhibits 1 and 2 is the reason that the 20 percent rate change was seen as an upward sloping line for four quarters, rather than a vertical line straight to the new rate level.

The next issue is to decide whether the premium trend analysis should be based on a series of average earned premiums or average written premiums. Arguments could be made for both.

The argument for earned premium: *Since these trends will apply to historical earned premium at current rate level, we should evaluate trends based on shifts in average earned premium.*

The argument for written premium: *Even though the historical premium is earned premium, we can determine the average written date for that block of premium and then observe changes in average written premium to establish the trend. Therefore, basing the trend analysis on average written premium is a valid approach. Furthermore, average written premium has an important advantage in that it allows us to capture more recent data than average earned premium. This is because of the simple fact that the premium for a given policy is not earned until well after it is written. In fact, at any given point in time, the latest quarter's average earned premium is based on a group of policies that is a half a policy period older than the group of policies comprising the latest quarter's average written premium. Using average earned premium would unnecessarily postpone the recognition of the effects of the most recent changes in the mix of business.*

Based on the above arguments, average written premium appears to be the better choice, although average earned premium would also provide acceptable results. The implications of the choice between written and earned on the applicable trending periods can be seen in the diagrams in the next section.

One-Step Trending vs. Two-Step Trending

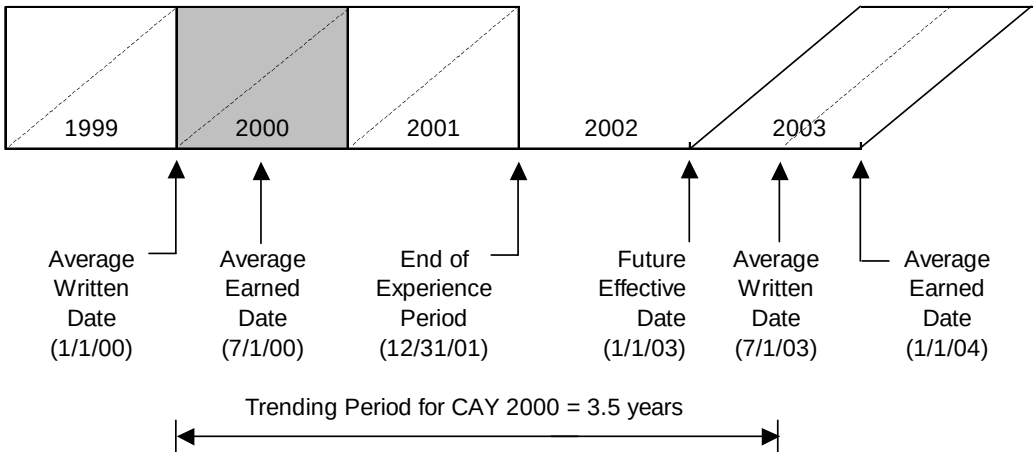
There are two main options available for the process of applying premium trend to the historical loss ratio. The first option is one-step trending. This approach applies a single annual trend factor across the entire experience period and into the future policy period. Each year's loss ratio in the experience period is trended separately, but all are trended to the same point in time. This approach is the preferred method for premium trending at many companies and is the standard method employed for loss trending. Exhibit 3 shows a graphical representation of an experience period consisting of three calendar/accident years, as well as a one-year prospective policy year. The bottom of the diagram is when the policy is written and the top is when it expires. The vertical axis can be thought of as "percent earned." The diagonals represent the earned premium lifespan for a policy written on a given date. The portion of the diagonal inside each calendar year is proportional to the portion of the policy premium earned in that calendar year. The key dates are identified for CAY 2000 and the appropriate trending period is displayed.

Exhibit 3

One-Step Premium Trending - 12-Month Policies

Experience period = 1999 through 2001
Planned effective date = 1/1/03
Rates are reviewed annually
Policies have a 12-month term

What is the trending period for calendar/accident year (CAY) 2000?



Since our trend analysis is based on average written premium, the appropriate trending period begins at the average written date for the particular year in the experience period being trended. The trending period ends at the average written date of the future policy period. But we need to be careful here. The premium in the experience period is typically calendar year earned premium, so we cannot simply use the midpoint of the year. The midpoint of a period of earned premium is the average earned date. The average written date of the earned premium would be half the policy term earlier. For a 12-month policy, this would be six months earlier, or the beginning of the year.

To see why this is true, consider the written dates of the various policies that contribute earned premium to a given calendar year. In Exhibit 3, the year being trended is 2000 and all policies have a 12-month term. The first policies that contribute to calendar year 2000 earned premium would be ones written on 1/2/99, since these policies would be effective until the end of the day on 1/1/00. The last policies that would contribute to 2000 earned premium would be ones written on 12/31/00. The total period of time between these two dates is 24 months, and the weights given to the various dates are symmetric about the midpoint of the time period. That is, 1/2/99 and 12/31/00 contribute an equally tiny amount to the 2000 earned premium, 1/3/99 and 12/30/00 contribute a slightly larger share, and so on. Therefore, the average written date is half way in between, at 1/1/00, which is six months before the average earned date of 7/1/00.

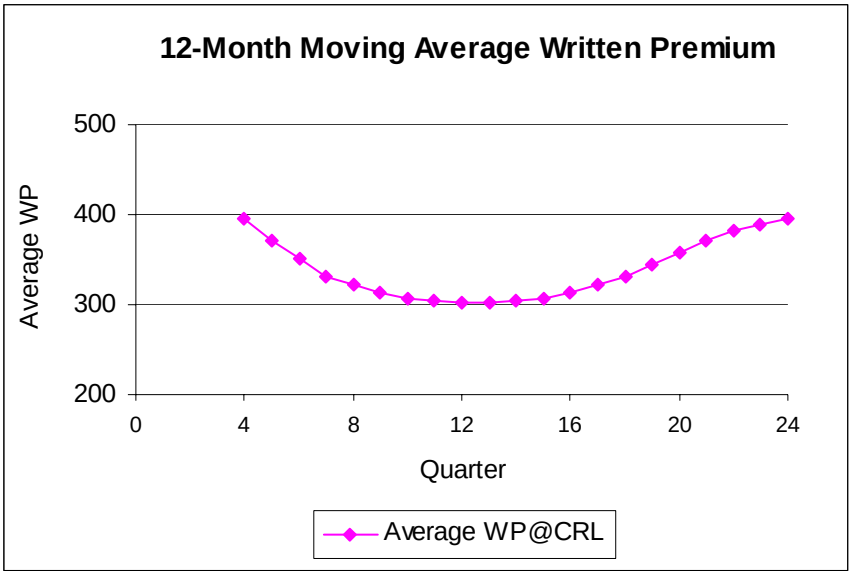
Another way to verify the average written date using the diagram is to determine what the written date was for the policy that was half earned at the midpoint of the calendar year. That policy can be identified by going to the center of the 2000 block, above the average earned date of 7/1/00, and tracing a diagonal back down and to the left until it reaches the time line.

The average written date in the future policy period is considerably easier to determine since we are dealing with a policy year, which groups the complete experience of a group of policies written in a particular year. Unlike for a calendar year, the average written date for a policy year does not depend on the term of the policies. Instead, the variable of interest in determining the trending

period is the length of time that the rates are expected to remain in effect. The standard assumption is one year, which would make the average written date six months after the proposed effective date.

The second option for a trending procedure is two-step trending, which can be a significant improvement over one-step trending. The advantage of two-step trending is that it recognizes that there are situations where a single annual premium trend may not be appropriate for each year in the experience period. Exhibit 4 shows an example of such a situation.

Exhibit 4



Notice that the average premium at current rate level dropped in the middle of the observation period and then returned to its initial value of $400. Assume that our best prediction for this trend going into the future is that it would continue upward at 5 percent annually. If we were using one-step trending, we would need to select a trend that was appropriate for the experience period (close to 0 percent) and the projection phase (5 percent). We would have to make some kind of compromise and select, say, a 2 percent trend. The problem with this approach is that, if year 1 (quarter 4 data point) were in the experience period, it would need about the same total amount of trend as year 6 (quarter 24). However, one-step trending would give year 1 five more years of trend adjustment than year 6. Furthermore, notice that year 3 (quarter 12) would need a much larger trend adjustment than either year 1 or year 6 in order to project it at the expected future level.

Rather than trying to compromise on the selection of a single long-term trend, the two-step trending method simply divides the latest average written premium at current by the average earned premium at current for each year in the experience period. This produces conversion factors for adjusting the total earned premium at current rate level for each year to the latest period's average written premium level. Average earned premium at current rate level can be calculated directly from the total earned premium at current rate level and the earned exposure counts.

In establishing the ending point for the first part of the trending period (step 1), it is important to recognize that the average written premium measures in the series are 12-month averages. This means that each figure provides a measure of the average premium at the midpoint of its 12-month

period. In other words, if the latest trend point in the series is for the year ending 12/31/01, then the measure of the average premium for that point corresponds to 7/1/01, not 12/31/01. Therefore, the first step of the two-step trending procedure trends the premium to the midpoint of the latest trend data point in the series.

The second step of the two-step trending procedure trends the premium from the midpoint of the latest trend data point to the average written date for the future policy period. If the target effective date were 1/1/03, then the average written date for the future policy year would be half way through, or 7/1/03, with the standard assumption that the proposed rates will be in effect for one year. The trending period in this example would need to extend from the midpoint of the latest average written premium measure (7/1/01) to the average written date for the future policy period (7/1/03). Therefore, the trending period for the second step would be two years. Appendix 2 provides an example of the two-step trending procedure.

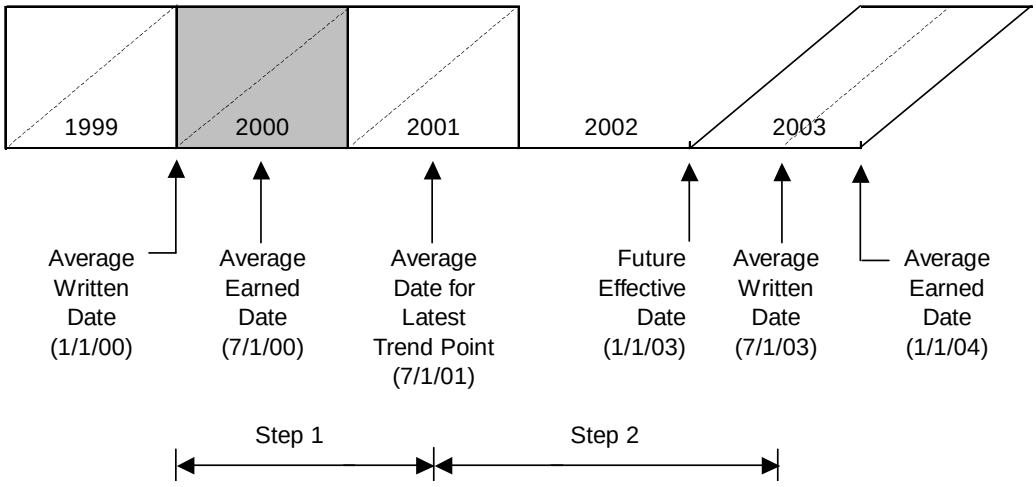
Exhibit 5 shows a graphical representation of two-step trending, identifying the key dates for calendar/accident year 2000 and displaying the appropriate trending periods for step 1 and step 2.

Exhibit 5

Two-Step Premium Trending - 12-Month Policies

Experience period = 1999 through 2001
Planned effective date = 1/1/03
Rates are reviewed annually
Policies have a 12-month term

What are the trending periods for calendar/accident year (CAY) 2000?



Note that the total trending period is still 3.5 years, just as it was in one-step trending, but it is now split into two separate steps.

Before continuing, we should make sure that we are comfortable with the theoretical implications of two-step trending. This trending method rests on the assumption that the last data point of the trend series is a "true" number. For loss frequency or severity, this can be a dubious assumption because of random fluctuations around the true expected value. For average premium, on the other hand, the individual data points are more believable because there is not as large a random element. If, for example, the last 12-month average premium has jumped up, this is probably not just a random occurrence that will disappear next quarter. It is more likely the result of some meaningful shift in the book of business that can be expected to persist.

Average Written vs. Average Earned Premium

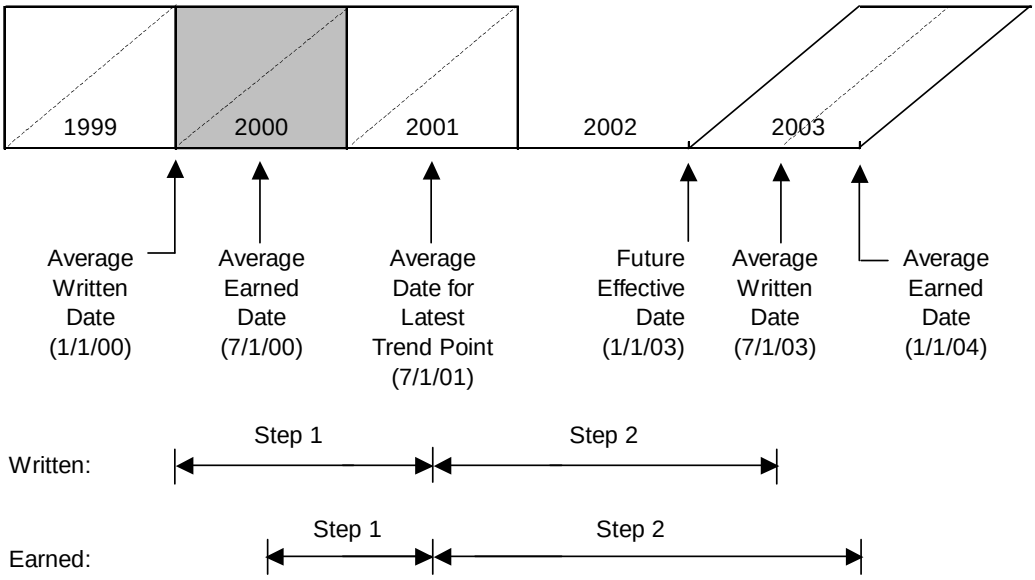
Even though the preference for average written premium has been established, it is a good exercise to compare the applicable trending periods under the written and earned approaches. Even though the two alternatives have the same length trending periods, these periods are not identical. The trending period for the average earned premium approach is shifted in time so that it is a half a policy period later than the trending period for the average written premium approach. Exhibit 6 shows the trending periods for the two methods.

Exhibit 6

Two-Step Premium Trending - Written vs. Earned

Experience period = 1999 through 2001
Planned effective date = 1/1/03
Rates are reviewed annually
Policies have a 12-month term

What are the trending periods for calendar/accident year (CAY) 2000?



Regardless of whether we use average written or average earned premiums for the trend analysis, the latest data point in the series will have an average date of the middle of the latest year. This is because each point in the series is a 12-month average premium. In other words, the average written date for a 12-month average written premium is in the middle of the 12-month period. Likewise, the average earned date for a 12-month average earned premium is in the middle of the 12-month period. Since the trending period for written premium is earlier and the date of the latest trend point is fixed on the time line, the date of the latest trend point falls relatively later in the trending period for written premium than it would in the trending period for earned premium. As a result, a trend analysis based on average written premium will have a longer trending period for step 1 and a shorter projection period for step 2. This confirms the intuitive appeal of using average written premium for the trend analysis in that the length of the inherently uncertain projection period is minimized.

If we were to use the one-step trending procedure and a particular annual trend, both the written premium trending method and the earned premium trending method will yield the same overall

trend adjustment since the two methods have the same length trending period. However, the selected annual trend is likely to be slightly different since the average written premium method makes use of data that is a few months more recent.

What About Six-Month Policies?

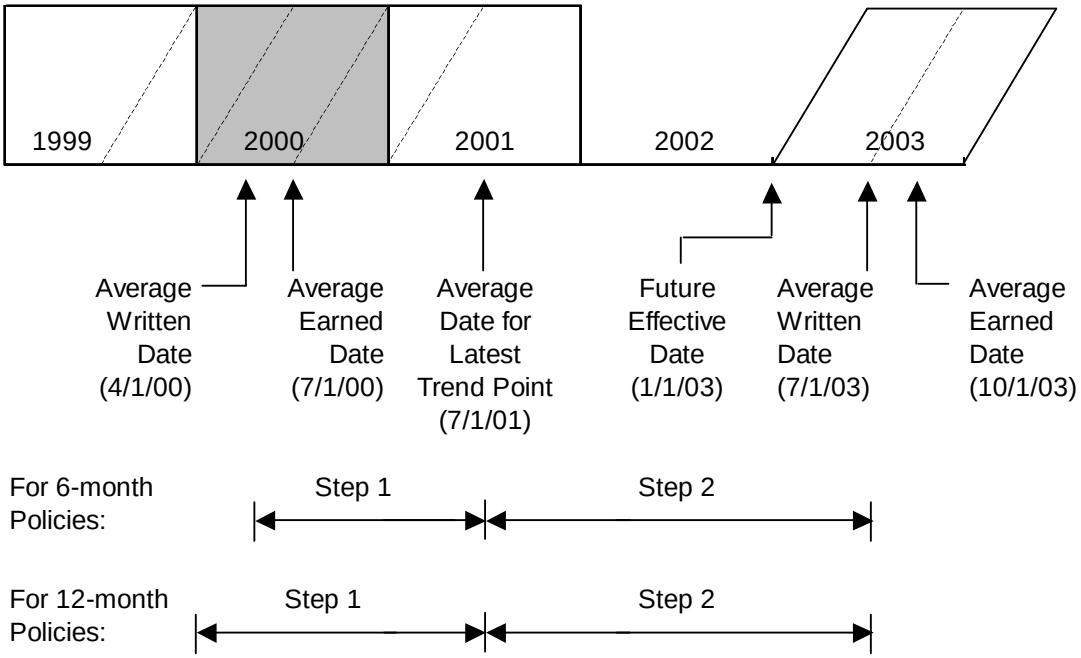
Many companies write six-month policies, especially for personal automobile insurance. A discussion of premium trending would not be complete without at least a brief comment on the treatment for six-month policies. Assume we are using a two-step trending procedure and that our trend is based on average written premium. For a six-month policy term, the first step of the procedure will involve a shorter trending period than the one used for 12-month policies. This is because the average written and average earned dates are closer together for shorter policies. The break point between the first and second step is still the same since we use 12-month moving averages of written premium in both analyses. The second step of the procedure results in the same length trending period as was used for 12-month policies. This is because the average written date in the future policy period does not depend on the length of the policies. Instead, it is the length of time the rates are assumed to be in effect before the next revision. In either case, the assumption is 12 months. Exhibit 7 compares the appropriate trending periods for six-month policies and 12-month policies.

Exhibit 7

Two-Step Premium Trending - Six-Month Policies

Experience period = 1999 through 2001
Planned effective date = 1/1/03
Rates are reviewed annually
Policies have a 6-month term

What are the trending periods for calendar/accident year (CAY) 2000?



For 6-month policies, the total trending period for CAY 2000 = 3.25 years, which is three months shorter than for 12-month policies.

Notice that the diagonals have gotten steeper. This is because the policies "earn out" at twice the speed. To determine the average written date, we can use either of the two methods described earlier. The first policies that contribute to calendar year 2000 earned premium would be ones written on 7/2/99, since these policies would be effective until the end of the day on 1/1/00. The last policies that would contribute to 2000 earned premium would be ones written on 12/31/00. The total amount of time between the two written dates is 18 months, so the average written date is 4/1/00. Also, tracing a diagonal on the diagram back from the center of the 2000 block will lead you to a policy written on 4/1/00.

Inflation-Sensitive Exposure Bases

The overall concepts described in this paper are logical enough when the exposure base is a simple, fixed unit such as a car-year. Unfortunately, things are not always so simple. For example, the standard exposure unit for Workers Compensation is $100 of payroll. For other types of insurance, such as Homeowners, the base rate used by many companies applies to each $1000 of coverage. These exposure definitions, because they are tied to dollars, are subject to economic trends just as losses and premium are. For this reason, they are often referred to as inflation-sensitive exposure bases. As inflation occurs, the number of exposures will increase, even though the underlying risk, such as the home or business itself, remains the same. Many Homeowners policies include an

"inflation guard" feature that automatically increases the amount of coverage by a certain percentage to make sure that the house continues to be adequately insured. This automatic increase in exposure is similar to a premium trend in that it reduces the need for the insurer to increase rates. In Workers Compensation, the insured employer's payroll is audited to make sure that the exposure is measured correctly. So how should we incorporate this exposure trend into our estimate of the expected future loss ratio?

The answer to this question is actually quite simple, and it relates back to the fundamentals of the indicated rate level change analysis. In calculating the expected future loss ratio, we need to make adjustments for changes in frequency, severity, and average premium. In order to maintain a valid loss ratio projection, the adjustments made to the numerator of the loss ratio should be on a consistent basis with those made to the denominator. Let's examine the components of the loss ratio more carefully to clarify this idea.

The numerator of the loss ratio is adjusted for frequency trend and severity trend, while the denominator is adjusted for average premium trend. Each of these measures has a basis. Frequency trend is the change in the average number of claims per exposure or per policy. Severity trend is the change in the average dollar amount of payment per claim. The combination of frequency and severity trend is the pure premium trend. Notice that the claim component of frequency and severity cancels and the result is the change in the average dollar amount of payment per exposure or per policy (whatever the basis was for frequency). In order to produce a valid projection of the loss ratio, we need to adjust the denominator for the change in the average premium on the same basis. In other words, the series of average premiums from which we derive the premium trend needs to be based on an exposure definition that matches the one that was used in the frequency trend analysis.

To understand why this is true, consider the purpose of the various trend adjustments to the historical loss ratios. These adjustments seek to account for the difference between the historical loss ratios and the expected future loss ratio that are due to trends in frequency, severity, and average premium at current rate level. The net effect of the adjustments should be equivalent to making a single adjustment for the expected change in the loss ratio due to these trends. Therefore, we need to make sure that the individual trend adjustments will mathematically reduce to a simple loss ratio trend. In fact, an alternative that is used in some lines of business is to employ this loss ratio trend concept directly and dispense with separate adjustments for frequency trend, severity trend, and average premium trend. This approach completely eliminates the need to choose a proper exposure basis for trending.

An example should help to clarify the proper treatment of inflation-sensitive exposure bases in the calculation of the expected future loss ratio. Exhibit 8 shows an example for Workers Compensation. The example assumes that annual wage inflation is 3 percent and the annual loss trend is outpacing wage inflation by 1 percentage point. For simplicity, assume there is no other source of premium trend besides the growth in payroll.

Exhibit 8

Premium Trending with Inflation-Sensitive Exposure Bases

Workers Compensation - Standard Exposure Base is $100 of Payroll

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Accident Year	Number of Insured Employers	Average Annual Payroll	Number of $100 Units of Payroll	Earned Premium at Current	Number of Claims	Developed Incurred Losses
1	10	$500,000	50,000	100,000	5,000	70,000
2	10	$515,000	51,500	103,000	5,000	72,800
3	10	$530,450	53,045	106,090	5,000	75,712
4	10	$546,364	54,636	109,273	5,000	78,740
5	10	$562,755	56,276	112,551	5,000	81,890
Total		$2,654,569	265,457	530,914	25,000	379,142

(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Accident Year	Average Premium Per $100 of Payroll	Average Premium Per Employer	Frequency Per $100 of Payroll	Frequency Per Employer	Average Loss Per Claim (Severity)	Average Loss Per $100 of Payroll (Pure Prem)	Average Loss Per Employer (Pure Prem)	Loss Ratio
1	$2.00	10,000	0.1000	500	$14.00	$1.40	$7,000.00	70.0%
2	$2.00	10,300	0.0971	500	$14.56	$1.41	$7,280.00	70.7%
3	$2.00	10,609	0.0943	500	$15.14	$1.43	$7,571.20	71.4%
4	$2.00	10,927	0.0915	500	$15.75	$1.44	$7,874.00	72.1%
5	$2.00	11,255	0.0888	500	$16.38	$1.46	$8,189.00	72.8%

Here is a summary of the annual trends for the key quantities in Exhibit 8.

Column	Description	Annual Trend
4	Exposures	3.00%
9	Avg. Prem (per $100 Payroll)	0.00%
10	Avg. Prem (per Employer)	3.00%
11	Freq (per $100 Payroll)	-2.91%
12	Freq (per Employer)	0.00%
13	Avg. Loss Per Claim (Severity)	4.00%
14	Avg. Loss Per $100 (Pure Premium)	0.97%
15	Avg. Loss Per Employer (Pure Premium)	4.00%
16	Loss Ratio	0.97%

Notice that wage inflation appears as exposure growth (columns 3 and 4), even though the number of insured employers remains constant at 10. If we observe the series of average premiums per exposure (column 9), we see that there is no premium trend. However, if we measure premium trend on the basis of average premium per insured employer (column 10), we capture the exposure growth and see a positive premium trend. The proper choice between these two measures of premium trend depends on the basis of the loss trend.

As with premium trend, the frequency component of the loss trend can be expressed on a per-$100-of-payroll basis (column 11) or a per-insured-employer basis (column 12). Severity (column 13) is always on an average-loss-per-claim basis. For convenience, we will combine frequency and severity into pure premium for the purposes of this discussion. Pure premium, or the average loss per exposure, can be expressed on a per-$100-of-payroll basis (column 14) or a per-insured-

employer basis (column 15). The various options for the treatment of premium trend are shown below, along with the resulting estimate of the expected future loss ratio.

The simple assumptions of this example allow us to observe from the pattern of historical loss ratios (column 16) that the expected future loss ratio for a policy year beginning January 1 of year 7 should fall around 74%. Keep that fact in mind as we experiment with the different options available for the basis of the premium trend.

Option 1 shows the direct adjustment of the historical loss ratios with a loss ratio trend.

Accident Year	Hist Loss Ratio	Annual Loss Ratio Trend	Years of Trend	Adjusted Loss Ratio
1	0.700	0.97%	6.5	74.5%
2	0.707	0.97%	5.5	74.5%
3	0.714	0.97%	4.5	74.5%
4	0.721	0.97%	3.5	74.5%
5	0.728	0.97%	2.5	74.5%
				74.5%

Notice that the loss ratio trend is the net effect of the numerator increasing by 4 percent per year and the denominator increasing by 3 percent per year. This approach shows that the expected future loss ratio is 74.5%.

In **Option 2**, the losses have been trended on a per-$100-of-payroll basis. Therefore, we should select a premium trend that has been determined on the same basis. The result is the same as in Option 1, but Option 2 has the advantage of allowing the analyst to select trends for each component of the loss ratio independently of one another.

Accident Year	Hist Loss Ratio	Annual Loss Trend Per $100 Payroll	Annual Prem Trend Per $100 Payroll	Years of Trend	Adjusted Loss Ratio
1	0.700	0.97%	0.0%	6.5	74.5%
2	0.707	0.97%	0.0%	5.5	74.5%
3	0.714	0.97%	0.0%	4.5	74.5%
4	0.721	0.97%	0.0%	3.5	74.5%
5	0.728	0.97%	0.0%	2.5	74.5%
					74.5%

Likewise, in **Option 3**, where the losses have been trended on the per-insured-employer basis, the proper choice of premium trend is the one that is based on average premium per insured employer.

Accident Year	Hist Loss Ratio	Annual Loss Trend Per Employer	Annual Premium Trend Per Employer	Years of Trend	Adjusted Loss Ratio
1	0.700	4.0%	3.0%	6.5	74.5%
2	0.707	4.0%	3.0%	5.5	74.5%
3	0.714	4.0%	3.0%	4.5	74.5%
4	0.721	4.0%	3.0%	3.5	74.5%
5	0.728	4.0%	3.0%	2.5	74.5%
					74.5%

Notice that in all three of these options, the "net trend" is approximately 1 percent.

Option 4 is **invalid**. It shows how quickly things can go wrong if one inadvertently uses a mixed approach. The losses have been trended on a per-insured-employer basis, but the premium trend measure is based on average premium per $100 of payroll.

Accident Year	Hist Loss Ratio	Annual Loss Trend Per Employer	Annual Prem Trend Per $100 Payroll	Years of Trend	Adjusted Loss Ratio
1	0.700	4.0%	0.0%	6.5	90.3%
2	0.707	4.0%	0.0%	5.5	87.7%
3	0.714	4.0%	0.0%	4.5	85.1%
4	0.721	4.0%	0.0%	3.5	82.7%
5	0.728	4.0%	0.0%	2.5	80.3%
					85.1%

This mismatch causes the full effect of inflation to be incorporated into the loss adjustment, while no inflation adjustment occurs to the premium. As a result, the projected loss ratio is overstated by more than ten percentage points.

The conclusion is that there are several ways to deal with inflation-sensitive exposure bases. The only requirement is that the exposure definition used in the premium trend analysis needs to match, or at least be consistent with, the exposure definition used in the loss trend analysis. An exact match of exposure base definitions is not needed, as long as the resulting trend in the numerator and denominator are consistent. For example, whether the exposures are measured in $1 units or $100 units, the percentage change in the average premium per exposure will be the same.

Credibility

Why is there no discussion of credibility in establishing a statistically reliable estimate of the future portion of the premium trend? After all, a premium trend based on a small volume of data could be subject to random variation and may not be a reasonable estimate of the future trend. Assume for the moment that we were able to determine an appropriate full credibility standard for premium trend. There is just one problem. The credibility weighting procedure requires a complement of credibility, or some second source of information that will serve as a second opinion on the quantity being estimated. For premium trend, what would this alternative source of information be?

Countrywide premium trends are not necessarily a good estimate of a particular state's premium trends, since rating plans and shifts in the mix of business are often quite different from one state to the next. Industrywide premium trends would be even less helpful because of these differences.

Rather than trying to use a strict credibility standard, the analyst should employ judgment when evaluating premium trends and should be prepared to reject unreasonable results. It is usually possible to have an intuitive expectation of the trend, based on the rating plans that impact the average premium. For example, if you were studying Collision coverage and were aware of an average model year factor increase of 5 percent and an average vehicle symbol trend that has tended to run around 1 percent, you could use 6 percent as the intuitive expectation. This approach ignores expected shifts in the mix of business and any other influences on the average premium, but those elements could be built in judgmentally if needed.

What Method to Fit a Trend?

Two common choices are linear and exponential regression to determine a statistical best fit. The exponential approach is more theoretically appealing because the resulting best-fit curve suggests a constant percentage change to the average premium. In contrast, linear regression would result in a best-fit line that suggests a constant dollar amount change to the average premium. The year-to-year change in insurance premium tends to be proportional to the premium, and is more accurately described by a constant percentage change.

Summary

Unadjusted historical experience is limited in its ability to serve as a predictor of future experience. Historical experience provides samples of the basic characteristics of a book of business, such as the frequency, severity and average premium. However, the observed values of these figures are already outdated as predictors by the time they are measured because of the constant economic, legal, and social changes affecting the insurance industry. Therefore, we need to adjust the historical experience for these changes so that it forms a better estimate of the expected levels of future losses, expenses and premium.

With regard to changes in the average premium level, there are several influences to consider. These include historical rate changes, historical rating plan changes, the existence of rating plans that change the average premium level over time, and shifts in the mix of business. Some of these influences will cause abrupt, one-time shifts in the average premium level, while others cause more gradual and continuous shifts. One-time shifts that have a measurable effect should be accounted for through a direct adjustment to the historical premium figures. By using this direct approach, those changes will no longer interfere with the observation of the more gradual, continuous shifts in average premium.

Another reason to use the direct approach for these types of changes involves the purpose of the indicated rate level change calculation. The overall rate level consists of base rates and rating plan factors. The indicated rate level change is based on the current rate level. Therefore, it would be incorrect to project anticipated changes to base rates and rating plan factors, which would yield a level higher rate level than the current rate level. This error would occur if historical rate changes and rating plan changes were captured in the overall premium trend and that premium trend is projected to a future date.

Some of the other influences on the premium level, such as measurable shifts in the mix of business, can also be accounted for through a direct adjustment, especially if such shifts are not expected to continue. The remaining influences are observed in a series of average premiums and accounted for by applying a premium trend to the historical premiums at current rate level. We must be careful to make the same direct adjustments to the series of average premiums that we did to the total premium figures. Otherwise, we will double count the effects of any of those direct adjustments.

In evaluating the series of data points to determine a trend, average written premium is preferred to average earned premium because it represents more recent distributional information. If the trend in average written premium is irregular, a two-step trending approach, where historical earned premiums at current rate level are converted to the latest average written premium at current rate level and then projected into the future, may yield more reasonable results.

Finally, for lines of business that uses an inflation-sensitive exposure base such as $100 of payroll, the exposure definition in the premium trend analysis should match the exposure definition in the loss trend analysis in order for the loss ratio projection to maintain its validity.

Appendix 1 – Indicated Change Calculation Using One-Step Trending

A Simple Example – 0% Annual Premium Trend

Assume the following data for a 3-year experience period:

Year	Earned Premium	Developed Incurred Losses	Loss Ratio
1	10,000	7,120	0.712
2	10,500	7,980	0.760
3	11,000	8,393	0.763
Total	31,500	23,493	0.746

Expense & profit ratio (including an allowance for investment income) = 0.254

Permissible loss ratio = 1 - 0.254 = 0.746

At first glance, one might conclude that no rate change is needed since the overall historical loss ratio is exactly equal to the permissible loss ratio. The fundamental problem with this reasoning, though, is that our analysis concerns the future loss ratio, not the historical ones, per se. Losses and premiums have not been trended, and premium is not at the current rate level, so the loss ratios are very much historical.

Assume that the three premium figures in this example are based on the exact same book of business and that the only difference between them is due to a 10 percent rate increase that occurred at the beginning of year 2. Since our analysis focuses on the current rate level, the premium figure of 11,000 for year 3 is the one that should be used for all three years. That is, the other two earned premium figures would also have been 11,000 if they had been written at the current rate level.

Now let's restate the example using premium at current rate level:

Year	Current Rate Level Earned Premium	Developed Incurred Losses	Loss Ratio
1	11,000	7,120	0.647
2	11,000	7,980	0.725
3	11,000	8,393	0.763
Total	33,000	23,493	0.712

Now the historical experience looks more profitable, but look at the loss ratios for the individual years. They are increasing rapidly. This is because premium is expressed in current terms (and projected to the future average premium level since there is no premium trend) but losses are still shown at historical levels. Once we apply a loss trend to express the losses at a level that can be expected in the future, we will have a meaningful adjusted loss ratio.

Assume the following: the loss trend is 4 percent, we are determining rates for an effective date of 7/1 of year 4, and the policy term is 12 months. Now we will adjust the historical loss ratios for the loss trend.

Year	Loss Ratio	Annual Loss Trend	Years of Trend	Projected Loss Ratio
1	0.647	1.04	4	0.757
2	0.725	1.04	3	0.816
3	0.763	1.04	2	0.825
Average	0.712			0.799

Expense & profit ratio (including an allowance for investment income) = 0.254

Permissible loss ratio = 1 - 0.254 = 0.746

The indicated change is 0.799/0.746 – 1 = +7.1%

Same Example but with 2% Annual Premium Trend

This example removes the assumption about the book of business being identical in each of the three years. Instead, assume that there has been a steady shift in the mix of business that produces a 2 percent premium trend, and that this shift is expected to continue throughout the future policy period. In order to maintain approximately the same total premium as in the previous example, we will assume that the premium at current for year 2 is $11,000, but the premium at current for the other years follows a 2 percent trend.

Year	Current Rate Level Earned Premium	Developed Incurred Losses	Loss Ratio
1	10,784	7,120	0.660
2	11,000	7,980	0.725
3	11,220	8,393	0.748
Total	33,004	23,493	0.712

Again, these loss ratios are not meaningful as estimates of the expected future loss ratio until the premiums and losses have been trended to their future levels. As in the previous example, we assume a 4 percent loss trend, a 7/1 of year 4 effective date, and a 12-month policy term.

Year	Loss Ratio	Annual Loss Trend	Annual Premium Trend	Years of Trend	Projected Loss Ratio
1	0.660	1.04	1.02	4	0.713
2	0.725	1.04	1.02	3	0.768
3	0.748	1.04	1.02	2	0.778
Average	0.712				0.753

Expense & profit ratio (including an allowance for investment income) = 0.254

Permissible loss ratio = 1 - 0.254 = 0.746

The indicated change is 0.753/0.746 – 1 = +0.9%

The indicated rate level change has dropped from 7.1% to 0.9%. The shift in the mix of business has resulted in increasingly higher premiums and they are projected to continue rising in the future. This trend will help the premium keep pace with the increasing losses. Therefore, a smaller rate increase is needed to achieve the indicated rate level.

Appendix 2 – Two-Step Trending

This method requires the average earned premium at current rate level for each year in the experience period. The components of these figures will be total earned premium at current rate level, which should be available as the basis of the calculation of the indicated rate level change, and earned exposures.

Once the average earned premium figures have been calculated, the two-step trending procedure can be applied. In step 1, bring the average earned premium at current rate level to the latest level available in the series of average written premiums at current rate level. This step will account for shifts in the mix of business and any other factors that we did not already account for with a direct adjustment to the historical experience. In step 2, project the average premiums for each year to the anticipated future level. In this example, a 4 percent annual trend is applied over a two-year period.

	(1)	(2)	(3)	(4)	(5)
Year	Avg EP @CRL	Latest Value of Avg WP @CRL	Step 1 Trend Factor	Step 2 Trend Factor	Total Premium Trend Factor
1997	334.87	347.49	1.038	1.082	1.122
1998	314.63	347.49	1.104	1.082	1.195
1999	308.29	347.49	1.127	1.082	1.219
2000	314.52	347.49	1.105	1.082	1.195
2001	333.54	347.49	1.042	1.082	1.127

(3) = (2) / (1)
(4) = selected annual trend for Step 2 applied from midpoint of (2) to the average written date in the future policy period
(5) = (3) * (4)

The total premium trend factors in column (5) are used in place of those developed by the one-step procedure.