NOTES ON THE EFFECT OF WAGE CHANGES ON WORKMEN'S COMPENSATION PREMIUMS AND LOSSES

BY

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For many years there have been extended discussions concerning the reflection of the effect of wage changes in the determination of workmen's compensation rate levels. The logic in favor of including such effect is as follows:

Workmen's compensation premiums are based on payrolls. When wage rates are increasing, payrolls are increased and more premiums are collected. Indemnity losses which are based on wages will increase, but not to the same extent as premiums. Therefore, rate levels as otherwise calculated should be reduced in order to avoid excessive premiums. It would follow from the same process of reasoning that a reduction in wage rates would require an increase in rate levels as otherwise determined.

This logic has a very strong appeal and, as a result, a wage factor is now used in some jurisdictions and is being considered in others. In view of this apparent trend toward the use of wage factors, it is important to inquire into why insurance companies have been experiencing some of the highest loss ratios in history during a period when wages have been increasing at a very substantial rate.

WAGE DATA

For such an inquiry it is necessary to calculate the assumed effect of wage changes on workmen's compensation premiums and losses taking account of all known factors affecting the relationship. The data used for the calculation of wage factors in this investigation are compiled by the New York Department of Labor. Wage statistics are published by the United States Department of Labor, but it would seem that individual state data should be used wherever possible in connection with the experience for such state in order to eliminate territorial fluctuations.

The New York Department of Labor statistics is a sampling study of wages in various industries. The data available include average weekly earnings, average hourly earnings and average weekly hours reported for each month. The percentages of all employees included in the samples for each industry group at a recent date are as follows:

Manufacturing	47%
Extracting	43%
Contracting	25%
Utilities	30%
Trade	23%
Finance and Insurance	14%

Manufacturing data have been published in relatively complete form since January, 1946. Other data have been made available more recently, but even now the only published data which can reasonably be used in the calculation of an all-industry wage factor are those for manufacturing, extracting, contracting and trade. The percentage of the sample varies rather widely by individual categories within industry group (20% to 100% for manufacturing). Reports are submitted each month by individual employers on a voluntary basis. The data are somewhat heavily weighted with large employers and, in general, the smaller the average reporting unit, the smaller will be the sample. There will naturally be some change in reporting units over a period of time and, since wage rates vary by territory, a change in territorial weighting due to such change in reporting units or to rapid employment expansion or curtailment in reporting units might affect the indicated statewide changes.

A review of the January, 1952, manufacturing data illustrates some of the variations to be expected. The data are for production workers only and average weekly earnings vary from $39.84 for leather gloves and mittens to $100.86 for fur goods. Average hourly earnings vary from $1.21 for men's and boys' shirts (excl. work), collars and nightwear to $3.31 for fur goods. Average weekly hours vary from 30.5 for fur goods to 46.9 for metalworking machinery.

In 1949, the classification system was revised to conform to a countrywide classification revision. The Labor Department indicates that many of the classifications, including the manufacturing group as a whole, are not comparable for the periods before and after the change.

The data cannot be used for the calculation of a wage factor without making certain adjustments. Average weekly wages include bonus overtime pay which is subject to exclusion in the determination of workmen's compensation premiums. An estimate must be made of the effect of limiting workmen's compensation payrolls to an average of $100 per week. An estimate must be made of the effect of wage changes on indemnity benefits which vary directly with total weekly wages subject to minimum and maximum limits.

CALCULATION OF WAGE FACTOR

The calculation of a wage factor must be made separately for the indemnity and medical portions of the premium. The factors below have been used in the illustrations which follow:

$$\text{Indemnity Factor} = \frac{\text{Effect on Indemnity} \times \text{Change in Average Weekly Hours}}{\text{Change in Adjusted Average Weekly Wages}}$$

$$\text{Medical Factor} = \frac{\text{Change in Average Weekly Hours}}{\text{Change in Adjusted Average Weekly Wages}}$$

Although medical costs tend to rise and fall with the cost of living, and, therefore, with wages, there does not appear to be a practical method of

measuring medical changes beyond the latest available experience period except by a projection procedure or by an assumption that the medical wage factor is unity. In New York, a measurement is made of changes in the minimum medical fee schedule and agreed hospital rates, so that the above medical factor appears to overstate the effect of wage changes only to the extent of residual medical changes such as in the costs of items not included in the fee schedule and in the fee charges in excess of the minimum schedule fees.

Exhibit A illustrates an adjustment of average weekly wages for the effect of bonus overtime wages and payroll limitation. The data were obtained from the *Labor Market Review* published by the New York State Department of Labor using weights of 56% for manufacturing, 7% for contracting and 37% for trade based on an estimate of total number of employees in each industry. Since complete data for the trade group are published only from August, 1949, the August data have been used for July. The period measured is from composite policy year July 1, 1949–June 30, 1950 to calendar year 1951. The weights for obtaining a policy year average are the usual policy year weights used in the reflection of law amendments. The calendar year average is obtained by giving each of the twelve months equal weight.

In adjusting for the elimination of bonus overtime wages, it has been asssumed that all hours in excess of an average of 37 are paid at time and one-half. Although overtime usually starts at 40 hours, the average is affected by employees who work less than 40 hours per week. Also, it is the practice of many employers to pay bonus overtime for all hours in excess of a normal work week of less than 40 hours. The adjustment is as follows:

$$\begin{aligned} \text{Let } W &= \text{Average Weekly Wages} \\ H &= \text{Average Weekly Hours} \\ R &= \text{Straight Time Rate of Pay} \\ \text{Then } W &= HR + (H-37).5R = R(1.5H - 18.5) \end{aligned}$$

$$R = \frac{W}{1.5H - 18.5}$$

$$HR = \frac{HW}{1.5H - 18.5} \qquad H \geqq 37$$

It has been suggested that this flat overtime adjustment is not proper, since there is a tendency for bonus overtime pay to increase at a slower rate than hours in excess of 37. The Economic Statistics Bureau of the United States Department of Labor has published average wages both including and excluding bonus overtime pay. For the four years 1948–1951, the ratio of full wages to straight time wages has been determined by the method of least squares to be .007707 × Average Hours per Week + .7230. This method appears to be theoretically more proper. However, it gives a somewhat smaller overtime adjustment than the 37 hour assumption, and even the 37 hour assumption does not appear sufficient in many instances. For example, there is a drop in

average weekly wage in November, 1949 as shown in Exhibit A in spite of an upward trend in such average wages. The drop remains in the adjusted figures regardless of which adjustment is made and there are many similar instances in these and other data reviewed. The 37 hour assumption gives a slightly higher wage factor when average weekly hours are increasing and a slightly lower factor when average weekly hours are decreasing.

The adjustment which has been made for the payroll limitation rule makes use of the wage distribution tables in the National Council law amendment calculations. These tables show:

A: The proportion of employees paid wages up to C.
B: The proportion of payroll paid to employees in A.
C: Ratios of wages to average weekly wages in 5% intervals.

For policy year 1949, $100 is 169% of the average adjusted weekly wage of $59.20. In all calculations, these percentages have been rounded to the next higher 5% interval, in this case 170%, as a conservative procedure. The payroll up to $100 per week is, therefore, $B + C(1.0 - A)$. From the table, A is .9668 and B is .9350 and the limit factor is $.9350 + 1.70(.0332) = .9914$.

The National Council law amendment factor procedure is used again in the calculation of the effect of wage changes on indemnity losses as illustrated in Exhibit B. Limit factors have been calculated for the policy year and calendar year unadjusted average weekly wages. For each type of injury, the wage change is adjusted for the reduced effect of the calendar year wage as measured by the change in limit factors in order to estimate the effect on indemnity losses. An overall effect is then determined by weights representing the estimated distribution by type of injury. The wage factors are then calculated as follows:

$$\text{Indemnity Factor} = \frac{\text{Effect on Indemnity} \times \text{Change in Average Weekly Hours}}{\text{Change in Adjusted Average Weekly Wages}}$$

$$= \frac{1.016 \times 1.005}{1.062} = .961$$

$$\text{Medical Factor} = \frac{\text{Change in Average Weekly Hours}}{\text{Change in Adjusted Average Weekly Wages}}$$

$$= \frac{1.005}{1.062} = .946$$

Using the premium developed in the latest New York rate revision as necessary for indemnity and medical losses separately, the overall factor becomes .957. Since this factor indicates a premium reduction of 4.3% between two periods of time when experience indications were increasing, it is important that the subject be investigated somewhat further.

VARIATION IN WAGE FACTORS

One apparent conclusion is that there will be considerable variation in wage changes by industry and by territory and that a reflection of the overall effect

of wage changes is not proper. Wage factor calculations have been made by industry and by territory for manufacturing only for the period from policy year 1949 to composite calendar year July 1, 1950–June 30, 1951 and are shown in Exhibits C and D.

There is considerable variation in changes in unadjusted average weekly wages both by industry and by territory. These variations, however, are reduced to a great extent by the necessary adjustments in the calculation of the wage factors. Substantially more variation would be found, of course, in the individual classifications within industry groups.

Another set of wage factors has been calculated in Exhibit E illustrating, from available data, what variation in wage factors may be expected over a period of several rate revisions. These data are calculated for six-month intervals starting with policy year 1946 and composite calendar year July 1, 1947–June 30, 1948. Since the entire period covered was a period of generally rising wage levels, wage factors are, as would be expected, generally less than unity. It is interesting to note, however, that wages decreased between policy year 1948 and composite calendar year July 1, 1949–June 30, 1950 but the wage factor indicates a rate level reduction. Also, wages increased between composite policy year July 1, 1948–June 30, 1949 and calendar year 1950, but the wage factor indicates a rate level increase.

COMPARISON OF WAGE AND EXPERIENCE INDICATIONS

The whole purpose of considering the application of a wage factor is to come closer than otherwise possible to the experience which is expected to develop. Therefore, the test of the propriety of applying a wage factor is a comparison of past wage and experience changes.

In order to make such a test, calendar year loss ratios on a standard premium Board level basis for New York workmen's compensation insurance have been obtained for calendar years 1942 through 1951. These loss ratios have been adjusted to a common rate level and a common law level, so that a comparison of loss ratios for two calendar years will give the experience change due to unmeasured influences including wage changes. Each calendar year loss ratio has been related to the loss ratio for the preceding calendar year resulting in the experience factors shown in the table below.

Wage factors were calculated for corresponding periods in the manner described above. The manufacturing wage data only were used, since complete data for other industries are not available for the entire period. Complete manufacturing data are not available prior to 1942. For calendar years 1942 through 1945, complete monthly data are not available and the overtime adjustment has been made on an annual basis.

The resulting experience and wage factors are as follows:

Calendar Year Period	*Experience Factor*	*Wage Factor*	*Other Factors (2) ÷ (3)*
(1)	(2)	(3)	(4)
1942 to 1943	.959	.991	.968
1943 to 1944	.978	.959	1.020
1944 to 1945	1.015	.947	1.072
1945 to 1946	.966	.889	1.087
1946 to 1947	.930	.929	1.001
1947 to 1948	.996	.940	1.060
1948 to 1949	.985	.961	1.025
1949 to 1950	1.124	1.006	1.117
1950 to 1951	.992	.952	1.042

The introduction of a wage factor in the rate level calculation assumes that the wage factor represents the expected experience factor. Yet it is noted from the above table that the wage factor is consistently lower than the experience factor except for the 1942 to 1943 period. Either the wage factor calculation gives too much effect to wage changes or other factors such as claim frequency and severity have substantially offset the wage change effect.

Assuming that the wage factors, as calculated above, represent a proper measure of the effect of wage changes, it is noted that the average annual effect of wage changes during this period is a reduction of 4.7% whereas the average annual effect of other factors is an increase of 4.4%.

CONCLUSIONS

Several conclusions are suggested by the above investigation:

1. Present published wage data are naturally not compiled for the purpose of calculating wage factors for workmen's compensation insurance. As a result, they have certain defects such as possible sample bias and absence of complete data for several industries. Also, it is probable that a substantial amount of self-rated and self-insured data are included.

2. Wage data are external statistics subject to external control. They may be affected by a change in reporting units or, as happened in 1949, a change in the classification system. A wage factor based on data collected both before and after such change might be virtually impossible to adjust properly.

3. It would be difficult, if not impossible, for insurance carriers to obtain proper wage data from insurance statistics. Average weekly wages based on loss reports would be heavily weighted by the presumed high wage scales of high hazard employments. The compilation of such data from payroll audits would place a substantial additional burden on the auditors and, if done on a sample basis, would require a reporting by classification in order to obtain an appropriate overall average.

4. In the calculation of a wage factor, adjustments must be made for the bonus overtime and payroll limitation rules and for the effect of wage changes on indemnity losses. Such adjustments are necessarily approximations.

5. The adjustments in (4) above will probably result not infrequently in an increase in rate level during a period of rising wage levels or in a reduction in rate level during a period of falling wage levels. Both of these effects are illustrated in Exhibit E. To the uninitiated, such effects would be final proof of the actuaries' disregard of realities.

6. The published data show some very substantial monthly variations and, in some industries and territories, substantial seasonal variations as well. It would, therefore, seem prudent to consider no period less than twelve months in the calculation of a wage factor.

7. The measurement of changes in wage rates is comparable to the measurement of changes in loss costs other than those caused by law amendments. Wage changes occur at different times in different degrees in different localities in different industries and in different sections of the same industry. Under the present ratemaking system, wage changes are measured in the same manner and to the same point in time as changes in loss costs.

8. The available sample indicates little, if any, correlation between experience changes and the assumed effect of wage changes. It is probable that other factors such as claim frequency and severity have as much or more effect on experience changes. It does not seem proper, therefore, to reflect wage changes to a greater extent than other changes in the rate level determination.

9. Although corresponding wage and experience data are not voluminous, the available New York data indicate that the wage change effects tend to understate the experience requirements, so that the application of a wage factor would hold down rate increases and would magnify rate reductions. It appears that one reason for this effect may be the assumption that wage changes do not affect medical costs. This suggests that a wage factor should be used only in conjunction with a medical projection factor.

10. Aggregate insurance statistics in the form of calendar year premiums and losses are available to approximately the same point in time as are wage data. These aggregate statistics include the effect of wage changes and of all other factors which affect the rate level. Under the present procedure, the rate level adjustment factor gives partial weight to all factors entering into the calendar year results. It is not proper to measure only one factor when there are other equally important factors, and it is an unwarranted complication to attempt to measure all such factors individually when an aggregate measure is readily available.

EXHIBIT A
WORKMEN'S COMPENSATION—NEW YORK
Wage Data—Manufacturing, Contracting & Trade Combined

Month	Avg. Hrs. per Week	Avg. Weekly Wage	1.5 × (1) −18.5	(1) × (2)	(4) ÷ (3)	Limit Factors	(5) × (6)	Weights
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
July '49	38.4	$57.99	39.10	2226.82	$56.95			.00347
Aug.	38.3	57.96	38.95	2219.87	56.99			.01042
Sept.	38.6	58.66	39.40	2264.28	57.47			.01736
Oct.	38.6	58.42	39.40	2255.01	57.23			.02431
Nov.	38.4	57.87	39.10	2222.21	56.83			.03125
Dec.	38.7	58.79	39.55	2275.17	57.53			.03819
Jan. '50	38.5	58.91	39.25	2268.04	57.78			.04514
Feb.	38.4	58.46	39.10	2244.86	57.41			.05208
Mar.	38.5	58.85	39.25	2265.73	57.73			.05903
Apr.	38.5	58.61	39.25	2256.49	57.49			.06597
May	38.8	59.19	39.70	2296.57	57.85			.07292
June	39.0	59.88	40.00	2335.32	58.38			.07986
July	39.0	60.44	40.00	2357.16	58.93			.07986
Aug.	39.6	61.89	40.90	2450.84	59.92			.07292
Sept.	38.8	61.08	39.70	2369.90	59.70			.06597
Oct.	39.4	62.39	40.60	2458.17	60.55			.05903
Nov.	39.5	62.86	40.75	2482.97	60.93			.05208
Dec.	39.7	63.67	41.05	2527.70	61.58			.04514
Jan. '51	39.4	64.44	40.60	2538.94	62.54			.03819
Feb.	39.0	64.06	40.00	2498.34	62.46			.03125
Mar.	39.2	64.34	40.30	2522.13	62.58			.02431
Apr.	39.2	64.45	40.30	2526.44	62.69			.01736
May	39.0	64.48	40.00	2514.72	62.87			.01042
June	39.1	64.61	40.15	2526.25	62.92			.00347
P.Y. '49–'50	38.9	60.68			59.20	.9914	58.69	
July '51	39.1	64.87	40.15	2536.42	63.17			
Aug.	39.0	65.21	40.00	2543.19	63.58			
Sept.	39.1	65.39	40.15	2556.75	63.68			
Oct.	38.6	64.49	39.40	2489.31	63.18			
Nov.	38.9	65.65	39.85	2553.79	64.09			
Dec.	39.4	66.21	40.60	2608.67	64.25			
C.Y. '51	39.1	64.85			63.17	.9868	62.34	
Ratio	1.005	1.069			1.067		1.062	

EXHIBIT B

WORKMEN'S COMPENSATION—NEW YORK

Wage Data—Manufacturing, Contracting and Trade Combined
Effect on Indemnity

Class of Injury (1)	Comp. Law (2)	% of Comp. (3)	Min. Weekly (4)	Max. Weekly (5)	Eff. Min. Wage (4)÷(3) (6)	Eff. Max. Wage (5)÷(3) (7)	Average Weekly Wage (8)	Ratios to Average: Min. (6)÷(8) (9)	Ratios to Average: Max (7)÷(8) (10)	Ratios to Average: Min. Rounded (11)	Ratios to Average: Max Rounded (12)
(a) Death (Widows & Children)	7/1/52	—	—	—	18	52.50	60.68	29.7	86.5	30	85
(a) Death (Others)	7/1/52	—	—	—	—	52.50	60.68	—	86.5	—	85
(a) Permanent Total	7/1/52	66⅔	15	32	22.50	48	60.68	37.1	79.1	35	80
(a) Perm. Part. & Temp. Total	7/1/52	66⅔	12	32	18	48	60.68	29.7	79.1	30	80
(b) Death (Widows & Children	7/1/52	—	—	—	18	52.50	64.85	27.8	81.0	30	80
(b) Death (Others)	7/1/52	—	—	—	—	52.50	64.85	—	81.0	—	80
(b) Permanent Total	7/1/52	66⅔	15	32	22.50	48	64.85	34.7	74.0	35	75
(b) Perm. Part. & Temp. Total	7/1/52	66⅔	12	32	18	48	64.85	27.8	74.0	30	75

B for (11) (13)	B for (12) (14)	(14)—(13) (15)	A for (11) (16)	A for (12) (17)	1.0–(17) (18)	(9)×(16) (19)	(10)×(18) (20)	Loss Limit (15)+(19)+(20) / 10,000 (21)	Indemnity Effect (21b)×64.85/60.68 (21a) (22)	Weights (23)
17	2684	2667	.65	39.39	60.61	19	5243	.7929		
—	2684	2684	—	39.39	60.61	—	5243	.7927		
37	2154	2117	1.24	33.15	66.85	46	5288	.7451		
17	2154	2137	.65	33.15	66.85	19	5288	.7444		
17	2154	2137	.65	33.15	66.85	18	5415	.7570	1.021	.06
—	2154	2154	—	33.15	66.85	—	5415	.7569	1.021	.07
37	1672	1635	1.24	27.13	72.87	43	5392	.7070	1.014	.02
17	1672	1655	.65	27.13	72.87	18	5392	.7065	1.015	.85
									1.016	

EXHIBIT C
WORKMEN'S COMPENSATION—NEW YORK
Wage Data
Policy Year 1949 to Composite Calendar Year 7/1/50–6/30/51

	Change in						
					Wage Factors		
Industry	*Average Weekly Wages*	*Average Weekly Hours*	*Indemnity Benefits*	*Adjusted Average Weekly Wages*	*Indemnity*	*Medical*	*Average*
Manufacturing and Contracting Combined	1.084	1.029	1.019	1.065	.985	.966	.980
Manufacturing Only	1.086	1.031	1.020	1.066	.987	.967	.982
Contracting Only	1.072	1.003	1.004	1.059	.951	.947	.950
Non-Metallic Mining and Quarrying	1.102	1.030	1.012	1.081	.964	.953	.961
Heat, Light and Power Companies	1.074	1.010	1.011	1.061	.962	.952	.959
Telephone and Telegraph Companies	1.056	1.005	1.013	1.051	.969	.956	.966
Local Railway and Bus Lines	1.071	1.008	1.007	1.059	.959	.952	.957
Laundries	1.048	1.005	1.034	1.045	.994	.962	.985
Cleaning and Dyeing	1.033	1.000	1.019	1.033	.986	.968	.981
Hotels (year-round)	1.052	.983	1.034	1.060	.959	.927	.950

EXHIBIT D

WORKMEN'S COMPENSATION—NEW YORK

Wage Data—Manufacturing Only

Policy Year 1949 to Composite Calendar Year 7/1/50—6/30/51

Territory	Change in Average Weekly Wages	Change in Average Weekly Hours	Change in Indemnity Benefits	Change in Adjusted Average Weekly Wages	Wage Factors: Indemnity	Wage Factors: Medical	Wage Factors: Average
New York State*	1.086	1.031	1.020	1.066	.987	.967	.982
New York City	1.048	1.013	1.014	1.039	.989	.975	.985
New York State excl. N. Y. C.*	1.127	1.050	1.030	1.097	.986	.957	.978
Albany, Schenectady, Troy Area	1.152	1.061	1.031	1.116	.980	.951	.972
Binghamton, Endicott, Johnson City Area	1.099	1.050	1.029	1.072	1.008	.979	1.000
Buffalo Area	1.121	1.032	1.023	1.093	.966	.944	.960
Elmira Area	1.104	1.028	1.026	1.086	.971	.947	.965
Rochester Area	1.128	1.045	1.027	1.099	.977	.951	.970
Syracuse Area	1.167	1.062	1.038	1.131	.975	.939	.965
Utica, Rome, Herkimer, Little Falls Area	1.111	1.038	1.033	1.089	.985	.953	.976

* Includes data in addition to that reported for individual areas.

EXHIBIT E
WORKMEN'S COMPENSATION—NEW YORK
Wage Data
Manufacturing Only

Policy Year	Calendar Year	Change in Average Weekly Wages	Change in Average Weekly Hours	Change in Indemnity Benefits	Change in Adjusted Average Weekly Wages	Wage Factor: Indemnity	Wage Factor: Medical	Wage Factor: Average
1946	7/47–6/48	1.079	.993	1.027	1.081	.943	.919	.937
7/46–6/47	1948	1.069	.990	1.023	1.071	.946	.924	.940
1947	7/48–6/49	1.041	.977	1.014	1.050	.944	.930	.940
7/47–6/48	1949	1.001	.975	1.000	1.013	.962	.962	.962
1948	7/49–6/50	.994	.992	.999	.997	.994	.995	.994
7/48–6/49	1950	1.034	1.021	1.009	1.023	1.007	.998	1.005
1949	7/50–6/51	1.086	1.031	1.020	1.066	.987	.967	.982
7/49–6/50	1951	1.085	1.013	1.020	1.073	.963	.944	.958