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When is 3 plus 1 equal to 3.1? Suggested methods of examining wage settlements to determine their annual rate of adjustment

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Clothiers to get 4 percent rise

About 20,000 clothing workers will gain a 3 percent wage rise in January and 1 percent more next August. The award will apply for 15 months. (The Dominion, 27 October 1988, p.3)

1. Introduction

One focus in the current debate over labour market "flexibility" has been the extent to which there is a dispersion of wage settlements. But determining the degree of dispersion is no easy task. With the abandonment of the "12 month rule", which had applied in the legislation from 1974, a proportion of documents now have terms greater or less than 12 months. Harbridge (1988) found that 13 percent of the documents negotiated in the 1986-87 wage round had terms other than 12 months with a range from 3.5 to 17.5 months.

When these shorter or longer term documents are reported by the press, or by union or employer advocates, they are frequently quoted as annual rates. However, converting increases which run for periods other than 12 months into annual rates is not as simple as it sometimes appears. As examples, is 6 percent for 6 months the equivalent of 12 percent for 12 months? Again, how should we treat a document such as the clothing workers, quoted at the head of this note, which has 2 increases and a 15 month term? What if the increase provided by a new document is not backdated to the expiry of the old one?

As we show below, there are a variety of solutions to these problems. There are several ways to annualise the increase of a wage settlement which does not run for 12 months from the expiry of the preceding document. The method chosen will depend primarily on the purpose of annualising. The key point in assessing the implication of wage settlements is that different settlements have different implications depending on what happens in the future. A settlement of 12 percent for 15 months may be considered worse than a settlement of 12 percent for 12 months for the reason that the 12 month expiry allows the *potential* of earlier re-negotiation of the document. But a settlement of 15 percent for 3 years may turn out to be a good settlement from a worker's point of view when price inflation is falling to very low levels. On the other hand, that settlement may be most unfortunate from a worker's viewpoint if inflation soared to double figures in the year following this settlement. The future cannot be known at the time of settlement although expectations will determine the preference for one settlement or another.

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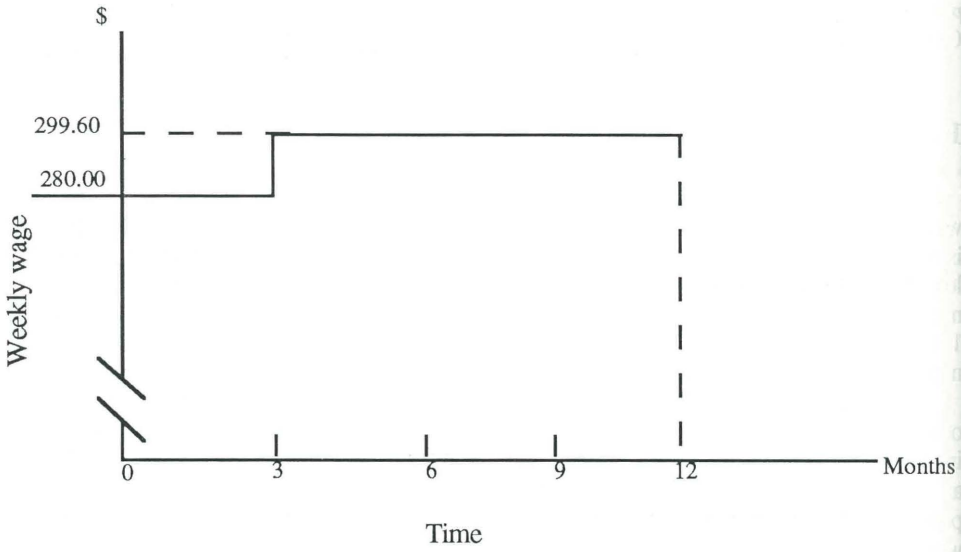
Our analysis of recent wage settlements is that there are 5 basic term and multi-step variations wage rises. These are as follows:

Type I

The majority of settlements follow this pattern. They are for a term of exactly 12 months, are backdated to the expiry of the previous document and provide for a single wage increase. For example, a document expires on 30 September 1988 and provides a wage rate of $280.00 per week. The new document runs from 1 October 1988 to 30 September 1989 and provides a new rate of $299.60 per week (an increase of 7 percent). This is illustrated in figure 1 below.

Figure 1: *Type I wage increase*



Type II

The most common type of multi-step wage rise is one where there is a nil rise for some period (i.e. no backdating) followed by an increase which runs until 12 months from the expiry of the previous document. In the 1986-87 wage round there were 48 documents that were not backdated to the expiry of the previous document - 7 percent of all renegotiated documents. By the 1987-88 wage round there were 62 settlements that were not backdated - 12.5 percent of all renegotiated settlements (Harbridge and McCaw, 1989). For example a document expires on 30 September 1988 and provides a wage rate of $280.00 per week. The new document runs from 1 January 1989 to 30 September 1990 and provides for a new rate of $299.60. This is illustrated in figure 2 below.

Figure 2: *Type II wage increase*

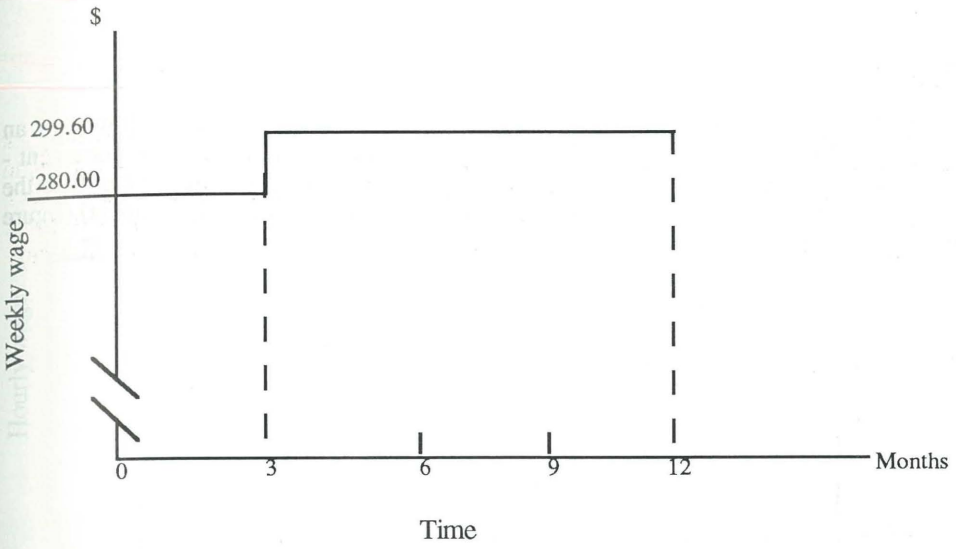
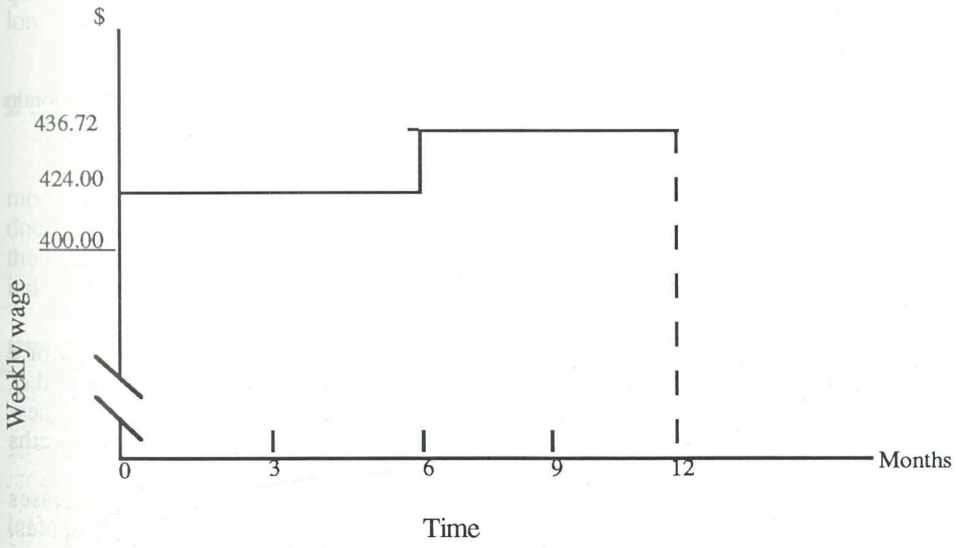


Figure 3: *Type III wage increase*



Type III

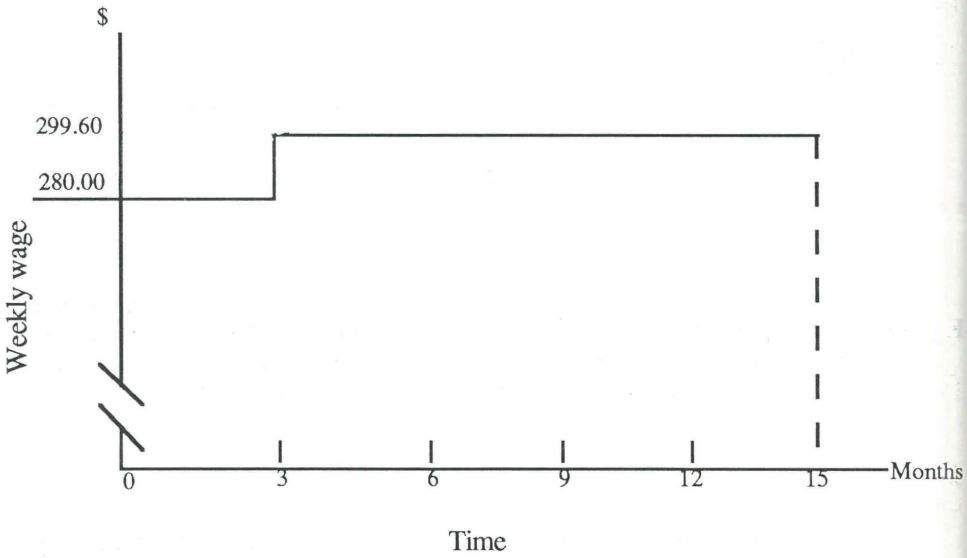
A less common occurrence is where the document provides a rise for part of the 12 months and is followed by a further rise for the balance of the 12 months. In the 1986-87 wage round, a number of trades-based documents were settled for 6 percent for the first

6 months followed by a "top up" of a further 3 percent for the second 6 months of the document's life (figure 3, above).

Type IV

A variation of Type II is where there is a nil rise for some period followed by an increase which runs for 12 months from the date of settlement of the new document - giving a term longer than 12 months. Take the example of Type II above but have the document run for 12 months (i.e. 15 months after the expiry of the old document) (figure 4).

Figure 4: *Type IV wage increase*

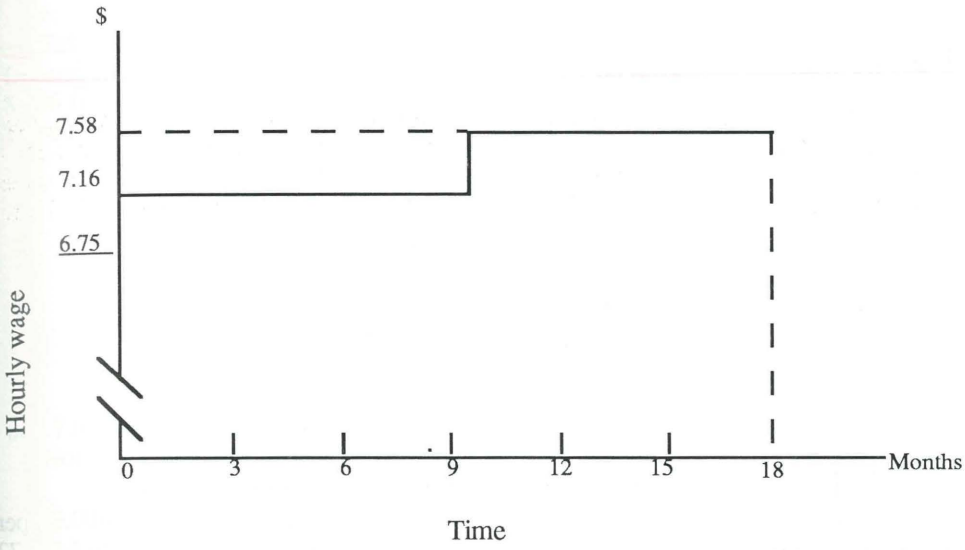


Type V

A comparatively rare variation of Type IV is where a wage rate is increased for a period less than 12 months followed by a further increase which runs beyond the end of 12 months For example, say the old document gave an hourly rate of $6.75. The new document increases this by 6 percent followed by a further 6 percent after 9 months which ran for a further 9 months (figure 5, below).

Comparing settlements of different lengths or those where the pay rate increases during the life of the settlement is somewhat like comparing oranges and apples. Nonetheless, such comparisons may need to be made for different purposes and we therefore require a method to adjust the different settlements to some common basis so that pay increases can be compared. We shall compare negotiated pay rates with the rates which prevailed immediately before.

Figure 5: *Type V wage increase*



The basis of the methods is to compare 2 scenarios: one where the previous rate continues indefinitely and the other where the new rate is provided by the document in question. The effect of inflation on the real values of wages will not be considered. The longer term changes in wage rates is another issue dealt with elsewhere.

2. Ratios

We will consider 4 ratios; Pay (P), Income (I), First year income (Y) and First year model income ratio (M), which reflect the changes for all or part of the term of the document. These will be introduced successively in the next 3 sections. In each case, the change is compared with a situation where the previous rate, or old rate, continues indefinitely. The methods are very versatile and can be used with weekly or hourly rates.

First we have the *pay ratio* P which reflects the change in actual *pay* rates over the term of the document.

$$P = \frac{\text{final wage rate}}{\text{old wage rate}}$$

Next we have the *income ratio* I, which reflects the change in total income *over the total term of the document.*

$$I = \frac{\text{average wage rate}}{\text{old wage rate}}$$

Both are determined for the total term of the document.

We can illustrate these with the Type II example above. The old rate was $280.00 per week when the old document expired at the end of March 1988 and the new document

provides for no change for 3 months and then $299.60 per week for the next 9 months. The pay ratio P is:

$$P = \frac{\$299.60}{\$280.00}$$

$$= 1.07$$

i.e. there is a pay increase of 7 percent over the term of the document.
The income ratio I is

$$I = \frac{3 \times \$280.00 + 9 \times \$299.60}{12} / \$280.00$$

$$= \frac{\$294.70}{\$280.00}$$

$$= 1.053$$

i.e. there is an income increase of 5.3 percent over the term of the document.

Consider now the example given for Type III above. The old rate is $400.00 per week. There is an increase to $424.00 for 6 months followed by an increase to $436.72 for the remaining 6 months of the 12 month term. The pay ratio P is:

$$P = \frac{\$436.72}{\$400.00}$$

$$= 1.092$$

i.e. a pay increase of 9.2 percent over the term of the document.
The income ratio I is:

$$I = \frac{6 \times \$424.00 + 6 \times \$436.72}{12} / \$400.00$$

$$= \frac{\$430.36}{\$400.00}$$

$$= 1.076$$

i.e. there is an increase in income of 7.6 percent over the term of the document.

When documents run for other than 12 months we need to use the "first year income ratio" and the "first year model income ratio" which give estimates of the effects of new rates over the first 12 months of documents.

3. The first year income ratio

This method is very simple. We see how much money a worker covered by the award or agreement will get over just the first 12 months from the expiry of the old document and compare this with what they would have got if the old document had remained in effect.

The ratio we use is Y for the *first year income ratio:*

$$Y = \frac{\text{average wage rate over the first 12 months}}{\text{old wage rate}}$$

Take the example of Type V above. We have a document which expired at the end of December 1987 where the hourly rate is $6.75. The new document increases the rate to $7.16 from January 1988 and then to $7.58 from October 1988 for a further 9 months. The document has a term of 18 months and expires at the end of June 1990.

$$Y = \frac{9 \times \$7.16 + 3 \times \$7.58}{12} / \$6.75$$

$$= \frac{\$7.27}{\$6.75}$$

$$= 1.076$$

or a 7.6 percent increase in income in the first year.

Note the other ratios P and I, are

$$P = \frac{\$7.58}{\$6.75}$$

$$= 1.123$$

i.e the pay increases by 12.3 percent over the term of the document, and

$$I = \frac{9 \times \$7.16 + 9 \times \$7.58}{18} / \$6.75$$

$$= \frac{\$7.37}{\$6.75}$$

$$= 1.092$$

or a 9.2 percent increase in income over the term of the document. Note the increase in income in the first year Y is less than the increase in income over the term of the document I. The 3 ratios differ and only Y relates to the first 12 months of the document.

4. The first year model income ratio

The growth rate method which gives the *first year model income ratio* is an alternative way to annualise a settlement which runs for more than, or less than, 12 months.

It has the advantage over the previous method for Y in that it can be used for documents of less than 12 months and it apportions an appropriate increase from the whole term to the first 12 months.

The method involves fitting a smooth exponential curve model to the actual wages over the term of the new document (described in Appendix A).

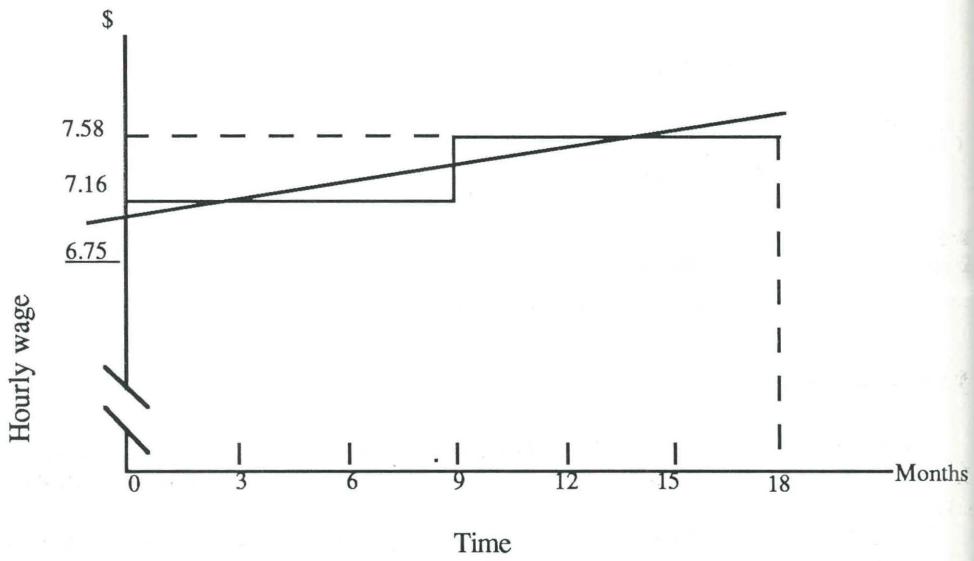
The curve is chosen to have 2 properties in common with the actual rates:

(a) the pay ratio P is the same, and

(b) the income ratio I is the same (i.e. the average income is the same).
See figure 6.

Property (a) requires that the ratio of the final wage rate to the old wage rate is the same for the smooth model curve and the actual rates in the document, and relates to the overall increase in wage rates. The other property (b) requires that the total income and hence the average income over the total term is the same for the smooth model curve and the actual rates. Wage rates are given by the height of the curves and incomes by the areas under the curves.

Figure 6:



Now if a document with pay ratio P and income ratio I runs for a period of length T months, then the annualised increase in income for the model over the first 12 months is given by the *first year model income ratio* M. From the appendix we find

$$M = \frac{\text{average wage rate over the first 12 months from model}}{\text{old wage rate}}$$

$$= F \times I$$

where

$$F = \frac{1}{f}\left(\frac{P^f - 1}{P - 1}\right)$$

and

$$f = \frac{12}{\text{term of document}} = \frac{12}{T}$$

Using the previous example for Type V, we find

$$f = \frac{12}{18} = 0.6667$$

$$P = 1.123$$

$$I = 1.092$$

Hence $$F = \frac{1}{0.6667} \times \left(\frac{1.123^{0.6667} - 1}{1.123 - 1} \right)$$

$$= \frac{0.08041}{0.6667 \times 0.123}$$

$$= 0.9805$$

and since $$M = F \times I$$

$$M = 0.9805 \times 1.092$$

and so $$M = 1.071$$

i.e. the increase is equivalent to a series of annual increases of 7.1 percent.

5. Discussion

For documents such as Types I and II whose term is 12 months, the 3 income ratios I, Y and M are equal, but there is a distinction between the pay ratio P and the income ratio I.

The pay ratio shows how much hourly or weekly *pay* has increased while the other ratios show how much *income* would increase over the relevant periods.

Perhaps the best way to compare the 3 methods is to apply them to our original question. The question remains "Did our clothing workers get 4 percent as suggested by the newspaper headline?" One pay rate in their previous award had been $261.98. It expired on 20 January 1989. That pay rate increased then to $269.84. It increased again on 28 August 1989 to $272.46 and the new document expired on 20 April 1990. What do our different methods show? The pay ratio P is

$$P = \frac{\$272.46}{\$261.98}$$

$$= 1.04$$

So the pay rate did increase by 4 percent over the life of the document as the newspaper headline stated. But what about income? The total increase in income over the life of the document I is:

$$I = \frac{7.25 \times \$269.84 + 7.75 \times \$272.46}{15} \Big/ \$261.98$$

$$= \frac{\$271.19}{\$261.98}$$

$$= \quad 1.035$$

So income increased by 3.5 percent over the life of the new document.

The first year income ratio Y is

$$Y = \frac{7.25 \times \$269.84 + 4.75 \times \$272.46}{12} \Big/ \$261.98$$

$$= \frac{\$270.88}{\$261.98}$$

$$= 1.034$$

Thus income increased by only 3.4 percent in the 12 months following the expiry of the old document.

Finally we consider the first year model income ratio M.

Now $f = \frac{12}{15} = 0.8$

and using the results just obtained, and the formula for F given above,

we have $$F = \frac{1}{0.8} \times \left(\frac{1.04^{0.8} - 1}{1.04 - 1} \right)$$

$$= \frac{0.03187}{0.8 \times 0.04}$$

$$= 0.99606$$

Therefore $M = 0.99606 \times 1.035$

$$= 1.031$$

Thus the settlement is equivalent to an annual increase of 3.1 percent.

Which annualised rate is appropriate would depend on the issue at hand and the other documents with which it was being compared but, as is clear from these calculations, although pay rates increased by 4 percent between the expiry of the old document and the expiry of the new one, income for clothing workers increased by a smaller amount. Thus the 3 plus 1 percent increase may be equivalent to an annual increase of just 3.1 percent.

Appendix: Growth rate method

An exponential curve is fitted to the actual wage rates so that over the term of the new document

(a) the pay ratio P is the same, and
(b) the income ratio I is the same (i.e.the average income is the same).

Now an exponential curve is represented mathematically by the formula

$$W(t) = Ae^{\mu t} \qquad (A.1)$$

where $W(t)$ is the wage rate at time t,

A and μ are constants,

the document runs from time $t = 0$ to $t = T$.

Now $P = \dfrac{\text{final wage rate}}{\text{old wage rate}}$ and by condition (a) above

$$P = \frac{W(T)}{W(0)} = \frac{Ae^{\mu T}}{Ae^{0}} \text{ where } e^0 = 1$$

$$= e^{\mu T} \text{ on cancelling A} \qquad (A.2)$$

Therefore $\mu T = \ln P$ taking natural logarithms

$$\text{or } \mu = \frac{1}{T} \ln P \qquad (A.3)$$

The average wage rate for the model

$$= \frac{1}{T}\int_0^T Ae^{\mu t}\, dT$$

$$= \frac{A}{\mu T}(e^{\mu T} - 1)$$

$$= \frac{A}{\mu T}(P - 1) \qquad \text{from (A.2)}$$

and so

$$A = \frac{\ln P}{(P-1)} \text{ x average wage rate}$$

But from condition (b) above

$$\frac{\text{average wage over term of document}}{\text{old wage rate}} = I$$

$$= \frac{A}{\mu T}(P - 1)/\text{old wage rate.}$$

Hence

$$\frac{A}{\mu}/\text{old wage rate} = \frac{T\ I}{(P-1)} \qquad (A.4)$$

Finally the first year model income ratio M is given by

$$M = \frac{\text{average wage rate over first 12 months from model}}{\text{old wage rate}}$$

$$= \frac{1}{12}\int_0^{12} Ae^{\mu t}\, dT/\text{old wage rate}$$

$$= \frac{A}{12\mu} (e^{12\mu} - 1) / \text{old wage rate}$$

$$= \frac{T}{12} \frac{(e^{12\mu} - 1)}{(P - 1)} \; I \text{ (from A.4)} \qquad \text{(A.5)}$$

Now $e^{12\mu} = e^{\frac{12}{T} \ln P} = P^{\frac{12}{T}} = P^f$

where we define $f = \frac{12}{T}$

Hence from equation (A.5) we find

$$M = \frac{1}{f} \left(\frac{P^f - 1}{P - 1} \right) I$$

$$= F \times I \qquad \text{(A.6)}$$

where $F = \frac{1}{f} \left(\frac{P^f - 1}{P - 1} \right)$ and $f = \frac{12}{T}$ (A.7)

and I is the income ratio for the whole term

For $T = 12$ months we find $M = Y = I$, since $f = 1 = F$.

For a linear model, instead of the exponential model used above, we find

$$F = \frac{1 + f(P-1)/2}{1 + (P-1)/2}$$

References

Harbridge, R. (1988) The way we were - a survey of the last wage round negotiated under the Industrial Relations Act 1987. *New Zealand journal of business*. **10**:48-65.

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