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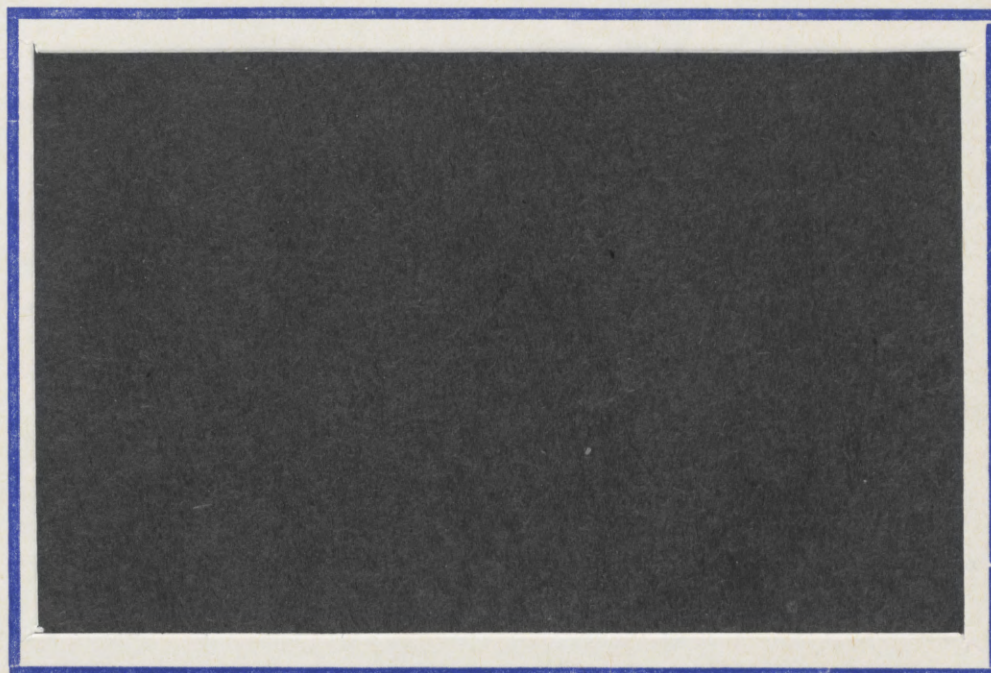
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*Labor and wages*

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GIANNINI FOUNDATION OF  
AGRICULTURAL ECONOMICS

APR 1 1980

מכון למחקר כלכלי ע"ש ד"ר ישעיהו פורדר ז"ל  
ע"י אוניברסיטת תל-אביב

*ON WAGE INDEXATION AND THE SEASONALITY  
OF PRICES*

*by*

*Leif Danziger*

*Working Paper No. 2-80*

*January, 1980*

FOERDER INSTITUTE FOR ECONOMIC RESEARCH,  
Faculty of Social Sciences, Tel-Aviv University,  
Ramat Aviv, I s r a e l

A B S T R A C T

*With real prices varying seasonally, the choice between full indexation of a constant base wage to the true price level and to the seasonally adjusted price level is examined. It is shown that both kinds of indexation may be preferred if the seasonality of prices is caused by a seasonality of the aggregate supply, but that indexation to the true price level is preferred if the seasonality of prices is caused by a seasonality of the aggregate demand.*

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## I. INTRODUCTION

If a worker's demand for goods and leisure is stable over time, and real prices do not change, the worker's preferred consumption of goods and leisure will also be stable over time. He will prefer to spend the same real amount on goods and to work the same number of hours in any two intervals of time with identical length. In case the future inflation is uncertain, and there is no asset with a safe real return, the worker has no riskless way of moving real amounts through time. He may borrow and lend nominal amounts, but because of the uncertain inflation, the real amount he must repay is uncertain. Accordingly, unless the worker has the same real amount at his disposal in each interval, he might not obtain the preferred steady consumption of goods and leisure.

A labor contract between the worker and a firm is capable of eliminating the impact of the inflation risk on the worker's consumption. The reason is that the wage may be indexed to the price level. In particular, if the contract determines a constant base wage, and the wage in any interval is the base wage fully indexed to the price level in that interval, the real wage is constant; if the contract also determines a constant number of hours to be worked in each interval, the worker will have the same real amount at his disposal in each interval. He has no need to borrow or lend; he will therefore not be exposed to the risky inflation and can obtain the preferred steady consumption of goods and leisure.<sup>1/</sup>

## 2. SEASONAL VARIATIONS IN REAL PRICES

In contrast to what was assumed above, real prices are not always constant. They often follow a seasonal pattern, i.e. they vary in a recurrent, systematic fashion over a number of intervals. These intervals are in the following called "seasons". This is in addition to a possible secular trend and random variations,

that will not be considered here. A seasonal pattern of real prices is caused either by seasonal variations in the aggregate supply or by seasonal variations in the aggregate demand. For instance, a seasonal increase in the aggregate supply of a good together with a stable aggregate demand for the same good implies a seasonal decrease in the real price of the good (assuming a downward-sloping or vertical demand curve). This is typically the case for fresh food and vegetables with a short harvest period. Likewise, a seasonal increase in the aggregate demand for a good together with a stable aggregate supply of the same good implies a seasonal increase in the real price of the good (assuming an upward-sloping or vertical supply curve). This is likely the case for ice cream in the summer and snow shovels in the winter.<sup>2/</sup>

Whatever the cause of the seasonal pattern of prices, the worker may no longer prefer a steady consumption of goods and leisure. He may prefer to spend different real amounts on goods and to work different number of hours in the various seasons. A labor contract should therefore not determine a constant base wage, full indexation, and constant working hours. It will now be more complicated to specify a contract that eliminates the impact of the inflation risk on the worker's consumption, i.e. that makes it unnecessary for the worker to borrow or lend. The contract could, for instance, determine a seasonal pattern of the base wages, the actual wage being the base wage for a season fully indexed to the price level for that season, and determine a seasonal pattern of the number of hours to be worked. In this way it would be possible to specify the base wages such that the worker in each season would receive the real amount he would want to spend in the same season. He would not be exposed to the risky inflation and could obtain his preferred pattern of consumption and leisure.

However, in practice labor contracts do not determine a seasonal pattern of the base wages (a possible exception being vacation allowances). Instead, contracts usually determine a constant base wage and determine the actual wage by indexing the wage to the seasonally adjusted price level rather than indexing to the true price level.<sup>3/</sup> This is a simpler and therefore cheaper way of obtaining a reduction in the riskiness that an uncertain inflation causes in the worker's consumption, although generally, it cannot eliminate the riskiness from the worker's consumption. For a contract with a constant base wage it is not obvious, though, that full indexation to the seasonally adjusted price level is better than full indexation to the true price level at reducing risk. This will be examined in the following with the help of a simple model.

### 3. THE MODEL

Assume that the base wage is constant, and that the worker can choose between full indexation to the true price level and full indexation to the seasonally adjusted price level. There is only one good that the worker cannot store and whose real price follows a seasonal pattern. There are two seasons; the real price in the first season is  $q_1$ , and the real price in the second season is  $q_2$ . The price level in the first season is unity, while the price level in the second season is uncertain and denoted by  $p$ . There is no safe asset, but the worker and the firm can borrow and lend nominal amounts at the expected real interest rate  $r$ . Accordingly, if  $E\frac{1}{p}$  denotes the expected value of  $\frac{1}{p}$ , a loan of \$1 in the first season must be repaid with  $\$(1+r)/E\frac{1}{p}$  in the second season.

The worker is a representative individual in the sense that his demand is always proportional to the aggregate demand. He has a von Neuman-Morgenstern utility function. The utility increases in  $c_1$  and  $c_2$ , the consumption in the first and second season. The worker is averse to risk in  $c_2$ . The labor contract covers two seasons, and the worker spends all his income from the labor contract during the two seasons.

The firm is risk neutral. The working hours are constant  $h$ , and the firm must, on average, pay the worker the constant, market-determined real wage  $w$ .<sup>4/</sup> In other words, the firm expects its total discounted (by  $r$ , since the firm is risk neutral) real payment to the worker to be  $wh + wh/(1+r) = wh(2+r)/(1+r)$  with either choice of index.

If the worker chooses indexation to the true price level, he will be paid a different real wage in the two seasons. With  $w_1$  and  $w_2$  denoting the real wages in the two seasons, the real wages must satisfy  $w_1/w_2 = q_1/q_2$  in addition to  $w_1h + w_2h/(1+r) = wh(2+r)/(1+r)$ .

Hence,  $w_1 = \frac{w(2+r)q_1}{(1+r)q_1+q_2}$  and  $w_2 = \frac{w(2+r)q_2}{(1+r)q_1+q_2}$ . If the worker chooses indexation to the seasonally adjusted price level, he is paid the same real wage -  $w$  - in the two seasons.<sup>5/</sup>

Let  $c_1$  and  $c_2$  denote the consumption in the first and in the second season. The worker can obtain the same  $c_1$  and the same expected  $c_2$  with either choice of indexation. Being risk averse, the worker will choose the indexation that together with his preferred  $c_1$  yields the less risky  $c_2$ . Let  $\hat{c}_1$  and  $\hat{c}_2$  denote the preferred  $c_1$  and  $c_2$  if there were no uncertainty. If the wage is indexed to the true price level and the worker consumes  $\hat{c}_1$  in the first season, he will save  $w_1h - \hat{c}_1$ . This becomes  $(w_1h - \hat{c}_1) \frac{1+r}{E \frac{1}{p}}$  in the second season, and he will



therefore obtain the uncertain  $c_2 = w_2h + (w_1h - \hat{c}_1) \frac{1+r}{E \frac{1}{p}}$ . If the wage is indexed to the seasonally adjusted price level and the worker consumes  $\hat{c}_1$  in the first season, he will save  $wh - \hat{c}_1$  and obtain the uncertain  $c_2 = wh + (wh - \hat{c}_1) \frac{1+r}{E \frac{1}{p}}$ .

It can therefore be concluded that if the saving with indexation to the true price level is nonnegative (nonpositive) and less than (exceeds) the saving with indexation to the seasonally adjusted price level, indexation to the true price level is preferred. Similarly, if the saving with indexation to the seasonally adjusted price level is nonnegative (nonpositive) and less than (exceeds) the saving with indexation to the seasonally adjusted price level, indexation to the seasonally adjusted price level is preferred.<sup>6/</sup>

#### 4. SEASONAL VARIATIONS IN AGGREGATE SUPPLY

Consider first the case in which the seasonal pattern of real prices is caused by a seasonal variation in the aggregate supply. The aggregate demand, and the demand of the worker as a representative individual, is stable in the sense that if the real price were the same in the two seasons, the same quantities would be purchased.

As an example, assume that the worker's utility function is  $\text{Min}(c_1, c_2)$ . Independent of  $q_2/q_1$ , the worker would then prefer to consume the same in both intervals,  $\hat{c}_1 = \hat{c}_2$ . Taking the budget constraint  $wh(2+r)/(1+r) = q_1\hat{c}_1 + q_2\hat{c}_2/(1+r)$  into account, this implies that  $\hat{c}_2 = \frac{wh(2+r)q_2}{(1+r)q_1+q_2}$ . Since indexation of the wage to the true price level entails that the worker is paid precisely  $\frac{wh(2+r)q_2}{(1+r)q_1+q_2}$  in the second season, it would fully insulate the worker against the uncertain inflation. A worker with this utility function therefore clearly prefers to index the wage to the true price level.

As another example, assume that the worker's utility function is  $\ln c_1 + \frac{1}{1+\rho} \ln c_2$ , where  $\rho$  is the discount rate and  $\rho = r$ . Independent of  $q_2/q_1$ , the worker would then prefer to spend the same real amount in the two seasons,  $q_1 \hat{c}_1 = q_2 \hat{c}_2 = wh$ . Indexation of the wage to the seasonally adjusted price level entails that the worker is paid  $wh$  in each interval. He would then be fully insulated against the uncertain inflation. A worker with this utility function therefore clearly prefers to index the wage to the seasonally adjusted price level.

Accordingly, if the seasonal pattern of the real prices is caused by a seasonal variation in the aggregate supply, indexation to the true price level and indexation to the seasonally adjusted price level may both be preferred.

##### 5. SEASONAL VARIATIONS IN AGGREGATE DEMAND

Consider next the case in which the seasonal pattern of real prices is caused by a seasonal variation in the aggregate demand. The aggregate supply is stable in the sense that if the real price were the same in the two seasons, the same quantities would be sold. Assuming the aggregate supply curve slopes upwards or is vertical, a higher aggregate demand in one season than in the other entails a higher real price in that season than in the other. If the aggregate supply curve slopes upwards, the worker, as a representative individual, would prefer to consume a higher quantity in the season with the higher price; if the aggregate supply curve is vertical, he would prefer to consume the same quantities in the two seasons. In the latter case,  $q_2 \hat{c}_2 = \frac{wh(2+r)q_2}{(1+r)q_1+q_2}$ . Since the worker is paid  $\frac{wh(2+r)q_2}{(1+r)q_1+q_2}$  in the second season if the wage is indexed to the true price level, and  $wh$  if the wage is indexed to the seasonally adjusted price level, the saving with indexation to the true price level will be nonnegative (nonpositive) and less (bigger) than the saving with indexation to the

seasonally adjusted price level. As a consequence, indexation to the true price level is always preferred when the seasonal pattern of real prices is caused by a seasonal variation in the aggregate demand. In the particular case where the aggregate supply curve is vertical, the worker will be paid the exact amount he wants to spend in the second season, and he will be fully insulated against the uncertain inflation.

#### 6. VARIABLE WORKING HOURS

For simplicity, it was assumed that the working hours were identical in the two seasons. However, this need not be the case. The working hours may be different in the two seasons; in particular, the contract may not fix the working hours in the second season, but specify how they depend on the realized real wage. In this way the impact of the uncertain inflation on the worker's expected utility may be reduced without changing the firm's expected (discounted) real profit.

In the case where the seasonal pattern of real prices is caused by a seasonal variation in the aggregate supply, variable working hours do not change the conclusion that the worker may prefer either kind of indexation. To see this, assume that the returns to labor are nonincreasing and extend the utility functions considered above to include the working hours. If  $h_1$  and  $h_2$  are the working hours in the two seasons, let the two utility functions now be  $\text{Min}(c_1, c_2) - h_1^2 - \frac{1}{1+\rho} h_2^2$  and  $\ln c_1 - h_1^2 + \frac{1}{1+\rho} (\ln c_2 - h_2^2)$ . In both instances, the preferred  $h_1$  would equal the preferred  $h_2$  if there were no uncertainty. As a consequence, for any given level of expected real profit, a worker with the first utility function prefers a contract with the wage indexed to the true price level and  $h_1 = h_2$  to any contract with the wage indexed to the seasonally adjusted price level and a variable  $h_2$ . Likewise, a worker with the second utility function prefers a contract with the wage indexed to the seasonally adjusted price level and  $h_1 = h_2$

to any contract with the wage indexed to the true price level and a variable  $h_2$ .

Turning to the case where the seasonal pattern of real prices is caused by a seasonal variation in the aggregate demand, the crucial matter is the relation between the worker's demand for the good and his demand for leisure (supply of labor). On the assumption that the seasonality is limited to the demand for the good, the possibility of varying the working hours does clearly not change the conclusion that the worker prefers to index the wage to the true price level.<sup>7/</sup>

#### 7. CONCLUSION

This paper examines the choice between full indexation of a constant base wage to the true price level and to the seasonally adjusted price level. A simple model shows that both kinds of indexation may be preferred if the seasonal pattern of the real prices is caused by a seasonal variation in the aggregate supply, but that indexation to the true price level is preferred if the seasonal pattern of the real prices is caused by a seasonal variation in the aggregate demand.

F O O T N O T E S

1. If the worker has perfect access to the capital market, a varying base wage and partial indexation may also insulate the worker against the risky inflation. See Danziger [1979].
2. See Zarnowitz [1961] for an empirical and theoretical discussion of seasonality and index numbers.
3. Israel is an exception, but it has no published statistics about the serially adjusted price level.
4. There is no seasonality in  $w$ .
5. Because of the different time profiles of the real payments and the firm's discounting, the two kinds of indexation have different base wages.
6. In the remaining cases the signs of the savings are different for the two kinds of indexation, and more information about the distribution of  $p$  and the utility function is required to determine which kind of indexation is preferred. For instance, in the case  $\frac{1}{p}$  has a symmetrical distribution, it can be concluded that if the absolute value of the saving with indexation to the true price level is less than (exceeds) the absolute value of the saving with indexation to the seasonally adjusted price level, indexation to the true price level (to the seasonally adjusted price level) is preferred.
7. If the demand for leisure were also seasonal, and the seasons of high demand for the good and for leisure would coincide, the worker would work relatively less in the season with the high demand for goods; the case for indexation to the true price level would only be strengthened. If, however, the season of high demand for the good would coincide with the season of low demand for leisure, the worker would work relatively more in the season with the high demand for the good; in this case indexation to the seasonally adjusted price level might be preferred.

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