INTERDEPENDENCE IN THE LABOUR MARKET

by

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Interdependence exists if an individual or firm's decisions are affected not only by the prices he sees, but also directly by the decisions made by other individuals or firms. It implies that other people's welfare enters directly into an individual's utility function. The notion of interdependence was proposed by Veblen [24] in his arguments that conspicuous consumption, competition among individuals for status on the basis of expenditures, is a major and increasingly important motivating force in behaviour. Since that early work, economists have examined the effects of interdependence on the demand for individual commodities ([14] and [17]) and have used it as a basis for explaining shifts in the aggregate consumption function [5]. While these results have been of interest analytically and, in the latter case, useful empirically, they are not based on any evidence that individuals do feel this interdependence. There is no \textit{ex ante} indication that individual decisions are based on interpersonal comparisons; any support for their existence would lie in the ability of the analysis based upon this construct to provide useful predictions.

There is definitive evidence that interdependence exists among individuals in the workplace, yet, except in its application by Ross [22] to competition among union leaders, it has not entered into the economic analysis of labour markets. It is thus ironic that the one area of economic endeavour in which interdependence clearly exists is also one where it has not been incorporated into the body of theory. In this essay we shall review the evidence of interdependent behaviour among workers and examine its implications for the firm's demand for labour, the worker's supply of effort and the adjustment process in a competitive labour market. This analysis has interesting implications which may be useful in resolving some
problems of empirical work in labour economics.

I. Definition and Basis in Studies of the Workplace.

Workers can be called interdependent if they exhibit behavioural changes other than switching jobs in response to changes in other workers' compensation when their own compensation remains unchanged. These changes in relative compensation may be in comparison to other workers doing the same job in the same plant; to workers in other jobs in the plant; or, at the farthest remove, to the average worker in the economy. The degree to which the individual's behaviour is affected by these changes depends upon how easily he sees them. A change in relative compensation within a plant is likely to have greater effects on behaviour simply because of the ease with which each individual can obtain information both about others' compensation and about the efforts which produce their earnings.

The role of information is thus crucial to the analysis of interdependence. In a world of artisans, each working alone in his home, the effects of interdependence are small; when workers are in close contact as in a factory system, the effects are likely to be greater. The growth of an institution like trade unionism, which increases the publicity surrounding industrial wage decisions, is likely to increase the importance of behavioural phenomena associated with interdependence. To the extent that they are publicized, government wage surveys would have a similar effect.

Information that other workers' compensation has increased relative to one's own with no concomitant change in responsibilities will affect the supply of effort. If the worker is free to vary the length of his workweek he may do so in response to this change; if his only choices are a fixed-duration workweek or not working, he will either stop working, vary the
number of weeks worked or change the effort he exerts during each hour at work. In the first two cases this supply response will have important effects on labour force behaviour, while in the third, worker productivity and firms' employment decisions will be affected.

Industrial sociologists early recognised the importance of this type of interdependence in their observations of the workplace. Henri de Man, writing in 1927 [19], noted the importance of this phenomenon in the behaviour of the workers whom he interviewed.¹ Homans [11] has built his theory of distributive justice in groups on the basis of his observations of interdependent behaviour. He suggests that if workers feel their rewards are out of line, they will decrease their effort if the rewards are low and increase them by working harder and helping other workers if the rewards are too high. The theory thus implicitly suggests symmetric responses of workers to any change in their relative compensation.

Later empirical studies of the workplace suggest that the effects of interdependence are most noticeable in times of rapid change. Thus Zaleznik et al [25, p.299] explain their failure to verify their hypothesis that a worker's satisfaction varies with his rewards by noting that the plant they studied underwent little change during the period of observation. They imply that interdependence can be observed most clearly when compensation and working conditions are changing. Davison et al [4, p.52] remark that "... wage-earners are very sensitive to changes in relative earnings, and that this sensitivity makes the setting of piece rates very difficult." Jaques [12] notes the same phenomenon in the engineering plant

¹ "Persons engaged on the same task in close proximity and under identical conditions are peculiarly accessible to a feeling of envy. Such a feeling is not necessarily the outcome of any conviction that the person who is envied enjoys economic advantages at the expense of the one who is envious". [19, p.178]. De Man saw the basis for these invidious comparisons in workers' needs to compensate for an inferiority complex, and felt that such divisive forces were as important as those factors causing cohesion within the working class."
Recent studies find that changes in compensation are important not only in their effects on behaviour at work, but also in comparisons with other individuals who are not part of the work group. Cunnison, in her study of a garment shop, notes that, "Wages must not be seen only as sums of money. They are also symbols of social status in and out of the work situation, and workers competed for them in both these terms". [3, p.92].

The effects of interdependence have also been noted in the comments of observers of plants which are engaged in government training programmes for disadvantaged workers. Other workers appear to resent subsidized trainees with lower productivity who receive equal wages. Their feelings have led some firms to undertake special programmes to mitigate this source of lost production. (Cf. [9, pp.39-40], for a discussion of these problems.)

These observations of actual work situations document the importance of interdependence among workers. While this behaviour is a supply phenomenon, in that it affects the efforts workers exert, it also enters the employer's demand for labour through its effects on productivity. It provides the basis for analyzing the role of interdependence in the demand and supply behaviour of labour.

Individuals' efforts vary with changes in their absolute or relative

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2 "What commonly occurs is that a person or a body of people complains of losing ground relative to some other persons or bodies. They may feel this because they are getting left behind by other persons or groups who are bettering their position. They may consider that somebody below them is catching up. ...An adjustment that satisfies one body leads to the same problem arising for others who then consider that their position has worsened." [12, p.4].

3 All of these examples are based on studies of factory systems in modern Western economies, and the same behaviour is not necessarily observed in other societies. Indeed, Firth [7, p.262], studying the behaviour of a Polynesian economy, notes that after an unsuccessful fishing expedition the men who catch something give part to their empty-handed fellows as a way of avoiding jealousy.
compensation, other things equal. The effects of such changes are large and immediate, especially if the change is imposed from outside the plant. They rest on changes in wages and work requirements to which currently employed workers have become accustomed. In the long run, as new workers who are unaware of previous conditions enter the plant, the importance of the effect decreases. A similar decrease occurs as the firm attempts to rationalize production in response to changes in the efforts of individual workers. Interdependence in the workplace is thus most important for short-run analysis and to the study of dynamics. It is likely to have little effect on behaviour in the long run.

Increases in one wage in a plant may affect the effort both of those workers receiving the increase and of other workers who are aware of it. The importance of wage variation for other groups depends upon the extent of formal and informal communication of wage information both within and outside the plant. In analyzing the effects of varying one wage rate, we should therefore examine the firm's demand for all types of labour, not just for the group whose wage has increased.

The results in Sections II - IV follow directly from the empirical literature we have discussed, for the only comparisons we assume are among workers in the same plant. We deal with the firm's substitution between two types of labour in response to a change in their relative wage rates, with the adjustment of the market to its new equilibrium and with the implications of interdependence for the process of collective bargaining. Throughout the discussion we discuss changes in relative wages, though changes in absolute differentials may be just as important in producing changes in productivity.
II. Interdependence and the Firm's Demand for Labour.

We postulate a homothetic short-run production function for the competitive firm employing two types of labour. We assume that hours per worker are fixed and that production depends not only on the manhours employed of each type of labour, but also on the wages paid to each. In particular, we assume:

\[(1) \quad Y = F(E_1, E_2, \frac{W_1}{W_2}); \quad F_i > 0, F_{ii} < 0, i = 1, 2,\]

where \(E\) denotes the number of workers and \(w\) the wage per time period. The two wage rates are included in the production function to reflect the effect of wages on productivity. We further assume that:

\[F_{12} > 0, F_{13} > 0 \text{ and } F_{23} < 0.\]

The last two of these assumptions are designed to capture the emphasis of the industrial sociology literature on the role of changes in relative wages in determining the effort (and thus the productivity) of all workers in the plant. The sign of \(F_{13}\) (\(F_{23}\)) implies that the productivity of the marginal worker in group 1 (2) rises when his wage increases, the other wage being constant. The absolute magnitudes of \(F_{13}\) and \(F_{23}\) need not be equal; one might imagine that the effect would be greater for those workers, presumably skilled employees, whose sense of pride in their efforts and in the rewards for them is greatest.

We assume that the firm is a price-taker in the labour and product markets and that for simplicity the product price is unity. It operates subject to a cost constraint and seeks to maximize in the short run:

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4 I am indebted to J. Black for pointing out the need to assume homotheticity.
\( h = F(L_1, L_2, \frac{w_1}{w_2}) + \lambda \left[ c_0 - w_1 \Gamma_1 - w_2 \Gamma_2 \right], \)

where \( \lambda \) is a Lagrangian multiplier. The first-order condition describing the profit-maximizing inputs of the two types of labour is:

\[
\frac{\Gamma_1}{\Gamma_2} = \frac{w_1}{w_2},
\]

exactly as in the standard case which excludes interdependence. The interesting results occur in the comparative static analysis of the model. Differentiating implicitly in (3) with respect to \( w_1 \) and \( w_2 \), we find:

\[
\frac{dE_1}{dw_1} = \frac{A}{B} ; \quad \frac{dE_1}{dw_2} = \frac{C}{B} ; \quad \frac{dE_2}{dw_1} = \frac{A}{D} ; \quad \frac{dE_2}{dw_2} = \frac{C}{D}
\]

where

\[
A = \frac{1}{w_2} \left[ \Gamma_{13} - w_1 \Gamma_{23} \right] - F_2
\]

\[
B = w_1 \Gamma_{12} - w_2 \Gamma_{22} > 0;
\]

\[
C = \frac{w_1}{w_2} \left[ \Gamma_{13} - w_1 \Gamma_{23} \right] - F_1
\]

and

\[
D = w_2 \Gamma_{12} - w_1 \Gamma_{11} > 0.
\]

Unlike the standard case, the net effect of an increase in one of the wage rates on the inputs of the two types of labour is ambiguous. Each wage change produces three separate effects: 1) The usual substitution toward that group which, holding relative productivities constant, has become more attractive by virtue of the relative wage change in its favour; 2) An opposite effect, by which the productivity of the relatively cheaper group declines because of its change in status; and 3) An additional effect in the same direction as the last one, for the group which is now receiving a greater relative wage increases its efforts and becomes more attractive to the employer. If the interdependence is strong enough (the second and
third effects predominate), we may observe the short-run result that employment in the group whose relative wage has increased also increases. The firm, extrapolating the decline in productivity among currently employed workers to potential hires of the same type, may possibly start to shift employment toward that type of labour whose wage has increased.

This short-run model has been couched in terms of the effects of relative wage changes on productivity. While this approach is more closely tied to the evidence on interdependence, another approach linking interdependence to the firm's specific costs of turnover could also be used. If, for example, the quit rate of one group increases when the other group's wage increases, we would find comparative static results which are qualitatively the same as those we have derived. An increase in would raise the wage cost of that group, but it would also decrease its turnover costs relative to the new, higher costs in the second group. The net result would depend upon whether the relative wage effect or the relative turnover cost effect is greater.

The model has thus far been restricted to the short run, and with that time horizon we have demonstrated the possible ambiguity of the firm's response to changes in relative wages. As time passes, the firm will be faced by deaths, quits and retirements of its current employees, and it will realize that new workers who are unaware of previous relative wages in the plant will be satisfied with existing wages. It will then begin to make substitutions in the usual direction. Eventually, the importance of the interdependence effect will be diminished and the implications of the standard theory of factor demand will hold.
An interesting problem to consider is the effect of changes in the behavioural effects of interdependence on the time path of adjustment between any initial equilibrium of relative employment and the long-run equilibrium in which all effects of interdependence have disappeared. We assume the firm is at some initial equilibrium of relative employment, say ER^A_oo, and at time zero some instantaneous change in relative wages takes place. The new equilibrium at t = 0 is that ER^A_o implied by the appropriate parts of (4), while the final equilibrium is the usual one, say ER^A_1, of substitution toward the group whose relative wage has decreased. (Since the function F is homothetic, we can be sure that the path of relative employment is not affected by changes in the scale of production.) We assume that ER^A(t) approaches the equilibrium ER^A_1 at some rate Q which is an increasing function of the mobility of workers out of the firm. Since greater mobility ensures that relatively few workers are aware of previous wage differentials; it seems reasonable to link mobility to the equilibrium implied by the relative productivities seen by the entrepreneur. At any time t the firm's temporary equilibrium of relative employment will be:

\[ \text{(5)} \quad ER^A(t) = ER^A_1 + \left[ ER^A_o - ER^A_1 \right] e^{-Qt}. \]

Relative employment desired decays exponentially toward the usual equilibrium, ER^A_1.

Let us now assume that there are increasing costs of adjusting relative employment, so that it pays the firm to spread the adjustment of actual

5 This suggests that skilled workers, whose attachment to a craft or firm is greater than that of the unskilled, may manifest greater interdependence in their behaviour. It may be an additional reason for the great emphasis on comparability between trades in the construction industry.
to desired employment. We assume that firms are completely myopic and adjust toward the equilibrium $\text{ER}^A(t)$ prevailing at time $t$; we thus envision lags in the adjustment of actual relative employment to desired relative employment which is itself moving over the path described by (5). This adjustment is characterized under some simplifying assumptions by:

$$
\dot{\text{ER}}(t) = a\left[\text{ER}^A(t) - \text{ER}(t)\right]; \quad a > 0.
$$

Substituting (5) into (6) and solving the differential equation, we get:

$$
\text{ER}(t) = \frac{a[\text{ER}^A_0 - \text{ER}^A_1]}{a - Q} \left[ e^{-Qt} - e^{-at} \right] + \left[ \text{ER}^A_{oo} - \text{ER}^A_1 \right] e^{-at} + \text{ER}^A_1,
$$

where the constant is chosen to make $\text{ER}(0) = \text{ER}^A_{oo}$.

What are the effects of increases in $|\text{ER}^A_0 - \text{ER}^A_1|$, a measure of the strength of interdependence, on the rate at which equilibrium is approached? We can write (6) as:

$$
\dot{\text{ER}}(t) = a\left[\text{ER}^A_1 - \text{ER}(t)\right] + a\left[\text{ER}^A_0 - \text{ER}^A_1\right] e^{-Qt},
$$

and differentiate with respect to the difference $\text{ER}^A_0 - \text{ER}^A_1$ to get:

$$
\frac{d}{d[\text{ER}^A_0 - \text{ER}^A_1]} \dot{\text{ER}}(t) = ae^{-Qt}.
$$

If $\text{ER}^A_0 - \text{ER}^A_1$ is negative, $\dot{\text{ER}}$ is positive unless the interdependence effect is great enough to make $\text{ER}^A_0$ less than $\text{ER}^A_{oo}$. Increasing the difference $\text{ER}^A_0 - \text{ER}^A_1$ is equivalent to decreasing the interdependence effect. Since (9) is always positive, this implies that increased interdependence produces

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6 If $a = 0$, one can show by L'Hôpital's rule that first term is:

$$
at[\text{ER}^A_0 - \text{ER}^A_1]\left[ e^{-Qt} + e^{-at} \right] .
$$

Relative employment is thus defined for all allowable values of $a$ and $Q$.
a slower adjustment to equilibrium. An analogous argument could be made for \( ER^0_0 - ER^0_1 \) greater than zero.

We have demonstrated that, if the target relative employment to which the system adjusts lies between the initial and final positions, the system adjusts more slowly than if it always adjusted directly toward the final equilibrium. While this result is not surprising, it is useful for the comparison it provides with the results of the next section. Moreover, it has some importance for empirical work on the lag in adjustment of employment behind output (see Section VI below).

III. Effects on Market Adjustment.

In the previous section we discussed the firm's response to an instantaneous change in relative wages. We now examine the effects of a change in demand or supply conditions in a labour market of interdependent workers. In particular, we consider how the introduction of the assumption of interdependence affects the speed with which relative wages are bid up or down from their initial to their final equilibrium.

Consider a market consisting of many identical small firms, each of which employs two types of labour. The relative supply in the market can be described by:

\[
ER(t) = c + d WR(t); \quad d > 0,
\]

where the "R" denotes a ratio of the wage or employment of type one labour relative to type two, and we assume linearity for simplicity of exposition. We assume that actual relative employment demand equals desired relative employment (there are no costs of quantity adjustment); that both are a
decreasing function of the relative wage, and that interdependence enters through the effects of deviations of actual from accustomed relative wages on relative demand. Our arguments in the previous section suggest that, holding relative wages constant, if they are greater than the accustomed relative wage, workers favoured by the change will produce more and those against whom differentials are changing will work less per hour. These arguments suggest the relative demand curve:

\[ ER_D(t) = a + b \cdot WR(t) + g \cdot [WR(t) - WRAC(t)] \quad ; \quad b < 0; \quad g > 0, \]

where \( WRAC(t) \) is the accustomed relative wage at time \( t \).

We postulate that the tâtonnement process can be characterized by the linear differential equation:

\[ \dot{WR}(t) = \beta [ER_D(t) - ER_S(t)] \quad ; \quad \beta > 0. \]

In order to complete the model we need to examine the determinants of the accustomed relative wage. Clearly, workers in the plant will have different notions about what is the customary fair structure of pay, and these notions are likely to be based on the history of pay differentials in the plant. For the sake of simplicity, however, we assume that each worker accepts as customary that relative wage which prevailed when he was hired. Then if the average rate of mobility out of the plant is \( Q \), the average employee was hired \( \frac{1}{Q} \) periods ago, if we assume that the probability of leaving is independent of the duration of unemployment. This last proviso is patently wrong, but our assumptions at least introduce the same note of realism as in the previous section, that interdependent behaviour persists longer when mobility is less. Our assumption on accustomed relative wages is:
\[ WRAC(t) = WR(t - 1/Q). \]

We substitute (13) into (11), and then substitute (10) and (11) into (12) to derive:

\[ WR(t) = \beta\left[\alpha - c\right] + \beta'\left[\beta - d + g\right]WR(t) + g\left[WR(t) - WR(t - 1/Q)\right], \]

the first-order mixed difference-differential equation characterizing the path of adjustment of relative wages. If we redefine the unit of time to equate it to 1/Q, we can rewrite (14) as:

\[ WR(t) = \beta'\left[\alpha - c\right] + \beta'\left[\beta - d + g\right]WR(t) - \beta'g'WR(t - 1), \]

where \( \beta' \) and \( g' \) are changed because of the changed definition of units of time. The properties of equations such as (14') have been examined by Frisch and Holme \([8]\). The roots of the solution to (14') are characterized by:

\[ \rho = \beta'\left[\beta - d + g\right] - \beta'g'e^{-\rho}. \]

The solution can be uniformly explosive, oscillatory or uniformly decayed, and the conditions for uniform decay are:

\[ \beta'\left[\beta - d + g\right] - \log \beta'g' \geq 1, \]

and

\[ \beta'g' < 1. \]

The first of these ensures that the system does not oscillate, while the second guarantees decay. If they hold, both roots of (15) are negative, and the solution to (14') is of the form:

\[ WR(t) = WR_0 + e\rho_1^t + C e\rho_2^t, \]
where \( WR' \) is the equilibrium value of \( WR \) and \( \rho_1 \) is the more positive of the two roots.

Table 1 lists for selected combinations of \( d \) and \( b \) the maximum value of \( g' \) which is consistent with conditions (16). If the relative demand and supply curves are not very steep, the Table indicates that the interdependence effect must decrease quite rapidly as the difference between the slopes of the two curves increases, if the solution is decayed. This can occur either if \( g \) decreases or if \( Q \) increases, i.e., either the initial effect of changes in wage relatives is smaller or it persists over a shorter period of time.

<table>
<thead>
<tr>
<th>Parameters Associated with (16)</th>
<th>Maximum ( B'g' )</th>
<th>Maximum ( \frac{B'}{d-b} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 0.5 )</td>
<td>0.3015</td>
<td>0.6030</td>
</tr>
<tr>
<td>( 1.0 )</td>
<td>0.1586</td>
<td>0.1586</td>
</tr>
<tr>
<td>( 2.0 )</td>
<td>0.0525</td>
<td>0.0262</td>
</tr>
<tr>
<td>( 5.0 )</td>
<td>0.0025</td>
<td>0.0005</td>
</tr>
</tbody>
</table>

Using (15), one can show that for any increase in \( g' \), \( \rho_1 \) must decrease and \( \rho_2 \) must increase. Since \( \rho_1 \) is the dominant root, this ensures

\[ Z_1 \] be the left-hand side of (15) and \( Z_2 \) its right-hand side. These are graphed as:

with the solutions being the two intersections of \( Z_1 \) and \( Z_2 \). Now \( \frac{\partial Z_1}{\partial \rho} = 0 \), and \( \frac{\partial Z_2}{\partial \rho} = B' - e^{-\rho} \) < 0, so that \( \rho_1 \) must decrease and \( \rho_2 \) increase with increased \( R' \).
that any increase in $g'$ will eventually result in WR being closer to its equilibrium value for all $t$ greater than $t^*$. If we consider two otherwise identical markets, one characterized by interdependence and the other not, this result shows that the first market will reach a new equilibrium earlier than the second if the same exogenous change occurs in both. In a market of competitive firms which bid for labour, interdependence speeds the adjustment to equilibrium. This result is opposite that of the previous section, where we showed that introducing interdependence slows the firm's adjustment in response to once-and-for-all changes in relative wages.\footnote{This anomaly is examined by the author in much greater detail and generality in some unpublished work.}

IV. A Digression on Collective Bargaining.

While interdependence in the sense of competition among union leaders in negotiating wage increases has a long history \cite{22}, the effects of interdependence of the sort discussed above have not been considered. Imagine an industrial union representing two distinct groups of workers in a plant, and consider the effects of interdependence on the behaviour of both union and management negotiators. Since any wage package the union achieves will be quickly known, any disparity in the wage increases gained for each group is likely to cause substantial dissatisfaction among some of the workers if interdependence is important. Only if the group which loses is not vital to the union leaders' power or prestige is the union likely to trade off its wage increase for larger increases for the other group.\footnote{Even a small faction in the union can exert a powerful influence on the leaders' behaviour if it feels it has been slighted. (Cf. the occasional unusually large wage increases the UAW has negotiated for its skilled trades to compensate them for feeling a decline relative to assembly-line workers. The leaders' response in this case was to the threat that skilled workers would seek to have the UAW decertified and a separate skilled unit formed.)} Moreover, as the strength of feelings produced by interdependence...
increases, this will become less likely. A similar spur to maintain uniformity in the wage increases it offers the two groups also exists for management. If it has established a wage structure which its workers feel is fair, it is hardly likely, in the absence of technical changes, to wish to change it and incur the losses in production arising from worker dissatisfaction.

Interdependent behaviour by workers in a plant will give both parties to labour negotiations an incentive to limit the range of discussion during bargaining. Negotiators would, in the absence of interdependence, feel free to settle on vastly different compensation packages for the two groups of workers if that were indicated by political and economic circumstances. Interdependence modifies this by making it beneficial for each party to discuss general wage increases and to avoid dealing in different packages for each group of workers. We thus find that most negotiations consist of discussions of some key wage rate in the plant. While this phenomenon may be a way of avoiding some of the costs of bargaining, it may also stem directly from the maximizing behaviour of both parties even in the absence of these costs.

Because interdependence produces a smaller trading set, any collective negotiation will produce a faster agreement than if workers were completely independent. Unless — and it seems unlikely — concession rates decrease because of interdependence, the realization by both sides of the benefits of limiting the topic of bargaining will mean that initial demands and offers will be closer together. By decreasing the size of the trading set interdependence adds to the efficiency of bargaining in a world free of legal restrictions, for it enables the bargaining process to reach its
outcome more rapidly than otherwise.

In terms of efficiency in bargaining, the only difficulty with interdependence is that it leaves less room for credible bluffing. Each side surely knows the other's interest in keeping separate wage increases in line, so that neither side will profit from, and thus neither will undertake, bluffing in the form of vastly disparate demands for different groups of workers. This limitation on the range of bluffs poses problems in view of the institutionalization of "horsetrading" in the NLRA requirements for bargaining in good faith. If there are constraints of this type imposed on the bargaining process, it is not clear that interdependence adds to its efficiency.

V. Interdependence and Labour Supply.

In this section we move further from the concrete observations of industrial sociologists and examine the role of invidious comparisons in an individual's labour supply. Our results are an extension of the Veblenian notion of conspicuous consumption to people's choice between labour and leisure. Because they pertain to the long-run, we must include interdependence in consumption decisions in addition to its demonstrated role in the workplace.

We assume that the utility-maximizing individual derives pleasure from having a wage above the average at any given level of the average wage of some comparison group which he can readily observe. Just as the ability to consume large quantities of goods raises his status among his

10 Cross [2, p.177] discusses legal requirements for bargaining and their effects on bluffing.
neighbours in a Veblenian world, so other people's knowledge that an individual is a "twenty-thousand dollar a year man" may increase that individual's happiness. (See Kahl [13, pp.19-52] for a discussion of the role of occupation and income in determining prestige.) In the world we postulate, status is achieved not only by consuming out of income, but also by virtue of the very fact of having a large income. "Conspicuous earnings", especially in a world where information about earnings is readily available to other individuals, may be as important as conspicuous consumption.

The individual is assumed to choose his labour supply to maximize:

\[
U = U(L, Y, \frac{w}{w^c}); \quad U_i > 0, \quad U_{i1} < 0, \quad U_{i2} > 0, \quad i = 1, 2, 3,
\]

where \( L \) is hours spent not working, \( Y \) is income, \( w \) is the individual's wage and \( w^c \) the comparison wage. Conspicuous consumption and conspicuous earnings enter the model through the following assumptions:

\[
U_{13} < 0 \quad \text{and} \quad U_{23} < 0.
\]

The first of these states that the value of an additional hour of leisure is greater (the disutility of work increases) when the comparison wage increases relative to one's own. The second states that the same increase raises the value of an additional unit of consumption. This latter assumption is based on the notion that individuals attempt to retain their old status by maintaining their consumption when their wage falls relative to that of the comparison group.\(^{11}\)

\(^{11}\) In one respect this contradicts one of Veblen's original observations. Rather than implying that interdependence spurs the newly-rich to increase their emulation of the highest-income individual, it suggests that the need for conspicuous consumption declines if one's relative wage rises.
The individual maximizes (18) subject to the constraint \( L = T - H \) and the definition \( Y = wH \), where \( T \) is the total number of hours during any given time period and \( H \) is the number spent in market activities. Following \([10, \text{p}.23]\), we substitute directly into (18) and maximize with respect to \( H \):

\[
(19) \quad -U_1 + wU_2 = 0.
\]

This condition is the same as in the case where interdependence does not exist. If we differentiate implicitly in (19) with respect to \( w \) and \( w^2 \), we derive the following comparative static results:

\[
(20a) \quad \frac{\partial H}{\partial w} = \frac{U_2 + H[U_{22} U_{12} - U_{12}^2] - \frac{1}{w^2} [U_{13} - wU_{23}]}{Z}
\]

and

\[
(20b) \quad \frac{\partial H}{\partial w^2} = \frac{U_{13} - wU_{23}}{Z^2} w^2
\]

where \( Z = -(U_{11} - 2wU_{12} + w^2U_{22}) > 0 \).

The effects of interdependence on the usual analysis of labour supply are thus critically dependent on the sign of the quantity \( U_{13} - wU_{23} \). If \( U_{13} \) (the increased disutility of work occasioned by an increase in the comparison wage) is greater than \( wU_{23} \) (the incentive to work to maintain consumption relative to the average), the individual will decrease his labour supply. If, on the other hand, he is bothered only little by the loss in status in and out of the workplace due to earnings, but is concerned about impressing people by his spending habits, he will increase his hours worked when the comparison wage rises and his own wage remains constant. The direction of his response to a rise in his own wage will be affected by this comparison in a way opposite that of a rise in the comparison wage.
In this model of interdependence the individual is torn by a change in his relative wage. Both his status due to his earnings and that due to his expenditures are affected by the change in the average wage. While his equilibrium supply of labour may not change, in arriving at the decision not to change it he must consider the effects on his status.

None of the implications of standard consumer theory for long-run behaviour are vitiated by the introduction of our assumptions about interdependence. If all wages rise proportionately, all the terms in equations (20) which involve relative earnings vanish if we subtract (20b) from (20a). The importance of interdependence here is in its effects on our predictions about changes in the allocation of time in response to wage increases when the comparison wage is unchanged.

VI. Applications.

In none of the following discussion do we suggest that interdependence is the sole cause of the particular phenomenon. Inadequate data, inaccurately specified models and inappropriate methods of estimation could all cause difficulties in the empirical literature. Rather, the discussion is meant simply to suggest that interdependence, which has been observed in a number of plants, might explain some of the problems in rationalizing empirical results with current economic theory.

Numerous studies have attempted to verify (or in some cases to contradict) the implication of the elementary theory of factor demand that imposition of a minimum wage will, other things equal, decrease employment among workers whose wage previously was below the minimum. A large number of these studies have been unable to verify this prediction (for example
While one may argue that most, if not all of these studies are riddled with deficiencies in data and in specification, another possibility is that the appropriate theory is not being tested. Imposition of a minimum wage on a plant is an excellent example of an externally-decreed change in the wage structure without any concomitant change in responsibilities among workers. It thus fits perfectly the model of the short-run effects of interdependence discussed above. If interdependence is important, we should not be surprised to find little or no employment effect of a required rise in wages among low-skilled workers, for, under interdependence, the wage increase itself will induce these workers to be more productive. The firm thus has little incentive to separate these workers, for this effect may raise their productivity to the new higher wage they must be paid. If there is a symmetric negative effect on the productivity of high-skilled workers because of interdependence, their employment may decrease in the short run. This discussion suggests that attempts to verify the employment effects of a minimum wage should examine total employment in a plant or industry rather than only the employment of workers whose previous wage was below the minimum. Total employment will decrease in the short run in any case, but the decrease may be concentrated as much among high-paid as among low-paid workers.

The marginalist controversy of the 1940's was chiefly over whether firms behave as profit maximizers, and it stemmed partly from the observations of institutional labour economists that firms' employment decisions did not appear to respond to wage rate changes. In plants where interdependence is important the firm might well not change its employment mix.

12 See [18] for a retrospective view of this discussion and a list of references.
Yet, as we have shown in our derivation of the results of Section II, such behaviour is perfectly consistent with the narrowest form of short-run profit maximization. To the extent that interdependence among workers exists in plants, it provides a possible bridge between theory and apparently contradictory empirical results.

A substantial literature has been concerned with measuring the lag of employment behind output, and some of the studies using quarterly data find average lags of over six months.\(^{13}\) It is difficult to believe that adjustment costs, the usual theoretical basis for the lagged specification, rise rapidly enough to account for this observed lag. Another possible basis is that any output change can be accompanied by changes in relative wages which produce interdependent behaviour of the type we have discussed. Our results of Section II show that the superimposition of this effect on the firm's lagged employment adjustment lengthens observed lags. It may be that adjustment costs alone cannot explain observed lags, but that together with the additional stickiness caused by interdependence they can.

Much effort has been expended recently to estimate the parameters of models designed to explain variations in individuals' labour supply. This work is important not only for our understanding of the labour market, but also because it can provide estimates of the potential work-disincentive effects of negative income tax schemes. Unfortunately, negative substitution effects of wage changes on hours worked have been produced \(^{[15]}\) and \(^{[23]}\). Even the simplest requirement of consumer demand theory does not

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\(^{13}\) Kuh \(^{[16]}\) finds average lags of over three quarters, while the average lag of own-adjustment of employment in Nadiri and Rosen \(^{[21, p.46]}\) is two quarters.
seem to be validated by the empirical work on labour supply. If we assume that interdependence of the type discussed in Section V exists, but that individuals compare themselves only to others who have incomes in the same range, the results can be made consistent with economic theory.

Consider a population composed of two income groups, high and low, with the individual comparing incomes to the average within his own group. Taking a sample of this population, the appropriate hours equation is:

\[ l_i = \beta_0 + \beta_1 w_i + \beta_2 I_i + \beta_3 \frac{w_i}{w^*_i} + \epsilon_i, \]

where \( w^*_i \) is the relevant comparison wage for the \( i \)th individual in the sample, \( I_i \) is his unearned income (or in some formulations for adult men, the wife's income) and \( \epsilon_i \) is a random disturbance term. (We have not included demographic variables, for the sake of simplicity.) In our model the terms \( w_i \) and \( \frac{w_i}{w^*_i} \) are positively correlated, and it is likely that \( I_i \) and \( \frac{w_i}{w^*_i} \) are also positively correlated. Leaving out the interdependence term thus biases the estimates of those parameters needed to derive the estimated income and substitution effects. In particular, if the conspicuous earnings effect predominated in (20a) and if the true coefficient \( \beta_1 \) is small, the coefficient estimate of \( \beta_2 \) will be biased upward toward zero and the estimated substitution effect, \( \hat{\beta}_1 - \hat{\beta}_2 \), will have a negative bias. The opposite result holds if the conspicuous consumption effect predominates, and the biases are unclear in any case if the parameter \( \beta_1 \) is large relative to \( \hat{\beta}_2 \). These results diminish in importance as the number of comparison groups increase, for such an increase lowers the correlations between \( w_i, I_i \) and the interdependence term.

\[14\] The groups could also be segmented by any correlate of income, e.g. race or region.
VII. Conclusions.

The motivation for interdependence in consumption has not been well established in the psychological literature, and the several different kinds make its implications for standard theoretical results unclear. Economists have therefore not been too concerned about its effects on microeconomic theory. The existence of a particular type of interdependence has been demonstrated by studies of the workplace, and it has implications which unambiguously modify traditional results. Under interdependence the short-run effects on relative labour demand of a change in relative wages become unclear, the firm's adjustment of employment is slowed, but the attainment of a new market equilibrium in response to some exogenous shock is speeded up. Individuals' supply of effort to the workplace is also modified by this effect.

In analyzing the effects on employment of changes in legislated minimum wages, the introduction of interdependence might be able to reconcile theory with empirical results which seemingly contradict it. The phenomenon also has implications for the empirical analysis of the individual's demand for leisure and consumption. Indeed, our discussion can be applied to any problem involving more than one type of labour and not concerning long-run equilibria alone. It may be especially useful in making bargaining theory more applicable to the analysis of collective bargaining than it now is. Despite the modifications which may be involved, the demonstrated importance of interdependence in the workplace makes it essential that the concept be introduced more widely into the theory of labour markets.
REFERENCES


