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The Concept of Job Vacancies in a Dynamic Theory of the Labor Market

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INTRODUCTION

Although the systematic collection of data on job vacancies goes back to the First World War, the vacancy concept has yet to be adequately refined, and a comprehensive theory of the labor market into which such a concept could be fitted has yet to be developed.

Continuing high levels of unemployment over the past seven years have focused national attention on changes in the labor market. Our statistics on the labor market have been examined [50] to determine what validity can be attributed to the recent trends in employment and unemployment. The Council of Economic Advisors [17] and economists such as Klein and Ball [29] have made an effort to determine the reaction of the labor market to changing levels of aggregate demand. Many careful case and survey studies supply a factual basis for understanding the functioning of labor markets [6, 34, 48]. Despite these and other studies, quantitatively formulated relations in the labor market are still relatively unexplored. Phillips [49], Lipsey [36], Eckstein and Wilson [16], and Bowen and Berry [7] have attempted to link price behavior in labor markets to other economic indicators.

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A great deal has been learned by these efforts, as well as others (see references at end of paper), but they have not yet yielded a comprehensive theory of the labor market. What is sorely needed are models that would be useful for study of such policy questions as the relations between aggregate demand, unemployment, and inflation; the impact of demand in particular submarkets, in specific regions, or in particular skills; the effect of changing industrial structure, or the structure of labor demand; the cumulative effect of unemployment on labor force participation and family incomes; and finally, the effect of unions on the structure and level of wages. In this paper we cannot and do not articulate a model in the detail required to answer all these questions, but we offer an approach that may be useful in the development of detailed theories of the labor market. However, we have little at this stage to say about the effect of unions.

We propose a definition of "job vacancy" that holds promise of being useful, and then proceed to sketch out a theoretical framework for analyzing the operation of labor markets. Not only are these our most important markets, but also our most complex ones. Hence our efforts to produce a simplified abstract formulation must be viewed as an initial effort requiring further modifications and refinements.

In the theory presented here, the labor market is viewed as a complex stochastic process that involves interaction among many participants. Their actions are governed by fairly complex relationships arising from the objectives and constraints of firms and families. Thus, the labor market is not considered in terms of such relatively simple constructs as supply and demand schedules.

We start by focusing on the two important stocks in the labor market, unemployed workers and job vacancies. Then we consider the interaction between these stocks and the corresponding flows, and determine how the flows and stocks influence each other and how the market reaches equilibrium.

The hiring of a worker is viewed as resulting from a random search process through which a nonstandard worker and nonstandard job are somehow matched to satisfy certain wage and skill criteria established by firm and worker. As a consequence of this

search process and other occurrences that are treated as random events, the labor market responds dynamically to a complex stochastic process. Some aspects of the stochastic equilibrium are considered, especially factors affecting the determination of money wages.

Finally, we consider briefly some of the research and policy implications of the theory.

THE CONCEPTS OF UNEMPLOYMENT AND JOB VACANCIES

In the theory which is developed below, the duration of unemployment or job vacancy is viewed as significant. The worker who has been unemployed two months is likely to exhibit substantially different behavior, in terms of search and wage-job preferences, than he did after having been unemployed for only one week. Similarly, a company that has been seeking a particular type of worker for two months is likely to behave quite differently, in terms of its recruiting, skill requirements, and offering wage, than it did when it had been recruiting for only a week. Although these changes constitute an important part of the theory, in identifying an unemployed person and job vacancy we need concepts which will not be overly influenced by the job search or recruiting behavior that prevails at the time of measurement. Workers who are long unemployed may hardly be searching at all,[1] and job vacancies which have long been unfilled in a tight labor market may hardly show up in recruitment efforts. Nevertheless, such unemployment and vacancies are real, important, and should be taken into account for both theory and policy purposes.

Both the concepts of unemployment and vacancies necessarily involve a price dimension (everyone would want a job if the wage offered were high enough and firms would hire all the workers they could get, if the wage cost were low enough). We need reference prices that are reasonably close to those available in the current market, given existing productivity, etc. Because the skill requirements

[1] Research has clearly shown the importance of the "discouraged worker" and the collection of unemployment data should be modified to take account of this effect. See [64].

and satisfactions of jobs, and the skills and performance qualities of workers, are varied, complex, and difficult to price objectively, we think that the most suitable reference price is that provided by the operation of the market itself, namely, the wages that were actually paid for the particular kind of job by that employer or actually received by a particular worker in the recent past. Hopefully, such references provide a sufficiently firm base in the experience of workers and employers that measurements of vacancies and unemployment, based on the following definitions, will have reasonable stability.

A person who is not working is considered unemployed if (1) he is actively engaged in the search for a job, or (2) he is able to work and would accept the opportunity, should it be offered, to work at his previous job and wage.[2]

Inclusion of the latter category is designed to prevent the concept of unemployment from relating only to job search behavior, rather than to all instances of inability to find work at reasonable wages. In the latter category the provision also must be made that the man still qualifies for holding the old job, if it were offered. We do not want to include among the unemployed the older worker who no longer is qualified for any job and has stopped looking for work. Although a hypothetical question will have to be asked to determine who is unemployed, the question relates to concrete past experiences of the worker, and hence should be amenable to valid answers. In any case, the data from the two categories of overt and concealed unemployment should be kept separate.[3]

Job vacancies are defined as (1) the number of unfilled job openings whose labor requirements and wage rates are formally specified in firms that are actively recruiting, and (2) the number of men who would be hired today (but not necessarily to start work immediately) if they had the same skills and wage requirements as the men that the company has recently hired to fill corresponding posi-

[2] The concept might be modified to include only the best of his recent jobs, to avoid giving undue weight to a job which the worker quit because it proved unsatisfactory. Basically, we want to know if a person would accept a "reasonable" job, but has been discouraged from looking actively.

[3] The inclusion of data on still another category has considerable interest—employed workers searching for a better job.

tions. The second category must be measured by answers to a hypothetical question; however, the question would refer to previous concrete experiences of the employer. Such experiences define both wages and skills which in the past have been acceptable to the employer. Efforts should be made to measure vacancies (including those involved in the recall of former employees) at all of the hiring points in the organization, in order for the sample to be representative; but double counting [4] should be avoided by appropriate queries concerning responsibility for hiring decisions.

The following questions are illustrative of the concepts involved. (1) How many positions are you actively seeking to fill by recalling former employees? (2) How many additional positions are you actively seeking to fill by hiring new workers? (3) In addition to the above, are there other positions for which you are *not* actively recruiting, but which would be made available *if* suitable applicants presented themselves? If so, how many? (By "suitable" we mean to indicate the wage rates and skills that you have been willing to accept in the recent past.)[5]

A worker who has not previously been employed, or a company that has never previously hired persons in a particular skill category will require other points of reference. The worker's general perceptions of jobs and wages offered to workers of comparable abilities and the employer's general perceptions of the skills and wages of employees who are currently being hired by other employers would need to be used to delineate unemployment and vacancies.

The concept of vacancies proposed is a stock, and the theory developed below requires measurement of a stock. Useful information pertaining to hires and labor market shortages could be obtained from business firms by asking about their plans to hire over some period of time, i.e., the planned flow of new workers. However, such a measure must be clearly distinguished from the stock of job vacancies.

[4] It might even be necessary to determine vacancies at several points in a firm, aggregate them, and resubmit to a higher level in management who, being aware of budget constraints, might make downward adjustments.

[5] More thought needs to be given to these questions before they are ready for inclusion in a questionnaire.

INTERACTIONS BETWEEN FLOWS AND STOCKS IN THE LABOR MARKET

The flows and stocks that are to be studied are shown in Figure 1. The lower case letters represent flows (i.e., units per period of time) and the upper case letters, stocks (i.e., units at the end of the time period). Sales of goods (s) flow from the stock of finished inventory (H), and the production flow (p) replenishes this inventory. Production requires a flow of man-hours (m) from the employed work force (E). This stock is regulated by retirements (r) and quits (q), both of which reflect worker decisions; by layoffs plus terminations (l) and recalls (c), which reflect decisions made primarily by the managements of firms; and by new hires (h), which occur when new employment agreements are made between unemployed workers and firms. The stock of vacancies (V), i.e., the unfilled jobs that firms are seeking to fill, is regulated by the difference between new hires (h) plus recalls (c) and the net flow of new vacancies (v) that are created by firms. The stock of unemployed workers (U) in the labor market is regulated by the flow of quits (q), layoffs plus terminations (l), recalls (c), and hires (h), and also the difference between entries (e) into the unemployed work force from households and the corresponding withdrawals (w). Finally, the number of family members (F) *not* in the work force is regulated by births (b) and deaths (d), as well as retirements (r), entrants (e), and withdrawals (w) from the work force. These variables may be given time subscripts for dynamic analysis and may be treated as vectors where disaggregation is desired by family, firm, occupation, industry, or region.

The definitions of variables in Figure 1 lead to a set of accounting identities between the flows and stocks (negative subscripts indicate earlier periods):

$$U - U_{-1} = q + l + e - w - h - c \tag{1}$$

$$V - V_{-1} = v - h - c \tag{2}$$

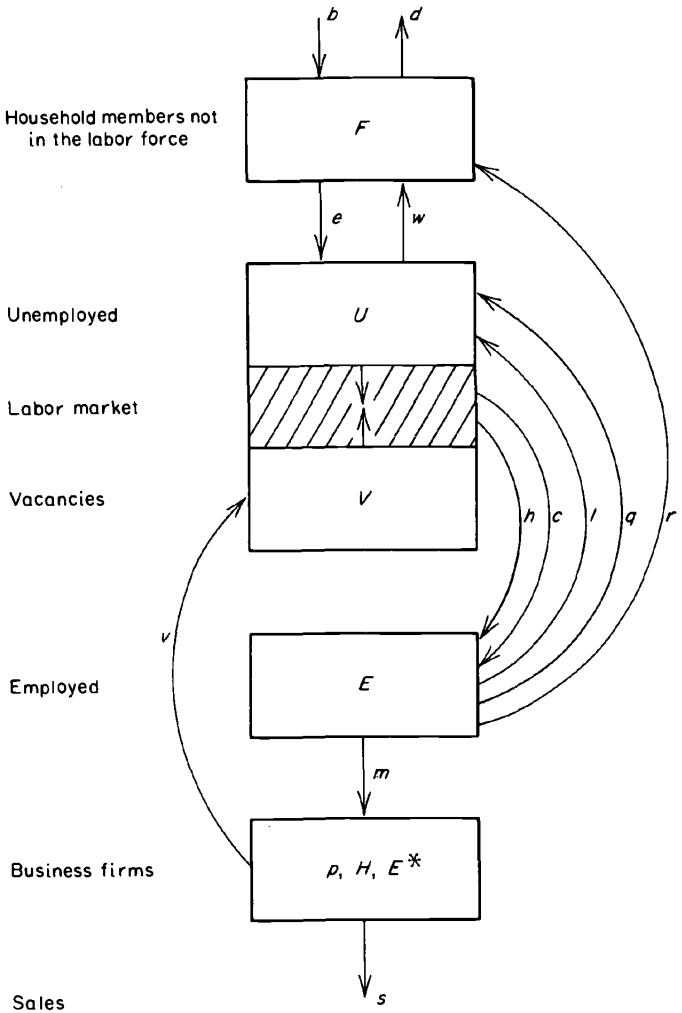
$$E - E_{-1} = h + c - r - q - l \tag{3}$$

$$F - F_{-1} = b - d + w - e + r \tag{4}$$

$$H - H_{-1} = p - s \tag{5}$$

FIGURE 1

Labor Market Flows and Stocks



F = number of family members not in work force; b = births; d = deaths; e = entries to work force; w = withdrawals from work force; U = number of unemployed workers; V = number of job vacancies; v = net new job vacancies; h = new hires; l = layoffs plus terminations and other separations; q = quits; r = retirements; E = number of employed workers; E^* = desired number of employees; m = man-hours; p = production of finished goods; H = finished goods inventory; s = sales of finished goods.

All variables are positive except v (net new vacancies), which can go negative.

In the interests of formal simplicity, we assume that only unemployed workers are hired. Thus, a worker going directly from one job to another one will be considered to be momentarily unemployed. Similarly, a vacancy that will immediately be filled by recalling a laid off worker will be considered to have been momentarily available in the labor market. This simplification can be readily dropped if greater richness of classification is needed—for example, to take explicit account of the employed-but-searching group.

This framework of labor market accounting in itself contains no explicit behavioral hypotheses, but does serve to focus attention on the flows in the labor markets which, in the United States, tend to be very high relative to the stocks.

Separations of employees from firms for all reasons typically average 2 or 3 per cent a month. In order to maintain a constant work force, a firm must replace in a year between 24 and 36 per cent of its workers. Many employees, particularly young ones, leave new jobs after short stays, possibly finding the positions less desirable than anticipated or hoped. Firms may have to hire several workers in order to keep one semipermanently. Older workers with seniority are, of course, relatively less mobile. *The tremendous turnover in the labor force of a firm means that failure to hire new workers can quickly lead to a catastrophic contraction of production. Thus, successful recruiting in the labor market is important to the firm, just as finding a job is important to the worker.*

We present certain hypotheses about the behavior of the participants in the labor market that are amenable to theoretical development and to empirical estimation and testing. In general, we assume that the participants act in line with their own economic interest within the limits of their knowledge about their economic environment.

Some of the behavioral relations, particularly labor force participation decisions, have already been studied [12, 26, 40, 43]. Indeed, one of the virtues of this approach is that it creates a fruitful framework for both stimulating and utilizing the research of others.

Probability Behavioral Models

While such a variable as the flow of workers who quit their jobs is a useful aggregate concept, the behavior of a particular individual is dichotomous—he either quits or does not. Although the behavior of individuals is influenced by a myriad of factors that may be highly local and specific, for an analysis of the labor market we should concentrate on the factors that have an important influence on the probability of quitting by people generally, and hence are of economic importance. Probability theory can then be used to infer for large samples of workers the flow of those who quit. The same argument applies for other variables. Behavioral theory, formulated and even estimated in probability terms on the micro-level, can also be applied on aggregate levels. Such probability models are especially appropriate in studying the search process of workers seeking jobs, which inherently involves a large element of chance; that is, a factor of dominant importance for an individual may be of negligible importance for the economy as a whole, and hence is treated as a random variable.

INDUCED LABOR DEMAND

Presumably, the demand for end products associated with consumption, capital investment, and government expenditures, etc., induces the demand for labor, but the response is rather involved. A demand change at the firm level splits into a price response and a production response, depending on capital utilization, inventory position, degree of price competition, and tightness of the labor market. The production response generates a secondary demand response, depending on the product mix of the original end-product demand, the input-output relations between industries, and the occupation mix of the various industries. Depending on the existing capital capacity, work force, and outstanding job vacancies of a firm, its production change leads to overtime and the generation of new job vacancies, as well as demand for investment goods (or, alternatively, idle time, worker layoffs, and the cancellation of job vacancies).

Note that on the downswing the firm directly controls its employment through layoffs; on the upswing, it directly recalls workers previously laid off. However, its search for suitable new employees may not be successful and is not directly controlled.

Desired Work Force

Considerable normative and empirical work has been done on the costs to firms of hiring and training, layoffs, overtime, idle time, inventory holding, and lost sales due to inventory shortages. On the basis of this work, a useful concept of desired work force (E^*) is formulated, i.e., the level of the work force which would be most profitable [26]. The size of the desired work force depends on the existing work force, the forecast of future sales, the present level of finished inventory, the backlog of unfilled orders, labor productivity, and wage rates. A work force either above or below E^* is less profitable, and the firm can be expected to take corrective actions to change the size of its work force. A particular flow of labor manhours (m) can be obtained from work forces of various sizes by varying overtime and short-time. However, both physical limits to available time and costs of hiring, separation, and overtime determine a relation between fluctuations in production (p) and fluctuations in desired work force E^*.

Vacancies

For a single homogeneous type of worker in a single plant, vacancies and temporary layoffs will not occur at the same time. However, when we aggregate over nonhomogeneous labor types, vacancies, recalls, and layoffs can all occur simultaneously in the same plant.

In the following discussion the principles can be shown most clearly by considering the determination of vacancies, recalls, and layoffs for one particular type of labor at a single plant, without the complexities of aggregation.

Firms recognize that a certain amount of time will be required to recruit, hire, and train new workers, or to recall old ones, i.e., there is a lead time in hiring workers. Consequently, new vacancies need to be created in anticipation of future needs, both to compensate for expected losses of the work force through quits, retirements, and

terminations during the lead time, and to build up the work force for higher production levels that may be desired in the future. Thus we would expect that the net flow of new vacancies (v) through the creation or cancellation of vacancies (as contrasted to the filling of vacancies) would be initiated by firms in order to maintain the stock of vacancies (V) at the level determined by the following relation:

$$V_t = \max\left[(E_t^* - E_t) + (\hat{q}_t + \hat{r}_t + \hat{l}_t)\, T_v + (\hat{\hat{E}}_t^*)\, T_v\,, 0\right]. \qquad (6)$$

The first component is the present gap between desired and actual work force. The second term provides for the anticipated quits, retirements, and terminations that will take place during the average lead time T_v for hiring and training new workers and/or recalling old ones (anticipated flows are designated by the caret [$\wedge$]). The last term provides for the growth or contraction of the desired work force during the lead time, where $\hat{\hat{E}}^*$ is the forecast change per period in the desired work force. Note that the last two vacancy components are associated with normal replacement and growth. Only the first component reflects a current labor shortage or surplus for the firm.

To understand (6) it may be helpful to look at the work force that will be desired in the future at time $(t + T_v)$ on the left of the equation below, and add enough vacancies on the right to hit that target:

$$E_t^* + \hat{\hat{E}}_t^*\, T_v = E_t - (\hat{q}_t + \hat{r}_t + \hat{l}_t)\; T_v + V_t. \qquad (7)$$

In this case we assume that the firm is actively recruiting. Hence layoffs are those terminations involving individual workers whose performance is unacceptable rather than those for the intentional reduction of the work force. When a worker is hired, V_t declines by one and E_t increases by one, thereby maintaining the equality with the expression on the left.

Recalls

If the work force of a firm needs to be increased and workers that previously have been laid off are still available, new vacancies often can be filled quickly by recalling former employees. This has the effect of reducing the average lead time T_v to recruit an effective

worker for the job. We should note the distinction between recalls *ordered,* i.e., recall vacancies, and actual recalls. Some recall vacancies cannot be filled because the workers have taken other employment.

The search for new workers clearly is more involved than the recall of a well-known former worker. In a more refined analysis, account should be taken of this distinction as well as the gradual attenuation of the stock of laid-off workers that takes place with the passage of time. Also, the expectation of recall affects the search activity of the worker who has been laid off.

Layoffs

When a smaller work force is desired, the level of vacancies is lowered and the work force is reduced through quits, retirements, and terminations. However, when vacancies have been reduced to zero, so that no new hires or recalls are ordered, further reductions in the labor force will necessitate layoffs. The layoffs during a period should be given by the following relation:

$$l_t = \max [E_{t-1} - E_t^* - \hat{r}_t - \hat{q}_t, 0], \tag{8}$$

where E_t^* is the work force desired by the firm at the end of the period.

Wage Offers

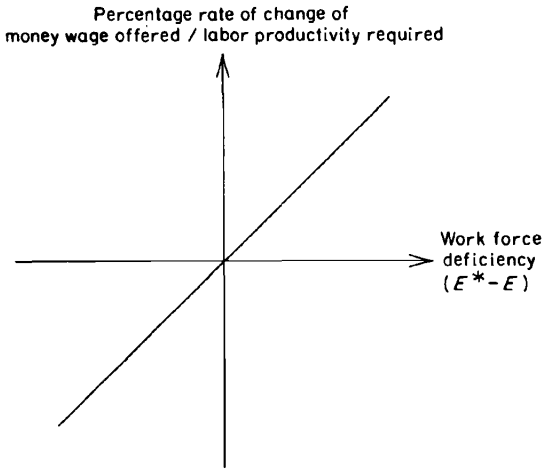
If new hires are not successfully made to fill the job vacancies during the expected lead time, the company will have a smaller work force than desired. It would then face the following costly alternatives: working overtime, losing sales, or reducing inventories to a level lower than desired. Hence the company has an incentive to reduce the vacancies, even at the penalty of raising its unit labor costs. This cost increase may take the following forms: raising the money wage rate of the job, reclassifying the job into a category that carries a higher wage rate, and/or lowering the productivity standards that the worker must satisfy by accepting less skill, experience, etc.

The more unfilled vacancies there are, or the longer the lead time required for hiring, the greater the likelihood that the firm

will have a work force smaller than desired (see equation 6) and will raise its unit labor costs in an effort to increase the effectiveness of its recruiting efforts (see Figure 2). As these more attractive offers are made, the labor deficiency tends to decline because of more effective recruiting and possibly because of reductions in the size of a desired work force that has now become more costly. Since productivity standards determine the number of prospective employees

FIGURE 2

Response of Wage Offers to Excessive Vacancies Reflecting a Deficiency in the Size of the Work Force



that would be considered acceptable, while the wage level affects the probability of workers accepting, the success in filling vacancies should be directly affected by these changes in recruiting behavior.

The opposite arguments apply if vacancies are quickly filled and the work force is larger than desired; the firm will tend to lower its money wages and raise its productivity standards for new employees. The firm is likely, if it is permitted to do so by the union, to lay off its less productive workers during periods of low production. If replacements are needed, they can be obtained from the pool of the unemployed.

Unstable queuing occurs when firms speculate on availability by placing orders for materials in *anticipation* of shortages, i.e., longer lead times may also develop in the labor market. Firms anticipating that the time to find and hire suitable employees will increase, will tend to increase the number of vacancies (see equation 6). If other firms do likewise, the general increase in the number of vacancies will increase the average lead time for hiring a worker. (This point is clearer in equation 15.)

A high quit rate necessitates hiring and training replacements at considerable cost to the firm. Hence, firms have an inducement to raise wage rates of their current employees and advance them internally to better jobs when quit rates are high. However, firms will tend to take advantage of the fact that their present workers are committed in a variety of ways to the company, and hence will not *fully* meet the current wage offers being made to prospective new employees unless a union intervenes.

We recognize that unionization may influence the relationships suggested, but we have not developed a theory of its effect. Since unionized workers are a minority of the American work force, and unions with substantial market power affect an even smaller group of workers [71], it may not be unreasonable to view the above as a first approximation.

THE LABOR SUPPLY

The exact motivation of the worker in offering his labor in the market has been less carefully explored and is less easily derived from simple assumptions than are the cost-profit motivations that influence firm behavior. We assume that basically the worker controls whether and on what terms he seeks work in the market and whether he quits his current job. The theory could be elaborated to permit limited choice of hours of work on his job, slowdown, absenteeism, etc.

Labor Market Entry, Exit, and Retirements

Motivations to work are strongly influenced by the worker's family role as income earner and/or as the supplier of services.

Other strong influences are the number of children or other dependents and the living standards that are deemed acceptable by the family.

The principal change in the size of the labor force during cyclical fluctuations in the short run stems from the participation decisions of secondary workers—mainly the young, the aged, and wives. Primary workers, on the other hand, are nearly always in the labor force; their important change in status is from employed to unemployed.

In addition to the choice between work for money and leisure, secondary workers have open to them such options as formal education, housework, and child care. This permits them a flexibility which results in a relatively elastic supply of labor. We could expect on a priori grounds, and indeed we have empirical evidence, that secondary workers would be highly responsive to changes in wage rates in deciding whether to enter or not to enter the labor force. At the same time, the influence of the income effect on work choices makes it important to know about the employment and earnings of the chief breadwinners in the families of secondary workers [12, 32, 40, 43].

An important link exists between the employment status of primary workers and movements in and out of the labor force by secondary workers. When the head of the household becomes unemployed, other family members seek work as a means of maintaining the family income. The length of time spent by the unemployed worker in search for a job and his acceptance wage will be related to the earnings of other family members. The presence of family members who are dependent and unable to work would be a sharp spur to maintain or regain employment even on onerous terms.

It is clear that slumps in business activity set in motion two opposing forces with respect to labor force participation choices of secondary workers. Declines in family incomes because of the unemployment of primary workers stimulate participation; lower wages and decreased vacancies discourage participation. Preliminary results of research with aggregative data indicate that the effect of unemployment in the market is on net to diminish the participation in the labor force of secondary workers. This consti-

tutes a hidden cost of unemployment of considerable magnitude [13], and is one reason for broadening the concept of unemployment suggested earlier.

To examine the labor supply decisions that are made within the family unit, detailed data are almost indispensable. In addition to the obvious requirements for information on the standard demographic variables and data on the work status and work histories of the family members, we need to know how these relate to the income and asset position of the family, the composition of assets, including home ownership, the geographic residence of the family, etc.

The unemployed worker's decision to withdraw from the work force rather than continue his job search is influenced by the duration of unemployment, eligibility for unemployment compensation, liquid assets, contractual commitments, and local labor market vacancies [43]. The last are particularly important for older workers whose investment in housing precludes moving to other areas.

Temporary retirements are influenced by childbirth, illness in the family, return to school, seasonal factors, etc. Permanent retirements depend on age, health, pension rights, wealth [19, 32], etc.

Quits

Workers voluntarily quit for a wide variety of personal and transitory reasons, but also for economic reasons. When the number of vacancies is high, a worker will have a relatively good opportunity to find a significantly better job from the many available. Every vacant job that is more attractive than his present one constitutes an opportunity for advancement, if he can qualify; and the standards for qualifying will tend to lower as the result of a prolonged high stock of vacancies. Clearly if the wages offered in the market are higher than those being paid in present employment, workers who think that they can qualify for the new jobs will be inclined to quit their present jobs.

The chance of succeeding *quickly* in the search for a better job without a long period of lost earnings is better when vacancies are high, i.e., the average duration of unemployment will fall with increases in the number of vacancies available. If jobs are sufficiently

plentiful, a worker may find a new job while still working at the old job.

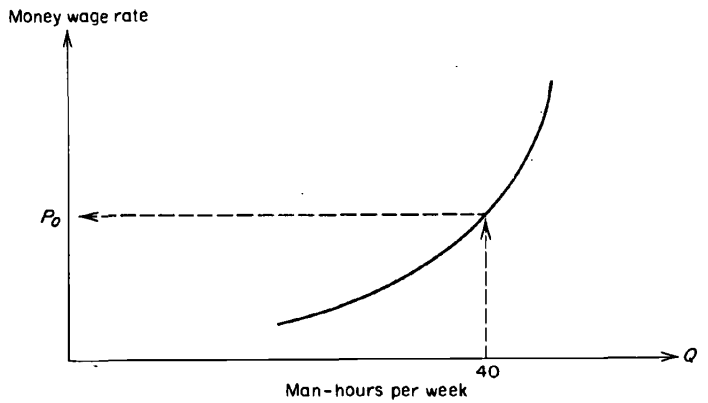
In a tight labor market, the chance that a man can find an offer of a better job is enhanced both by the rising wage levels and by the downgrading of skills required for a given position. Workers are attracted both by the opportunity to move up the industrial skill ladder and by a pay boost.

Labor Supply and the Acceptance Wage

A direct application of classical analysis would show the supply curves for an individual worker shown in Figure 3. This would indi-

FIGURE 3

Supply of Labor



cate that at a low wage rate the worker would only take part-time work of perhaps 10 hours per week. At a higher wage rate he would take a full time job, but through absenteeism would work only a 35-hour week on the average. At wage P_0, the worker would work a full 40-hour week. At sufficiently high wages he would "moonlight."

While such a supply curve may suffice in describing secondary workers, it is hardly satisfactory as a description of the behavior of the family's breadwinner who is likely to be offered a full-time job on a take-it-or-leave-it basis. We cannot really think that a worker would accept *permanent* unemployment if the highest offering wage to be found is below a rigid acceptance level P_0. Nor do we observe

cases of such deliberate choices to remain unemployed while the unemployment compensation runs out and the family starves. To be sure, rare cases may fit this model, but it is hardly adequate to describe the general behavior of labor markets.

A better hypothesis would be that the unemployed worker's supply curve continually drifts downward as he becomes more and more discouraged, and as the family's financial and emotional resources are consumed by continued failure to find an acceptable job. As the job search continues without success, the weight of experience accumulates to convince the worker that high aspirations are not likely to be fulfilled in the present situation. Thus, the accumulation of information tends to lower aspirations toward levels that are more compatible with the jobs currently being offered.[6] The lower limit on the acceptance wage undoubtedly will reflect the unemployment compensation that is available.

The *downward drift of the supply curve* seems a much more important phenomenon in describing the unemployed worker than the graduation of working time vs. wage rate emphasized by the supply schedule itself, although both may be useful. Thus a relevant analysis is to use the acceptance wage P_o for a full-time job, and emphasize its dependency on duration of unemployment (see Figure 4). If the worker is offered a wage greater than P_o he accepts it; but with continued unemployment the acceptance wage gradually falls. There is some empirical support for this hypothesis [61].

This behavior of an acceptance wage is closely related to the aspiration level mechanism which has been subjected to consider-

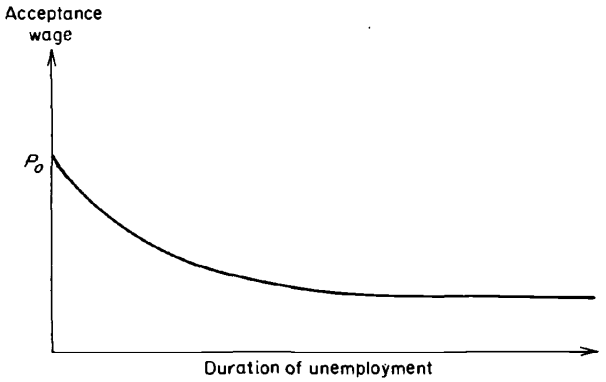
[6] The formal theory of search is in a very primitive state in general. One of the pioneering articles appeared in 1953. See [31] for subsequent work.

Two interesting models are in the economic literature. H. A. Simon [60], in analyzing the sale of a house, assumed that only one offer was received at a time and that sequential decisions had to be made to accept or reject each offer individually. George Stigler [62], in analyzing the labor market, assumed that offers could be *accumulated* by extending the search, but at a cost; ultimately the best offer was accepted. Market search gradually runs into diminishing returns.

Both of the models are purely normative. Much more work needs to be done to develop a model that adequately reflects the sequential nature of the decision problem, the increase in information that comes with search, the financial cost of search, and the influence of changes in aspirations. Also stochastic learning theory would seem to have some relevance for understanding the behavior of the unemployed worker [11, 64].

FIGURE 4

Acceptance Wage for a Full-Time Job



able study. Social psychologists find it a basic phenomenon often observed in human decision making. The worker presumably starts his job search where he thinks his chances of finding an acceptable job are best, and gradually explores the less and less promising opportunities. However, if his initial acceptance wage is high relative to the opportunities in the market, a considerable period of unemployment may elapse as his acceptance wage declines and the probability increases of his finding an acceptable offer. Employers may interpret extended unemployment as evidence that the worker lacks merit and this may reduce the probability of employment. If so, this may contribute to "hard core" unemployment. These tendencies may cancel so that the probability of finding a job per period of time is nearly constant or at least changes slowly.

Effect of Quits and Layoffs on the Acceptance Wage

The initial acceptance wage P_0 for the worker who has been laid off or terminated would probably be approximately the wage that he had been receiving and presumably would have been satisfied to continue accepting. The acceptance wage for the laid-off worker may be virtually constant as long as he has hopes of recall, but will fall later. However, for the worker who quit his old job to seek a better one, the initial acceptance wage would probably be higher

than his previous wage. Thus the worker who quits tends to have a higher aspiration level than the worker who is laid off.

General Determinants of Family Decisions

In the case of the business firm we found that a fairly complex dynamic analysis of costs and benefits throws considerable light on the concept of desired work force, which in turn is the basis for determining job vacancies. The foregoing consideration of the family suggests that a dynamic analysis of costs and benefits may help to clarify the concept of desired employment. Clearly the family's desire for work depends on such dynamic phenomena as habit persistence in consumption, contractual saving, and psychological costs and benefits of the process of work itself.

The assumptions of rational behavior probably will need to be extended considerably in the case of the family to take account of the limitations of its decision-making time and talents, and the costs of obtaining relevant information. The employment desired by a family member depends on many factors as outlined above. The search process may prove so costly and unproductive that it is dropped, and with good reason, but the person may still be unemployed in a significant social and economic sense.

THE MARKET FOR WORKERS AND JOBS

The two-sided search process of workers for jobs and firms for workers yields a flow of new hires plus recalls $(h + c)$, which would tend to reduce both U and V except for offsetting inflows. The wage agreements that are made in this process collectively constitute the level of *market* wages.

The flows in the labor market are important even when the stocks are unaffected. For example, an employed person may search the job market, quit his current employment, and move almost immediately into a job vacancy. This turnover transaction leaves the stocks virtually unchanged. Because he is unemployed for a very short time, unemployment is little affected and the early appearance of a replacement vacancy leaves vacancies little affected except possibly in composition. However, this flow is likely to increase the

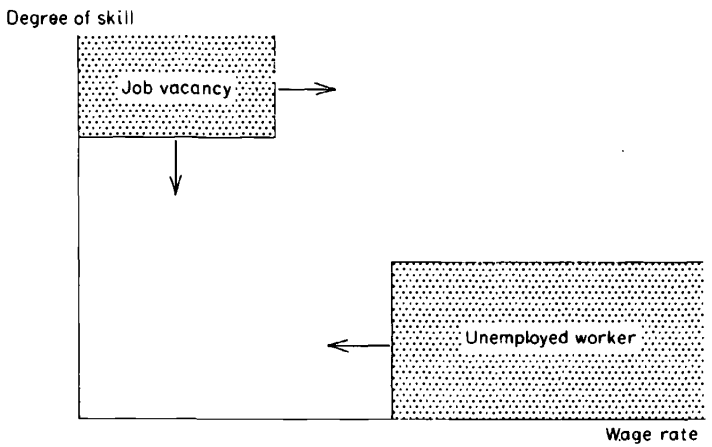
money wages of the worker, and often this is the prime motivation for such a move.

The likelihood of filling vacancies depends on the number of unemployed workers with the necessary qualifications, on the effectiveness of their search in finding the available vacancies, and on their willingness to accept the jobs at the wages offered. For the worker, considerable time may be consumed in locating vacancies that come close enough to his requirements to merit investigation. Even then, a job may be accepted only to be quit a week later and the search continued. On the company side, the economic productivity of a potential worker is difficult to predict and often requires time-consuming interviews, etc. Thus considerable delay is involved for both worker and job vacancy while the search for a satisfactory match between job and worker takes place.

Since the worker offers maximum skills and specifies minimum wage, and the vacancy specifies minimum skills and maximum wage, there is a conflict of interest in striking the individual wage bargain. In Figure 5, the shaded areas indicate points that are acceptable to firm and worker, respectively. The lack of overlap of the shaded areas indicates that an inquiry by this worker about this job is unlikely to result in a hiring agreement *at this time.* His acceptance wage is too high and the skill requirements are too high.

FIGURE 5

Nonmatching Vacancy and Worker



It is clear that finding an acceptable job is a rather difficult and time-consuming search process. The complex random process of job seeking and finding arises from the nonstandardization of jobs and workers and the lack of perfect knowledge. This accounts for the *simultaneous* existence of unemployed workers and job vacancies, a situation not contemplated in classical economic theory, in which there may be excess supply or excess demand but not both.

The typical worker enters the labor market with an initial acceptance wage which is higher than the wage he is likely to be offered immediately.[7] Offers below his acceptance wage will be rejected as he will prefer to search further rather than accept. As his search continues and his acceptance wage falls, he will ultimately encounter an acceptable offer, but the time required involves a large element of chance. On the other side of the market, firms try initially to hire very productive workers at low wage rates. If the firm fails in this, it gradually extends offers to less productive workers or offers higher wage rates. These changes in worker and vacancy which take place with the passage of time are indicated by the arrows in Figure 5.

Stochastic Equilibrium in the Labor Market

The dynamic solution of such a complex stochastic process usually is unobtainable by present analytic methods, although simulation methods by electronic computer can often be used to obtain practical results. In the absence of either of the above methods, a rough outline of the equilibrium solution can be surmised. Since the average duration of unemployment is of the order of a few months, this process is probably close to stochastic equilibrium over the course of the business cycle, so that results derived from the assumption of stochastic equilibrium will suffice as a first approximation. The unemployed workers and job vacancies flow into the market and accumulate until the acceptance levels drift down far enough to meet the offering levels which are drifting up. As these levels meet in random pairings of jobs and workers, hiring transactions increase until an equilibrium is reached such that the out-

[7] The house seller who sets a high price and gradually lowers it as he gets the feel of the market is a relevant parallel.

flow from the market equals the inflow, and the stocks of unemployed workers and job vacancies are stabilized at constant levels.

Viewing the labor market as a whole, it is clear that the level of unemployment, i.e., stock of unemployed workers, is determined by the inflows and the outflows. When unemployment is at a constant equilibrium level, the total inflow will equal the total outflow. The same applies to vacancies. Also note that the hiring or recalling of an unemployed worker reduces by one the stocks of *both* unemployed workers and vacancies. Hence, in equilibrium, this outflow of vacancies through hiring and recalls equals the inflow of vacancies, and also equals the net inflow of unemployed, i.e.,

$$h + c \approx v \approx l + q + e - w. \tag{9}$$

Indeed, these equalities are nearly maintained even when the market is not in equilibrium because the flows are so large relative to the change in stocks. For example, an increase of unemployment of 5 per cent in a year would be a large change in this stock, but this compares to a flow *through* the American labor market during the year of between 24 and 36 per cent of the employed work force, as noted earlier. Thus we see that relatively small deviations in these large flows from the equality relationships can produce the changes in the stocks that are observed. However, the composition of the flows through the labor market may change drastically over the cycle; for example, the relative magnitude of quits and layoffs, both of which are flows of workers from jobs into the unemployed category, are subject to large changes. When layoffs are high, voluntary quits are low, and vice versa.

Hiring Flows and the Durations of Unemployment and Vacancies

Because the hiring process involves much random search, it is best analyzed in probability terms. The flow of new hires depends on the number of unemployed workers and the probability per unit of time of their finding an acceptable job. In equilibrium this probability will depend on the number of job vacancies available to find and choose from. In its simplest form we would expect that the probability per period of time P_u that an unemployed

worker would find an acceptable job vacancy is in direct proportion to the total number of vacancies available, i.e.,

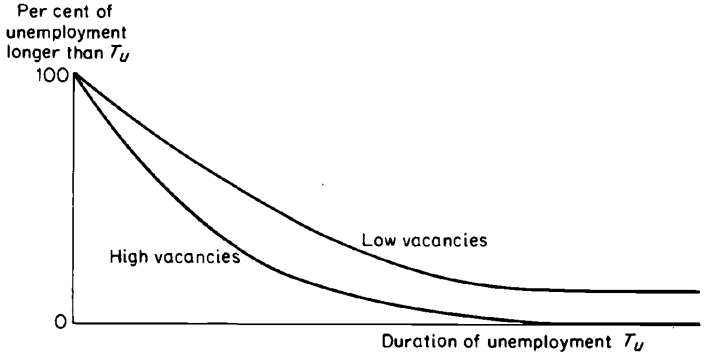
$$P_u = kV, \tag{10}$$

where k is a constant.

Thus, if the vacancy level changes slowly and other factors that might affect this probability are of secondary importance, we would expect to observe an exponential distribution for duration of unemployment. Furthermore, this distribution should change systematically over the business cycle with changes in the level of vacancies (see Figure 6). These hypotheses seem to receive considerable support from the work of Woytinski [72] and Berman [3], although there is some tendency for the probability of employment to fall with longer durations of unemployment.

FIGURE 6

Duration of Unemployment



It follows further that the flow of new hires plus recalls in a period is the product of the number of unemployed and the probability that each will find a new job in the time period or be recalled to an old one:

$$h + c = U P_u; \tag{11}$$

or using equation 10,

$$h + c = k UV. \tag{12}$$

By analogous reasoning we would expect that the probability per period of time P_v that a vacancy would be filled with an acceptable worker would be proportional to the number of unemployed workers available from which to choose.

$$P_v = k\,U \tag{13}$$

Again we would expect an exponential distribution of the duration of a vacancy, and this distribution would be expected to change systematically over the business cycle. Perhaps hard-to-fill vacancies would show some decline in the probability of being filled as durations increase.

Figure 7 shows a plot of John Myers' data on duration of vacancies in Rochester, New York (see Table 4 of his article in this volume). The anticipated straight line on a semilog plot seems reasonably supported.

The flow of new hires plus recalls should be the product of the number of vacancies (V) and the probability (P_v) of each being filled per period. Thus, again we obtain equation 12 for the hiring and recall flow. Although the stocks and flows in the labor market are cyclically active, the total of new hires and recalls (total accessions) does not fluctuate proportionately as much as unemployment and vacancies. Consequently, using equation 12, we would expect to find U and V negatively correlated (a rise in unemployment being accompanied by a fall in vacancies, and vice versa) and when plotted on log-log paper would fall close to a straight line with a slope of $-45°$. The former point is in general consistent with Charlotte Boschan's findings reported in this volume, and the latter roughly consistent with the work of Knowles and Kalacheck (see [69], Chart 15, p. 73).

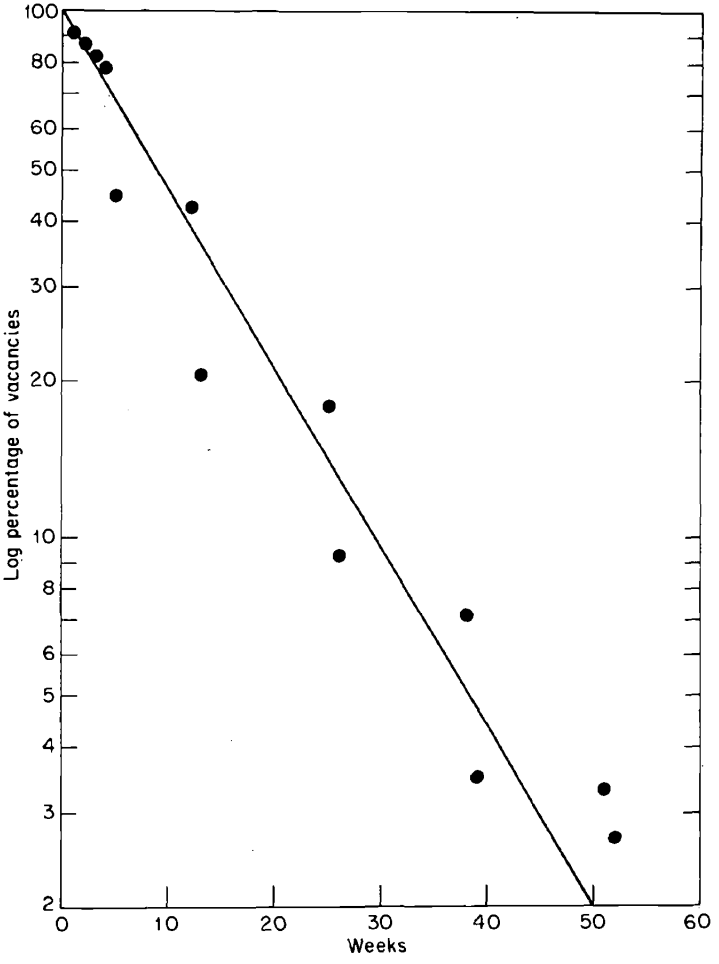
Since, in equilibrium, the average duration of unemployment T_u will be the stock U divided by the flow $(h + c)$, and similarly for the duration of a vacancy T_v, we have, using equation 12:

$$T_u = \frac{U}{h+c} = \frac{1}{kV} \tag{14}$$

$$T_v = \frac{V}{h+c} = \frac{1}{kU}. \tag{15}$$

FIGURE 7

Duration of Vacancy



Thus the average duration of unemployment is directly related to unemployment and inversely related to vacancies, and the reverse for vacancies.

Wage Determination

The larger the number of unemployed, the longer on the average

they are unemployed (equation 14), and the longer they are unemployed the lower their acceptance wage (Figure 4). Since firms will try to hire the most productive men available for the wage offered, they will tend to pay the lowest wage acceptable to the workers. Hence with a steady flow of workers through the market we may expect a relation in equilibrium between the rate of change of money wages and the level of unemployment.

If equilibrium occurs with *low* unemployment and high vacancies, then every worker who passes through the market is likely to receive an increase in money wages. As much of the working population gradually passes through the labor market, and the wages of those who don't are raised to prevent their quitting, the whole money wage level will steadily rise. Firms and unions would both tend to push up the wage rates of the workers who didn't quit in an effort to keep up with the market rates for new workers.

If, on the other hand, the equilibrium occurred when unemployment was *high* and vacancies low, the workers would stay in the market until wage rates lower than had been previously received become acceptable, and wage rates would fall steadily.

We assume that fluctuations in the labor market arise primarily from the demand side. An increase in sales leads sequentially to increases in production, man-hour requirements, desired work force, vacancies, and employment. Finally, unemployment declines.

Now we may drop the assumption of equilibrium in the labor market and examine what will happen if aggregate demand starts to increase. This will lead to an increase in the desired work force; E^* is positive. From equation 6 we see that vacancies increase, and with more vacancies available we would expect the quit rate to rise. The layoff rate would decline, as is clear from equation 8. The composition of the unemployed gradually shifts, so that there are fewer unemployed workers laid off and more who voluntarily quit. Since the latter have higher aspiration levels, money wages rise even faster. Hence, the rate of increase of money wages at any given level of unemployment is greater if unemployment is falling than if it is constant. The opposite sequence of events occurs for rising unemployment.

UNION BARGAINING

The operation of the labor markets that has been described constitutes the economic environment in which union-management bargaining takes place, and the conditions in this market influence strongly the relative bargaining power of the parties. For example, when there are few unemployed workers available and the quit rate is high, firms have an incentive to raise their wages in line with competitors in the labor market, even without union pressure. Such circumstances will tend to tip the bargaining in favor of the union; conversely, high unemployment favors the management side. The outcomes of the bargaining process in turn affect the labor markets.

Clearly, the institutional structures for decision-making in firms, unions, and government, the bases of bargaining power and influence, and the bargaining strategies of the participants, introduce problems of analysis that go far beyond this theory of the labor market. Although relevant to the present analysis, extension of the theory to encompass this complex area is not attempted here.

IMPLICATIONS FOR RESEARCH AND POLICY

The foregoing theoretical framework raises more questions than it answers, and invites tests, revisions, refinements, and applications in many directions. Its value will depend upon its usefulness in bringing empirical and theoretical problems into sharp focus. It has been possible from logical extensions of the above theory to derive mathematically the Phillips' relation between percentage of unemployment and its rate of change, and the percentage rate of change of wages [25]. These conclusions are in general agreement with Phillips' empirical results [49], and hopefully are a first step in explaining them. The following is a sketch of some areas where the proposed theory may be applicable.

A Stochastic System as a Model of the Labor Market

If we could achieve a quantitative model of the labor market from which reliable predictions could be drawn, we would take a significant step forward, both in understanding a complex area and

in obtaining an important tool for policy use. The theory proposed here suggests that (1) the market is a complex system involving many important relationships, and (2) the heart of the process is the random interaction between unemployed workers and job vacancies. If this is true, we are challenged with the need to study a large number of relationships, to fit them into a stochastic system and learn how to manipulate it for validation and application.

It might appear that the theory as presented visualizes a single labor market free of occupational and regional distinctions. In a sense this is true because the possibility of marginal substitutions means that some random diffusion of both workers and vacancies occurs across all boundaries of conventional classifications. Nevertheless, it is clear that the probabilities of crossing certain barriers may be low, and the model should be developed to reflect this. Much more work is needed to identify the occupational groups and regions *within* which movement is easy, and to find the paths between those occupational groups and regions which are most likely to be used when more substantial adjustments are required. We need to extend the theory of the worker's search for jobs to describe the extent to which workers invest time and money in searching markets successively more remote in occupation and location from their previous employments.

All the major parts of this formal framework of the labor market require estimation and testing. Furthermore, it is clear that we must use simultaneous-equation estimating techniques, if we are to obtain parameters that accurately reflect the underlying behavior of families and firms. Lack of data especially suited to estimation of the model may force the artful combination of existing time series data with available cross-section materials to obtain a model of the market that can be simulated.

A first step in the research might be to estimate a macroeconomic model of the manufacturing labor market, using available data on turnover, vacancy indexes, wage levels, and production. This should be useful in showing the rough dynamics of wage movements in response to sales and production.

Substantial development of both theory and empirical sources of data are required to explore the conditions under which workers

choose to quit jobs and the process by which they locate new employment. Such work clearly needs to be carried out to test the model of wage aspirations that we have sketched in the supply side of the market.

Because of the limited mobility of workers in the short run, it may prove extremely valuable to explore the response of a local labor market using this model. In relatively small markets it might be possible to estimate parameters determining the decisions for optimum production scheduling and work force for individual firms, and to study the reactions of individual families through survey techniques.

Careful attention should clearly be given to making estimates of the cost of job search to the individual, and the economic pressures that determine the rate of decline of acceptance wages. Such work has been begun by Cohen, Haber, and Mueller [14].

Clearly, the model needs to be elaborated to account adequately for recall of workers and the ties that hold them to their former employment. Turnover associated with no intervening unemployment must also be admitted. However, the dynamic formulation of the behavior of firms and workers suggested above will continue to be the core of these more elaborate theories. Vacancy data are critical to the whole effort, as they are vital to any estimate of how the market operates stochastically to induce flows of newly hired workers. Ideally we should have sets of detailed time series data on a representative sample of firms and families. If panels were organized for this purpose now, we would gradually accumulate the kind of data that is needed to advance our fundamental knowledge.

Costs and Benefits

The detailed study of the behavior of market participants leads naturally into a consideration of the costs and benefits that are involved. For example, estimates of the costs of unemployment and vacancies, taking account of durations, will throw light on the policy choices that need to be made. Similarly, the costs of job search, mobility, recruiting, and training can be weighed against the costs of vacancies, unemployment, and the benefits of increased productivity, when the stochastic relationships are better known.

Inflation and Unemployment

If there were no fear of inflating the price level, unemployment could be wiped out simply by increasing aggregate demand. Hence, the relation between wage rates and unemployment is of crucial importance. Phillips' work indicated that a steady drift of the wage rate was associated with a given level of unemployment and the rate of change of unemployment. The fact that this drift rose sharply at low levels of unemployment came as no surprise—the full employment ceiling was being approached. But we had little insight into the determinants of this relation whose existence has now received empirical support from the data of several countries including the United States.

The theory presented above suggests the mechanisms at work. When vacancies are scarce and unemployment is high, an unemployed worker has a relatively small chance of connecting successfully with a job, per week of job search. Consequently, on the average, the duration of unemployment is long and the unemployed worker's aspiration level falls. The acceptance wage declines substantially from levels prevailing at the time of last employment. The employers, facing a large number of job applicants, try to hire the best men for the wages that are offered. If unemployment is high enough, and the average duration of unemployment long enough, the hiring wage may be lower than that the men were receiving at the time that they became unemployed. The consequence is a gradual downward drift of the money wage level as workers gradually pass through the market.

Conversely, when vacancies are many and unemployment is low, the unemployed have a high probability of being offered acceptable jobs per period of time, and consequently experience a short duration of unemployment on the average. Their wage acceptance levels are correspondingly high. If employers are going to succeed in hiring workers, they will pay the high money wage or accept lower productivity in positions with a given title. When the contract wage is higher than the wages previously received by the worker, the wage level drifts upward. The lower the level of unemployment the faster wages rise.

Corresponding pressures to adjust wages arise through the changing relative importance of quits and layoffs at different stages of the business cycle. Even if such pressures are ignored, we see that the Phillips' relation depends critically on (1) the speed with which men and jobs are matched in the labor market, and (2) the rate at which the unemployed worker's acceptance wage falls with extended unemployment. The former depends primarily on the speed of communication, transportation, interviewing, information processing, etc.; the rate of change of acceptance wages depends primarily on a psychological aspiration level mechanism, but also on the information on which the worker bases his expectations.

Furthermore, we can predict that a similar relation can be found between the rate of change of wages and the number of job vacancies divided by the size of the work force. This relation also will depend on the speed of the search process; in addition, it will depend on the rapidity with which employers respond to labor shortages by raising effective wage rates. Employers' wage responses, in turn, are the product of complex interactions among inventory levels, capacity use, capital-labor substitution potentialities, and the possibilities of expanding overtime hours.

Further study will be required to determine how much light this model and its refinements throw on our policy choice between inflation and unemployment.

Structural Unemployment and Mobility

If we should find, as is likely, that the experience of unemployment not only depresses the acceptance wage, but also the search activity, then presumably the probability of finding a job would decrease for the long unemployed. This would tend to perpetuate the duration of unemployment for the long unemployed. Other influences that would inhibit search might play a role, such as the declining financial and emotional resources to continue the search, or the lack of resources to move to new locations and locate distant opportunities.

If the unemployed worker's aspiration level in terms of wage and occupation did not fall with the passage of time, there might be a complete failure of the individual to make a needed adjustment.

Although this is not likely, certain groups may adjust slowly or have very large adjustments to make, thereby "requiring" relatively long unemployment to achieve the adjustments.

Similar adjustment problems could occur on the hiring side. If employers did not raise the wage offers for job vacancies that were long unfilled, not only would this inhibit production, but the lack of sufficient incentive might prevent qualified workers from shifting to these vacancies, thereby precluding the "upgrading" process that would create more easily filled vacancies at the lower level.

Development of quantitative estimates of parameters are clearly of major importance for creation of policies to deal with unemployment. Estimates of the value of k in equation 12 will give a quantitative notion of the effectiveness of present information channels in bringing together workers and vacancies in compatible combinations. Some preliminary estimates by the authors suggest that k depends on the duration of unemployment. This phenomenon requires some elaboration of the underlying theory, but it is certainly suggestive of the important qualitative differences in skills of short- and long-term unemployed that have already been observed.

The implications of such differences for job counselling and the process of job search certainly ought to be developed by empirical study. Simulation of the model with alternative values for the parameter k will give policy-makers some idea of what changes in the unemployment rate can be anticipated if the job search process can be made more efficient.

Manpower Projections and Training

Many vacancies are associated with labor turnover, as workers circulate from one employer to another and as retirements are replaced with new employees. Others are associated with company growth. Only the first component of vacancies in equation 6 reflects a labor shortage. Consequently, vacancy data and plan-to-hire data must be used very carefully in drawing inferences about the aggregate manpower requirements for the country in various occupational categories. Stated differently, we must be careful not to confuse flows and stocks.

The theory suggests that data collected from companies on their

projections of desired work forces (which are stocks) classified by occupation might be useful for training programs and other manpower planning. If vacancy data are used, they must be carefully corrected for quit rates, etc. For example, a company with just the right number of tool makers will *always* have vacancies for tool makers to replace those who quit to work for other companies. Because it takes time for the search process required to fill a vacancy, a company will not wait to *start* its search until the worker is needed. Instead, it will create a vacancy in anticipation of the need.

There is a clear trade-off between the costs of retraining a man for a job at hand and the cost of a man's search for a job that will use the skills which he already has. Only when we better understand the operation of the labor market will we be prepared to handle the policy choices between subsidizing job-worker search, mobility, and retraining in our efforts to find the best response to technological change.

The authors do not want to claim too much for their efforts, but it does seem clear that much interesting work lies ahead in trying to answer the many questions raised. They propose to pursue research based on this approach, hope that others will be attracted to do so, and welcome all comments and criticisms.

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