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THE REPLACEMENT OF THE UV-CURVE WITH A NEW MEASURE OF HIRING EFFICIENCY

by

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ABSTRACT

In this paper we show that changes in the position of the UV-Curve do not unambiguously reflect changes in labour market adjustment ability. In fact, the UV-Curve is displaced not only when hiring efficiency changes but also when the volume of hiring changes. To identify changes in hiring efficiency, we should use the relation between either the duration of vacancies and the stock of unemployment or, alternatively, the duration of unemployment and the stock of vacancies. These measures are applied to Swedish data and produce interesting new evidence on the hiring efficiency of the labour market in Sweden.

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Introduction

Since the article by Dicks-Mireaux and Dow (1958) the relationship between the stock of unemployed U and the stock of unfilled vacancies V - or the UV-curve - has been used as an indicator of the degree of flexibility in the labour market. These authors claimed that at a given degree of flexibility changes in labour demand correspond to movements along a rectangular hyperbola in the UV-plane, while an outward shift in this curve indicates increased 'maladjustment' in the labour market.

The UV-curve was introduced in the same year as the Phillips curve and appeared to be a natural complement to it. As dynamic price theory at that time predicted that the rate of change of money wages is a function of the excess demand in the labour market and excess demand ought to be measured as the difference between the stock of vacancies and the stock of unemployed, a stable UV-relation ought to be the basis of a stable relation between money wage changes and unemployment.

The interpretation of shifts in the UV-curve as changes in 'ability of adjustment' or 'flexibility' was almost self-evident within a neoclassical conceptual framework. The only real embarrasment was caused by the neoclassical implication that unfilled vacancies and unemployment cannot coexist in one market. To reconcile theory with facts it was thus necessary to assume that the labour market

consisted of several imperfectly connected submarkets, where either unfilled vacancies or unemployment could persist. Hansen (1970) showed that several restrictive assumptions, unlikely to be met in practice, are needed to yield a stable aggregate UV-curve under such conditions.

By the time Hansen wrote his article the theory of labour market dynamics was undergoing a drastic change, as models of search under imperfect information in a few years completely replaced the neoclassical models. With special regard to the analysis of vacancies and unemployment in a search theoretical framework the pioneering work was done by Charles Holt in a series of contributions (notably Holt and David (1966), Holt (1970)).

It is the aim of this paper to demonstrate that the position of the UV-curve cannot be given the traditional interpretation as an indicator of 'flexibility' or 'adjustment ability', when it is regarded as the outcome of search under uncertainty in the labour market. It is remarkable that this conclusion can be reached without adding anything substantially new to the analysis by Holt. As a matter of fact it seems as if Holt overlooked those elements in his own analysis which pointed to a reinterpretation of the UV-relation. It also appears reasonably clear that this happened because of the strong influence of the Phillips curve (see below).

The interest in the UV-curve reached its peak in the mid-seventies, but the research was almost exclusively empirically oriented. Since then the apparently capricious behaviour of the UV-curves in different countries has produced a diminishing con-

fidence in its usefulness. Still, the following quotation is representative of the current state of opinion: 'Another common test of the working ability of the labour market is the so called UV-relation ... If this relation changes so that one observes higher unemployment at a given vacancy rate, or a higher vacancy rate at given unemployment, it is a sign of worsened matching ability in the labour market' (Åberg (1982), translated from Swedish).

As an authoritative example of the wavering belief in the UV-curve analysis (or the 'Beveridge curve' as it is nowadays often called) we may quote a recent OECD Working Paper: 'Another possible, though indirect, indicator of labour mobility, which must, however, be used with considerable caution, is the relationship between vacancy and unemployment rates. On ... strong assumptions ... increased labour market mismatches are indicated if vacancies and unemployment rise simultaneously. Inspecting the 'Beveridge curves' for twelve OECD countries points to outward shifts since the late sixties or early seventies in several countries ... However, ... there does not remain much, if any, support for the notion that labour market mismatches have universally increased.' (Klau and Mittelstädt (1985))

Quite recently, however, Jackman, Layard and Pissarides (1984) have looked into the foundations of the UV-curve and found that a relation between the stock concepts is not necessarily the most appropriate one. The findings of these authors are in important respects related to ours, but the focal point of our attention is rather obscured in their presentation as they hasten to consider many other aspects of job vacancy creation.

We will make frequent references to Holt's contributions as well as to the paper of Jackman et al. as our discussion proceeds. It will be organized as follows: First we will present a treatment of the labour market search in terms of the established theory of stochastic processes, leading to a reinterpretation of the UV-relation. Then there follows a critique of the traditional use of the UV-curve and we propose an alternative indicator. The framework is then widened to include on-the-job search and the paper concludes with an empirical demonstration, making use of Swedish data.

Unemployment and vacancies as realizations of stochastic processes

As Holt pointed out already in the late sixties, when there is job search under uncertainty the labour market is to be conceived as a 'dynamic stochastic system'. Surprisingly enough, there has since then been little attempt to develop the stochastic approach beyond some basic concepts. Although the processes in the labour market may 'in reality' be very complex, this is no reason why one should not try to apply some more elaborate, but still tractable probabilistic tools such as simple Markov processes in representing them.

This is precisely what we are going to do. More specifically we will make use of the established theory of time-homogeneous birth-and-death processes, the application of which to labour market flows offers itself quite readily (see Cox-Miller (1965)).

We will retain all the standard assumptions of the basic models used in Holt and David (1966), Holt (1970) and in Jackman et al. (1984). Vague points and diverging opinions will be currently commented on. We will adhere to the assumption of homogeneity throughout, so the unemployed job-searchers and the vacant jobs (and later on the on-the-job searchers) will have all relevant characteristics in common. Homogeneity prevails also with respect to time, i.e. we do not leave the area of Markov processes in our analysis. Furthermore, we will be content just to consider expected values, i.e. we make use of the deterministic approximation of the processes.

In modeling the unemployment process the most immediate alternative to choose should be the immigrant-death-process (in the terminology of Cox-Miller (1965)). This means that there is an inflow intensity of individuals into the unemployment stock at a rate u, at the same time as every individual in that state has a constant instantaneous probability, μ, of leaving unemployment. So with U denoting the number of individuals in unemployment, i.e. the stock of unemployed, the outflow intensity from unemployment is $U * \mu$. This is in turn equal to an inflow intensity into employment, as we follow the basic models in assuming that the only way to leave unemployment is by entering employment.

For the immigrant-death-process to be applicable it must hold that both u and μ are independent of U. As we shall see, however, the exact nature of the inflow process is of no relevance for our main results. We just note that the possible effect on u is likely to derive from μ rather than from U. What is of crucial importance, though, is whether the

outflow intensity is a linear-death process, i.e. whether μ is independent of U.

This question is hardly addressed in an explicit way by earlier writers. However, it should be answered affirmatively as long as there exist 'enough' unfilled vacancies, so that the unemployed are not forced to queue (in the strict sense) at an employer before possibly getting the vacant job. Otherwise, a more elaborate queueing model, which allows for waiting time in the queue, would be more suitable (cf. also footnote 15 in Holt (1970)). Presumably, this qualification is of relevance for an analysis of very depressed labour markets. Unfortunately, such labour market situations have been the rule rather than the exception in many Western European countries in recent years.

In such cases, where there are very high unemployment stocks compared to the vacancy stocks, the immigrant-emigrant process may well offer a better but still simple alternative as a model of the unemployment process. Here the outflow intensity is independent of the volume of the stock of unemployed. Denoting this intensity β, the individual probability of leaving unemployment varies inversely to the stock volume, as

$$\mu = \frac{\beta}{U}$$

It is very important to understand the difference between the causal structure in the two types of processes. In the immigrant-death process, the independent parameters are u and μ, in the immigrant-emigrant process they are u and β. This distinction is of crucial importance as our further analysis will show. (For convenience the processes

will from now on be referred to as I-D-processes and I-E-processes, respectively.)

Regardless of how the outflow intensity of the unemployed depends on U, it should depend on V, the stock of vacancies. Otherwise, the notion of an interaction between unemployment and vacancies in the labour market, giving rise to new employment, is deprived of any causal content; we will illustrate this point more in detail later on. Nevertheless, it is not hard to present a quite convincing version of search behaviour in the labour market, which has such implications.

Fortunately, there exists empirical evidence that bears upon this matter. Several studies of the determinants of the duration of unemployment have investigated the relation between this variable and the stock of vacancies quite thoroughly (Barron (1975), Axelsson and Löfgren (1977), Björklund and Holmlund (1981)). Given the homogeneity assumptions of the present analysis, μ^{-1} is nothing but the expected duration of unemployment. Hence we are able to use the findings of these studies in ascertaining that there exists a strongly significant influence from V on μ.

Here we must add a qualification. As pointed out in the studies referred to, the measured effect of V on μ can be expected to be the resultant of two forces working in opposite directions. One is the pure 'probability' or 'availability' effect, which reflects the impact on the employment probability of more employment opportunities being available. This is the effect of V on the outflow intensity that we have focused on. But there is possibly also a 'supply' effect, reflecting the fact that the

unemployed may become more demanding in their choice as more opportunities present themselves.

From these considerations we may draw the conclusion that the 'availability' effect is at least as strong as the total reported effect of V on μ. As a matter of fact, on the basis of the comparatively reliable Swedish vacancy data, the findings reported in Holmlund (1976) and in Björklund and Holmlund (1981) are consistent with the hypothesis that the 'availability' effect of vacancies on μ is linear in V.

To sum up, we may conceive the flow intensity out of unemployment into employment as

$U * \mu = U * k * V$ for an I-D-process

$U * \mu = k * V$ for an I-E-process

where k may not be independent of V.

It now turns out that we have in fact also deduced the type of process that applies to vacancies. This is a consequence of the fact that the flow out of unemployment and the flow out of vacancies are both equal to the flow of hires. Denoting the hiring intensity by e, we have

$e = U * \mu = V * \lambda$

where λ is the instantaneous probability of a vacancy being filled.

If unemployment follows an I-D-process as specified, we get

$$e = U * \mu = U * k * V = \lambda * V \Rightarrow \lambda = k * U$$

If in addition k is indeed independent of V we get the symmetric result that the vacancy process is also an I-D-process, as we have no reason to believe that the inflow of vacancies is dependent on V. Consequently, the truly symmetric interaction system obtains:

$$\begin{cases} \mu = k * V \\ \lambda = k * U \\ e = k * U * V \end{cases}$$

The reader may recognize the basic Holt model in these relations, especially as it is presented in Holt and David (1966).

If unemployment follows the specified I-E-process, we get

$$e = U * \mu = k * V = \lambda * V$$

Again if k is independent of V, vacancies follow an I-D-process, but now it is independent of the unemployment process, which is completely passive as regards the employment intensity. Hiring is determined by vacancies only. On the margin there is really no interaction in the system:

$$\begin{cases} \mu = \dfrac{k * V}{U} \\ \lambda = k \\ e = k * V \end{cases}$$

It is now due time to pay attention to the important parameter k in our system of processes. In our I-D/I-D-system the availability of vacancies has a

linear impact on the probability of an unemployed person being employed; the availability of the unemployed has the same linear impact on the probability of a vacancy being filled. k is this probability adjusted for the availability effect. Consequently, k reflects most of those characteristics of labour market search which are regarded as constituents of search efficiency or adjustment ability: the intensity of search among the unemployed and firms with vacant job positions, the willingness of job-applicants to accept offered jobs and wages and the willingness of employers to accept the qualities of job-applicants. An indicator of search efficiency should be able to identify changes in k in an unambiguous way. This conclusion also holds when the I-E/I-D-system is applicable. The only difference is that the marginal availability effect of U on the vacancy filling probability is non-existent so the indicator must be chosen accordingly.

We end this section by calling the reader's attention to the fact that nowhere in our presentation has it been necessary to assume that the processes of unemployment and vacancies are in equilibrium. In fact, for an I-E-process an equilibrium may not even exist! (See Cox and Miller (1965), p. 170.)

The UV-Relation and the 'Hiring Production Function'

In the preceding section we demonstrated how the applications of two simple stochastic systems lead to mappings of the stocks U and V into the hiring intensity e. With a more general (or rather more heuristically oriented) formulation, we write

$$e = k(U,V) * U * V \qquad (1)$$

where k is made dependent on U and V in an unspecified, but probably non-increasing way.

Our I-D/I-D-system implies that k is independent of U and V, while in the I-E/I-D-system it holds that $k(U,V) = k * U^{-1}$. To complete the taxonomy, we note that $k(U,V) = k * V^{-1}$ is consistent with an I-D/I-E-system and $k(U,V) = k * (U * V)^{-1}$ with an I-E/I-E-system. Those latter cases will later be commented on.

What is really the expression (1)? It is a 'hiring production function', transforming the stocks of unemployment and vacancies into a hiring intensity. Provided that the absolute value of the elasticity of k with respect to both U and V are not too large (and well below one) or varies irregularly, (1) will behave as an ordinary production function at the same time as the I-D/I-D-system should serve as a good approximation of the process interaction. Likewise it is clear that (1) defines a stable, convex relation between U and V at any fixed hiring intensity. Thus the UV-curve is nothing but an isoquant of the 'hiring production function'. There are as many UV-curves as there are levels of hiring flows.

The situation is particularly transparent when the pure I-D/I-D-system or the basic Holt model applies. The linear availability effect on the transition probabilities μ and λ corresponds unambiguously to the scale effect in the production function (1). The 'adjustment ability' or search efficiency factor k is the factor of 'technical

efficiency' in (1). The UV-curve can move outwards for two reasons: hiring is produced on a larger scale or the efficiency in hiring production is reduced.

In principle the same dichotomy holds when e is not strictly linear in both U and V. However, the identification of scale shifts vs. efficiency shifts becomes less easy, unless one is prepared to maintain parts of the Holt assumptions. For example, by postulating that the availability or scale effect is linear in U and V, the remaining effect of these variables on e is interpreted as endogenous changes in adjustment ability; alternatively, the scale effect is defined as the influence of U and V on e, and hence changes in adjustment ability is by assumption exogenous to these variables.

If the labour market is so depressed that an I-E/I-D-system applies, (1) degenerates into

$$e = k * V$$

As pointed out in our discussion in the preceding section, hiring is now a function of vacancies only. Unemployment has no influence and the UV-curve has no meaningful interpretation.

Let us end this section by pointing to the consequence of assuming that the vacancy and unemployment processes form an I-E/I-E-system. This is equivalent to rejecting the concept of a hiring function in terms of vacancies and/or unemployment. The hiring intensity is independent of both vacancy and unemployment stocks. Vacancies are filled and the unemployed are hired at a rate that is determined by factors that are not causally linked to

these stocks. In such a case any UV-relation is only a statistical regularity, which happens to show up because of correlations in cyclical variables.

A Review of Earlier Research

Equipped with a framework of reference, we will now scrutinize earlier research on the UV-curve, that are based on search theories of the labour market.

As we indicated in our introduction, the seminal contribution in this field is Holt and David (1966). They introduced the idea of job matching as a result of stochastic interaction between stocks of unemployment and vacancies. Substantiating their argument with reference to empirical studies they proposed a model that is equivalent to a pure I-D/I-D-system and they explicitly wrote down our Equation (1), k being independent of U and V.

Holt and David did not probe too deeply into the structure of their model, but noted that at a constant hiring rate it would generate a stable hyperbolic UV-curve. Such stability was in accordance with empirical evidence, they thought. On the other hand, they seem to have been quite aware of the meaning of the parameter k: 'Estimates of the value of k ... will give a qualitative notion of the effectiveness of present information channels in bringing together workers and vacancies in compatible combinations.' (ibid. p. 105).

One would have expected Holt to develop these lines of thought in his later contribution Holt (1970). Unfortunately, however, the sharpness of the analy-

sis is lost in a multitude of interesting, but formally loosely connected observations and comments. More serious are the consequences that result from Holt's mistake to conduct the analysis exclusively in an equilibrium setting.

If the processes are in equilibrium the outflow and the inflow intensities are of course equal. Now, Holt argued, the components of the inflow into unemployment - quits and layoffs - vary in such a way that their sum is approximately constant over the cycle. Hence, in equilibrium all flows, including the flow out of unemployment (into employment), are constant over the cycle! Surprisingly enough, Holt did not seem aware of the fact that by imposing the equilibrium condition and by letting the inflow intensity into unemployment 'determine' (that is exactly the word he used) all other flow intensities, he violates the causal structure of his model and rejects implicitly the notion of hiring as a function of vacancy and unemployment stocks.

This strange error can only be explained by the influence of the Phillips curve hypothesis, which had at that time reached its peak of authority. But it was really at the expense of distorting his own model that Holt was able to conclude:

'Because the expression on the right of the equation (15) (i.e. UV = e/k in the present notation, our note) tends to change slowly, we see that cyclical fluctuations in unemployment are highly correlated with those of the vacancy rate, so ... we can obtain a fairly stable Phillips relation that suppresses the role of vacancies.' (Holt (1970), p. 241.)

Having made his basic analytical mistake, Holt's further arguments were consequently confused. e (in our notation) was not just the hiring rate; for Holt it was the general turnover rate of the unemployed and of vacancies. Clearly Holt was aware that an increase in the 'turnover rate' must shift the UV-curve outwards. He took great pains in finding arguments why such a shift ought to be interpreted as increased mismatches in the labour market, so that any shift outwards of the UV-curve could be seen as a sign of increased maladjustment. With the correct interpretation of e such an effort is of course in vain.

In the same celebrated volume in which Holt (1970) was published, there is an impressive contribution by its editor Edmund Phelps (Phelps (1970)). Focusing on money wage dynamics, he also discussed the relation between hires, vacancies and unemployment. Without using the notion of interacting stochastic processes, he arrived at the conclusion that the volume of hires is a function of the stock of vacancies and unemployment: 'My theory denies a strict and simple short-run relation between the unemployment rate level and the vacancy rate level. ... unemployment and vacancy levels together determine the rate of change of employment ...' (ibid. p. 149). In other words, Phelps argued that the UV-curve is not cyclically stable and stated the reason for it: unemployment and vacancy stocks 'produce' new employment. His conclusion is in complete accordance with our analysis.

Phelps' contribution did not go unnoticed by other researchers; his UV-analysis is described e.g. in Holmlund (1976) together with Holt's. However, Phelps presented his assumptions in a way that

looked unnecessarily ad hoc and he hastened to transform the rate of change of employment into one of unemployment, a procedure which required additional assumptions. In that way Phelps was able to come closer to the ubiquitous Phillips relation, and he claimed quite consistently that it should be amended with the rate of change of unemployment as an additional explanatory variable. Thus the notion of a basic causal relation between the hiring rate and the stocks of vacancies and unemployment fell into the background and was obscured. The contradiction between Holt's and Phelps' simultaneously published contributions on the UV-relation was not conceived as so fundamental as it really was. In that situation Holt's more traditional message was accepted.

Those researchers who used the UV-relation during the seventies did not question its traditional interpretation, at least not on its weakest point. Apart from the empirical problem, whether registered unemployment and vacancies corresponded to the 'true' variables, most concern centered around the possible effects of various heterogeneities in the labour market (see e.g. Foster (1974) with references, Holmlund (1976)).

The contributions by Bertil Holmlund seem to merit special attention. His dissertation (Holmlund (1976)) and still more a revised and condensed version of it (Holmlund (1978)) reveal how very close Holmlund was to a reinterpretation of the UV-relation: '... the position of the curve in the UV-plane depends i.a. on how efficiently the search processes in the labour market work, i.e. how rapidly a job applicant can find a job and a vacan-

cy can be filled. Besides, the position of the curve is determined by the volume of unemployment inflow' (Holmlund (1978), p. 438, translated from Swedish).

Apart from the confusion about which flow to focus on (a heritage from Holt (1970)), the conclusion seemed to be just at hand that the UV-curve should be replaced by some relation that eliminates the effect of the flow component and isolates the effect of the degree of efficiency of the search processes. However, Holmlund withdrew at the last step and repeated the usual interpretation of shifts in the UV-curve.

At the same time we want to emphasize that Holmlund's contributions (later in cooperation with Anders Björklund in Björklund and Holmlund (1981)) contain penetrating studies of the duration of vacancies and of unemployment. As was made clear in the preceding section, the empirical evidence on the determinants of the durations is essential for understanding the character of the interacting processes of vacancies and unemployment.

The presentation given above should give an accurate picture of the state of the UV-analysis up to the publication of Jackman et al. (1984). Before we consider their contribution it is convenient to summarize the results which follow from our analysis in the preceding sections.

The Alternatives to the UV-Curve

Let us return to Equation (1)

$e = k * U * V$

where $k = k(U,V)$ may depend on U and V.

Now it is clear that for any homogeneous birth-and-death process e/U and e/V are to be interpreted as the instantaneous probability of an unemployed person being employed, μ, and of a vacancy being filled, λ, respectively. So we have in general

$$\mu = k * V; \qquad \lambda = k * U \qquad (2)$$

as we found for the I-D/I-D-system. The only difference is that k may not be a constant. It is easy to check that the other systems of processes which we explicitly considered earlier are covered by (2).

Expressing (2) in terms of the expected duration of a vacancy and an unemployment spell, which we denote by T_v and T_u, respectively, we have

$$T_u = \frac{1}{k * V}; \qquad T_v = \frac{1}{k * U} \qquad (2')$$

So if the pure I-D/I-D-system (or the basic Holt model) is applicable, it is a change in the relation between the duration of vacancies and the stock of unemployment, or equivalently, between the duration of unemployment and the stock of vacancies that indicates changes in the hiring efficiency of the labour market.

If one is not prepared to make such strong assumptions, the interpretation of the relation between durations and stocks is not so clear-cut; we pointed to this qualification earlier. Some other

assumptions, preferably based on more detailed empirical evidence, are needed to distinguish between the effect of changes in 'availability' and in hiring efficiency.

In the I-E/I-D-system, which we claimed might be a suitable model for a depressed labour market, we have

$$T_u = \frac{U}{k * V}; \qquad T_v = \frac{1}{k}$$

It is immediately clear that cyclical changes are solely reflected in the unemployment duration, while changes in the vacancy duration correspond unequivocally to changes in hiring efficiency (with the caveats of the preceding paragraph still applying).

It is now convenient to compare our results with those of Jackman et al. (1984). First of all, their study must be given credit for having reestablished the notion of a hiring function in vacancies and unemployment and for conducting their UV-analysis in these terms. It should also be acknowledged that the approach of Jackman et al. has inspired the presentation of the present paper as regards the systematic comparison between the notion of a hiring production function and that of interacting stochastic processes.

Nevertheless, the specification of the stochastic mechanisms in Jackman et al. (1984) is not particularly successful. With reference to a certain example of search behaviour they argue that the hiring function is homogeneous of the first degree in the vacancy and unemployment stocks. A scrutiny of their example (in footnote on p. 6) shows that if

we transform their fixed period chain into the corresponding continuous time process, their search model implies an I-D/I-E-system, i.e. hiring is determined solely by the unemployment stock, while vacancies are completely passive.

Consequently, the corresponding hiring function has the suggested homogeneity property only in a degenerate sense:

$$e = k * U; \qquad \mu = k; \qquad \lambda = \frac{k * U}{V}$$

While one might conceive of an over-heated labour market, where such a model can apply, it is not very appropriate for the British labour market in recent years, with which Jackman et al. are primarily concerned. In fact, their data, showing small variations in vacancy durations and steadily increasing unemployment durations since 1975, point more to an I-E/I-D-system at work, where the unemployment I-E-process is clearly out of equilibrium.

The suggested passive role of vacancies lacks empirical support (cf. the studies of the dependence of unemployment durations on the stock of vacancies, not referred to by Jackman et al.). However, if one accepts their homogeneity assumption for the sake of the argument one immediately finds that the reasoning of Jackman et al. follows the same line as ours. Let $f(U,V) = e$ have the proposed homogeneity property: then it clearly holds that

$$f(\frac{U}{e}, \frac{V}{e}) = 1$$

For example, it may be that

$$f(U,V) = k * U^{\alpha} * V^{1-\alpha}$$

and, consequently,

$$\frac{1}{k} = \left(\frac{U}{e}\right)^{\alpha} * \left(\frac{V}{e}\right)^{1-\alpha}$$

In this case, the elimination of the scale effect in the production of hires yields a relation in T_u and T_v, which changes when there are changes in hiring efficiency. Consequently, Jackman et al. argue that this relation should replace the UV-relation. Thus we conclude that their principle aim is the same as ours: to eliminate the effect of the volume of hires on a vacancy-unemployment-based relation in order to establish a measure that can be used as an indicator of hiring efficiency.

As we indicated the search theoretical argument in favour of a hiring function that is homogeneous of the first degree in vacancies and unemployment is weak. However, this assumption does take care of a complication that may otherwise arise. One would like to think that changes in size between labour markets (as between different countries) should be reflected in equiproportional changes in flows of hires and in stocks of unemployment and vacancies, ceteris paribus. If U and V are interpreted as absolute numbers, this result does not hold in the basic Holt model or our I-D/I-D-system; it exhibits strong 'economies of scale' in hiring. Incidentally, Holt (1970) addressed this question and proposed increased 'compartmentalization' in large labour markets as a counteracting force.

However, if U and V are interpreted as the ratio of the stocks to the total labour force (or total employment) and e as the corresponding relative hiring intensity, the intuitive result with respect to changes in the size of the labour market obtains.

To see this let us denote the absolute number of the unemployed and of vacancies by U_a and V_a, respectively, and the labour force size by L, so that $V = V_a/L$ and $U = U_a/L$.

If the outflow intensities depend on V and U we get

$$\lambda = k * \frac{U_a}{L} \; ; \qquad \mu = k * \frac{V_a}{L}$$

and

$$e_a = V_a * \lambda = k * \frac{V_a * U_a}{L} = U_a * \mu,$$

where e_a is the absolute hiring intensity,

and hence

$$e = \frac{e_a}{L} = k * \frac{V_a}{L} * \frac{U_a}{L} = k * U * V$$

So with the suggested interpretation of the variables U, V and e as ratios, our Equation (1) obtains in a form that is neutral with respect to equiproportional changes in the volume of hiring flows, unemployment and vacancy stocks and the labour force size.

It should be noted that the procedure adopted above is often used in the application of birth-and-death processes in chemistry, where the transition probabilities are made dependent on the concentration ratio rather than the volume of an active substance in a large system (cf. Gardiner (1983), Section 7.2.3, especially example b)).

Admittedly, we know too little of the search mechanisms in the labour market to be able to take a

strong stand a priori on the exact properties of the stochastic processes that are to represent them. Fortunately, the implications of our assumptions can be made subject to empirical testing. The short-run behaviour of e, V and U can e.g. be used to estimate the parameters of a relation $e = k * U^{\alpha} * V^{\beta}$, by which we may gain further insight in the properties of the hiring function and the underlying search processes. The choice between a stock-duration relation and a duration-duration relation is predominantly an empirical issue, while the traditional stock-stock relation is to be rejected on theoretical grounds.

An Extension to On-the-Job Search

An extension of the model to include on-the-job search offers few additional conceptual difficulties. The supply side of the labour market is now made up by two independent processes, one referring to the unemployed and the other referring to the employed job searchers.

Let the stock of employed job searchers be denoted by J and the expected search duration until a new job is found by μ_J. We might expect that the stock of vacancies has the same kind of impact on μ_J as on μ (which we will in this section denote by μ_u) so that

$$\mu_J = k_J * V; \qquad \mu_u = k_u * V$$

As vacancies will be filled by both types of job searchers the hiring function now reads

$$e = U * k_u * V + J * k_J * V \qquad (3)$$

and, repeating the above argument,

$$\lambda = U * k_u + J * k_J$$

So we get the relations

$$\begin{aligned} \mu_u &= k_u * V = T_u^{-1} \\ \lambda &= U * k_u + J * k_J = T_v^{-1} \end{aligned} \qquad (4)$$

The relation between V and T_u reflects as before the ability of the labour market to turn the unemployed into employees, whereas the relation between U and T_v is now in addition also dependent on the stock of on-the-job searchers and their 'availability effect' adjusted reemployment probability.

While one may conceive of reasons why a higher stock of employed searchers indicates higher labour market flexibility, so that changes in the UT_v-relation can be given a consistent interpretation, such a conclusion does not accord well with the well-defined concept of hiring efficiency which we have elaborated in this paper. The straightforward conclusion is rather that changes in hiring efficiency are reflected in changes in a relation between T_v, U and J.

When there is no reliable information available on the stock of employed job searchers, one may take advantage of the fact that the inflow into the stock seems to be highly labour market induced. The Swedish data on the volume of this inflow show a strong procyclical pattern and Holmlund (1984) explains this observation by the impact of the changing probability of finding a job offer, i.e. the availability effect of vacancies, over the cycle. This conclusion can be formalized by stating that

the propensity of employees to enter job search is an increasing function of $\mu_J = k_J * V$. Provided now that the function is not strongly non-linear in μ_J, we should expect the equilibrium value of J to be approximately the same in the face of changes in labour market conditions and hence J should tend to be stable at the same value. In that case the UT_V-relation should be only marginally disturbed by the existence of on-the-job search; its changes can be interpreted as formerly stated. (Note that the inflow into unemployment - at least in Sweden according to Björklund (1981) - is not labour market induced, so short run equilibrium arguments cannot apply to U.)

Some Remarks on the Concepts of Efficiency and Flexibility

It should by now be clear that our analysis focuses on the efficiency of the labour market in a well-defined sense, i.e. the efficiency of the interaction between vacancies and unemployment in bringing about new hires. Some readers may feel that this efficiency concept is too narrow. I accept this objection in part and in this section I broaden the discussion somewhat in order to clarify some concepts. However, a comprehensive treatment of the efficiency of a search labour market requires a more general approach that extends beyond the border of unemployment-vacancies analysis.

In this context it is worthwhile to reflect on the conspicuous absence of an explicit hiring production function interpretation of the UV-relation in the literature between Phelps (1970) and Jackman et. al. (1984), including Holt (1970). As we have

argued, this causal interpretation is really one of the important results that emerges from the application of search theory to the labour market. The hiring efficiency concept is an immediate consequence of that result. How can it be that it has been overlooked?

The answer is connected with the confusing influence of the Phillips curve hypothesis, because behind it there exists a vague 'efficiency' notion that has veiled the one inherent in the search theoretical approach to vacancies and unemployment. Regardless of which mechanism it is that governs the flow of hires, the stock of vacancies and of unemployment can always be interpreted as temporarily unsatisfied demand for hires (i.e. for new employees and for new jobs, respectively). So in a sense these stocks can be seen as indicators of how 'efficiently' the labour market satisfies the demand for hires. However, even in this sense they remain vague, as one may clearly assign the same intuitive meaning to e.g. the duration of vacancies and of unemployment.

The essential point, however, is that search theory assigns an important complementary meaning to vacancies and unemployment. They do not only constitute demand for hires, they are the 'resources' by which hires are 'produced' through stochastic interaction. The vague notion of 'efficiency' in demand satisfaction can be replaced by the strict concept of production efficiency, but this important consequence does not seem to have always been properly understood.

Nevertheless, there might exist other elements of 'efficiency' or rather flexibility in the unemploy-

ment and vacancy formation that requires an investigation of the inflow intensities. More precisely one would like to know how sensitive the inflow of vacancies and of job-searchers (whether unemployed or not) are with respect to changing conditions in the labour market; in other words, we are interested in the flexibility of the resource inflow into the hiring production process.

To fix ideas let us assume that firms open up more vacancies and presumably increase wages. The effect on the behaviour of job-searchers implies a mixture of higher reservation wages and shorter search durations (the composition of the mixture is an empirical issue and Björklund and Holmlund (1981) find evidence that the reservation wages increase so much that the effect on the duration stems predominantly from the availability of vacancies).

The question now is how responsive the inflow of job-searchers is to this improvement in expected wage and employment probability conditions. If the elasticities of the inflow intensity with respect to expected wage and to employment probabilities are higher, one is entitled to say that the labour market is more flexible; flows of resources into the hiring production process are more sensitive to incentives.

Not surprisingly these considerations show that flexibility and efficiency in the vacancy-unemployment processes have several aspects and cannot be captured by a one-dimensional measure. We do not pursue the matter of inflow flexibility further as it is outside the aim of this paper. However, it should be noted that a higher degree of flexibility of the inflow into unemployment produces higher

stocks of unemployment, ceteris paribus (higher flexibility in this sense corresponds to a stronger marginal 'discouraged worker' effect). The ambiguity of the UV-relation as an adjustment ability indicator is certainly not decreased by taking the inflow processes into account.

Finally I want to state explicitly an obvious point; I do not venture into the area of analyzing the social efficiency of search labour markets, where the realized allocation of search costs and job positions is compared to the socially optimal one. The interested reader should consult Pissarides (1984) with references for that type of analysis.

Empirical Evidence for Sweden

We are now going to apply our analysis to Swedish labour market data, the reliability of which we are able to assess.

As has been made clear we need figures on the stocks and durations of vacancies and of unemployment. As regards the employed job-searchers there are some figures available since 1976 for those who search through the public employment offices. We do not make use of them except as a complement at the end of this section, however, as we need series for longer periods of time.

Data on vacancies are found in the monthly statistical reports of the Labour Market Board. They are made up by all unfilled job positions that are notified by employers at the public local employment offices. As employment exchange is a public monop-

oly in Sweden, all notified vacancies are included in the statistical reports.

The vacancies are reported as being notified for the first time during the month as well as remaining unfilled at the end of the month. They are divïded into different categories e.g. by occupation. We have used the figures for manufacturing occupations besides the figures for the total.

Denoting the number of unfilled vacancies at the beginning and the end of a month by V_0 and V_1, respectively, and the number of new notified vacancies by v * t (where v is an intensity and t is the length of the month), we have, assuming constant inflow and outflow intensities during the month,

$$V_0 * e^{-\lambda t} + \frac{v * t}{\lambda * t} (1 - e^{-\lambda t}) = V_1$$

This equation determines λt and, as t is given, λ. Hence we obtain an estimate of the expected value of T_v.

Apart from the homogeneity of the vacancies, which condition is always violated to some extent in empirical work, the most pertinent question concerns the effect of some vacancies not being notified at the employment offices. In 1977 compulsory notification was introduced in Sweden, taking effect gradually in subsequent years as the new rules were extended into more regions. A study, carried out at the first stage of the introduction, indicated that the flow of new vacancies was increased by forty percent and the stock of unfilled vacancies by fifty percent as a consequence of the compulsory notification (see Labour Market Board (1983)).

The reliability of this result may be questioned as to the impact on vacancy figures in recent years. As the inflow of notified vacancies during this time has reached unprecedented lows, an upward correction of earlier vacancy figures with as much as forty percent would produce an implausibly sharp decline in 'real' vacancies for these years. Presumably the effect is of less magnitude than was reported at first.

We are left with the disturbing conclusion that the stock figures on vacancies are not consistent over the two last decades and that a correction is not easily accomplished. However, there is some encouraging evidence, too. With regard to vacancies in manufacturing occupations, we know that the notification rate has traditionally been much higher than for salaried occupations or for occupations in the public sector (ibid.). Hence we are entitled to assume that the stock of notified vacancies in manufacturing occupations has been far less influenced by the new legislation than the total vacancy stock, so that the inconsistency over time for this vacancy category is not too disturbing. Another reason for paying special attention to data on manufacturing occupations is of course the higher degree of homogeneity within this group.

With regard to the calculated duration of vacancies, it is clear that this measure is invariant in the face of equiproportional changes in the stock and inflow variables. If we accept the reported magnitudes of the overall effect on these variables of the introduction of compulsory vacancy notification, the result should be an increase of the duration measure by around seven percent as the notification rules took full effect (calculated on

an equilibrium basis). A disturbance of such a magnitude is not likely to affect our results. For the calculated vacancy duration in manufacturing occupations the disturbance can be expected to be even smaller.

Turning to the quality of the unemployment figures, the situation is reversed compared to that of vacancies, insofar as the stock figures are more reliable than the calculated duration measures. Data on unemployment are obtained from the Labour Force Surveys, which are carried out according to international standards. Although the stock figures are subject to sampling errors, these can be safely ignored for yearly averages of both total unemployment and unemployment in manufacturing occupations, especially from 1970 and onwards when the surveys have been made on a monthly basis. Earlier the survey figures were based on only one month for each quarter. Nevertheless, one can conclude that the stock figures are consistently calculated since 1963.

There is, however, no immediate information on the inflow into unemployment between two consecutive surveys, so we cannot apply the same method of calculating the outflow intensity as we did for vacancies. The problem of estimating the expected duration of unemployment from Labour Force Surveys is notorious, as is made clear in Björklund (1981). One approach, which is applied in Axelsson and Löfgren (1977), is to make use of the figures on the number of unemployed persons with different durations of experienced unemployment spells, published in the Survey reports. We will use this approach, too, but in a slightly different way than what these authors did.

From the Survey reports we have the number of persons who have been unemployed for at most four weeks. Assuming that four weeks is also the period between the consecutive monthly surveys, which should hold approximately, we conclude that the remaining part of the stock of the unemployed (with unemployment spells of at least five weeks) consists only of those individuals who were reported unemployed in the preceding survey. Hence we have

$$U_0 * e^{-\mu t} = U_1 - U_{1,T_u} \leq 4$$

and can calculate μt, where t is equal to four weeks, and consequently the expected duration of unemployment T_u.

The measure of T_u, calculated in this manner is as good as the available data permit, but its precision is presumably not very accurate. The elimination of the inflow component during the period between consecutive surveys is only approximate and the sampling error in the monthly estimates of the stock components may not be negligible. It is not surprising then, that the calculated monthly outflow intensities show a more unstable pattern for unemployment than for vacancies.

To make a check of the calculated outflow intensities we have applied the equation above to the yearly averages of the respective stocks. It turns out that such a calculation produces almost the same figures as a yearly average of calculated monthly intensities. In fact, the more simple calculation procedure must be applied to the years before 1970, where data are not available for every month. So for the pre-1970 years we calculate a yearly average directly by solving

$$U * e^{-\mu t} = U - U_{T_u \leq 4}$$

for μt, U and $U_{T_u \leq 4}$ being yearly averages of the stocks.

Unfortunately, the data presented in the Survey reports are not so detailed that we can calculate the duration of unemployment in manufacturing occupations. This deficiency ought to be remedied in a more detailed study, but here we must be content to consider the total labour market only.

The figures on reported stocks and calculated durations of vacancies and unemployment for the manufacturing occupations and the total labour market are reproduced in Table 1 and Table 2, respectively.

In Figures 1-5 the observations on stocks and durations are depicted as to illustrate the relations between these variables.

Figure 1 shows that there is no stable relation between the rates of unemployment and of vacancies in manufacturing occupations. The same is true for the total labour market; the observations are not graphed here, as they are also depicted in Klau and Mittelstädt (1985), Chart 7. As has been argued in this paper, this lack of stability in the UV-relation should not surprise us.

Figures 2-4 all depict stock-duration relations of type (2'), changes in which should reflect changes in hiring efficiency. They convey very interesting information in that they all point to a marked deterioration in efficiency around the years 1967-69. There are fairly few observations available for the

sixties. Still the evidence is that the years 1963-67 produce observations generated by one hyperbolic relation, the years 1969-84 by another; 1968 seems to be a year of transition.

As it happens the quality of the data is best for the stock of unemployment and the duration of vacancies as we just demonstrated. Hence the T_vU-relation should be the most reliable one, provided that the job-search process of the employed does not change independently of that of the unemployed. Utilizing the immediately observable shift in the curves 1967-69, we introduce a dummy variable to take care of this shift, exclude the 1968 observation and obtain as OLS estimations (t-values in parenthesis):

Manufacturing occupations (Figure 2)

$$\ln T_v = \underset{(10.77)}{1.34} + \underset{(9.21)}{1.02}\, D - \underset{(-7.41)}{1.01}\, \ln U, \quad \bar{R}^2 = 0.83$$

D = 0 for 1964-67; D = 1 for 1969-84

Total labour market (Figure 4)

$$\ln T_v = \underset{(22.15)}{1.04} + \underset{(12.79)}{0.59}\, D - \underset{(-9.64)}{0.72}\, \ln U, \quad \bar{R}^2 = 0.89$$

D = 0 for 1963-67; D = 1 for 1969-84

These estimated equations confirm the strong impression given by visual inspection of the figures. Something obviously happened to Swedish hiring efficiency in the late sixties. It is striking that this deterioration took effect so rapidly and that the lower level of efficiency has prevailed up to

now. No reason for this sudden change is easily produced.

The same estimation procedure applied to the $T_u V$-relation yields

Total labour market (Figure 3)

$$\ln T_u = \underset{}{1.82} + \underset{(7.75)}{0.40\ D} - \underset{(-8.97)}{0.59\ \ln V},\ \bar{R}^2 = 0.91 \quad (41.57)$$

D = 0 for 1963-67; D = 1 for 1969-84

This result confirms the conclusion from the preceding estimations, although unfortunately, the calculation procedure to obtain a measure of the duration of unemployment has to be changed just in the critical period between the years 1969 and 1970.

As regards the effect of the introduction of compulsory vacancy notification on the estimated $T_u V$-relation, a look at the residuals reveals that an increase of the reported vacancy stock of a magnitude of up to twenty percent is compatible with a roughly unchanged relation before and after the introduction. A reported stock increase of fifty percent, as was initially indicated, would of course imply higher hiring efficiency in recent years. However, as we argued, such a strong change in the notification rate seems implausible; the estimated $T_v U$-relation, which is just marginally disturbed by the change in notification rules, indicates no substantial change in hiring efficiency in these years.

As the estimated equations stand, they seem to indicate a linear effect of the unemployment stock on the vacancy filling probability in manufacturing occupations, while the corresponding effect for the total labour market shows an absolute elasticity of less than one. However, to investigate the properties of the hiring function we must take into account the strong (although not perfect!) correlation between U and V. Hence we estimate an equation

$$T_v = \frac{1}{k} * U^b * V^c$$

from which we can deduce the elasticities of the outflow intensity e with respect to U and V as

$$\frac{V}{T_v} = e = k * U^{-b} * V^{1-c}$$

OLS-estimation yields

Manufacturing occupations

$$\ln T_v = \underset{(7.96)}{1.01} + \underset{(10.43)}{0.93}\, D - \underset{(-3.84)}{0.60}\, \ln U + \underset{(3.61)}{0.26}\, \ln V, \quad \bar{R}^2 = 0.90$$

D = 0 for 1964-67; D = 1 for 1969-84

Total labour market

$$\ln T_v = \underset{(12.75)}{0.80} + \underset{(13.87)}{0.51}\, D - \underset{(-2.69)}{0.30}\, \ln U + \underset{(4.38)}{0.35}\, \ln V, \quad \bar{R}^2 = 0.94$$

D = 0 for 1963-67; D = 1 for 1969-84

The presence of multicollinearity prevents us from assigning much weight to the separate coefficients of ln U and ln V, but taken together they imply elasticities of hiring with respect to U and V

which amount to 1.34 for manufacturing and 0.95 for the total. (The corresponding calculation on T_u yields a value of 1.31 for the total but should be less reliable on data quality grounds.)

Given presently available information, we cannot really discriminate between on the one hand the basic Holt model, where the interacting stochastic processes have outflow intensities that are basically linear in the stocks ('availability effects') but are also influenced by changed behaviour of job-searchers and of employers in the face of changes in the stocks ('supply effects') and, on the other, the model of Jackman et al., where the processes (in some unspecified way) inherently give rise to an outflow that is homogeneous of the first degree in the stocks.

However, it is not very likely that the observed supply effects are very marked. The studies of the determinants of the duration of unemployment, referred to above, have argued that the supply effect comes about as a larger number of available vacancies will make the job-searchers more 'choosy' and prolong the duration of search, i.e. of unemployment, ceteris paribus. They seem to have overlooked that because more vacancies will generally appear together with fewer unemployed individuals, employers will at the same time face fewer job-applicants and, by the same argument, become less choosy. Thus two 'supply effects' will usually work in opposite directions and the resultant is hardly very pronounced.

At the same time, the theoretical argument in favour of the assumption of Jackman et al. is very weak when applied to a homogeneous labour market.

Thus we are left with the intuitively appealing suggestion in Holt (1970) that lower measured elasticities of the outflow into employment than those predicted by the basic Holt model originate from heterogeneities in the labour market. This is in accordance with our findings, where the elasticities are larger for manufacturing occupations than for the total labour market. It would be an interesting research project to study the relations between the relevant variables for a labour market which is more narrowly defined with respect to occupations and geographical proximity.

We should add that aggregation of homogeneous (and equally efficient) submarkets, where the basic Holt model applies, does not automatically lead to estimated elasticities of the aggregate outflow intensity with respect to aggregate stocks that are less than one, when the intensities in the submarkets depend on the ratio of the stocks to labour force size rather than on the sheer volume of the stocks. As a consequence and in contrast to the results presented in Holt (1970), compartmentalization is not a sufficient condition for reducing the outflow intensity at given aggregate stocks; if either the unemployment or the vacancy ratios are the same in all submarkets, compartmentalization will have no effect. To get a reduction in the aggregate outflow intensity, it must hold that vacancies and unemployment are distributed in an imbalanced way, so that vacancies are concentrated to some submarkets, unemployment to others. This is likely to be the usual case, but if some submarkets have more of both vacancies and unemployment, the estimated aggregate elasticities may even exceed one. Formally, the aggregate outflow intensity is linearly dependent on

$$\sum_i \frac{V_{ai} * U_{ai}}{L_i}$$

but we estimate its dependence on

$$\frac{\sum_i V_{ai} * \sum_i U_{ai}}{\sum_i L_i} = \frac{V_a * U_a}{L} ;$$

from this difference the above conclusions can be obtained.

As it happens that the outflow of vacancies for the total labour market seems to be nearly homogeneous of the first degree in the stocks of unemployment and of vacancies according to our estimates - by chance presumably - one might fear that the stock-duration relation is disturbed by cyclical factors. Consequently, we should check our preceding results by forming the duration-duration relation, proposed by Jackman et al. Estimation of T_u and T_v yields

Total labour market (Figure 5)

$$\ln T_u = \underset{(21.73)}{2.46} + \underset{(11.56)}{0.84}\, D - \underset{(-7.17)}{0.98} \ln T_v, \quad \bar{R}^2 = 0.87$$

This result confirms the general conclusion from earlier estimations. The shift in hiring efficiency around 1967-69 and its subsequent stability are robust results.

Finally, we should consider the available data on the stock of on-the-job searchers. As we showed above, changes in this stock may influence the relation between the duration of vacancies and the unemployment rate.

The only source for this variable is the data on job searchers registered at the local employment offices. This is a fairly recently established statistical series, and figures are available since 1976 only. In Table 3 the figures on the stock of job-searchers, who are not registered as unemployed (and prepared to take a job imnmediately) are reproduced.

As we see, the stock does not vary very much during the years 1976-81, especially not in comparison with the unemployment figures. This is in accordance with our suggestion that entrance into on-the-job search is largely labour market induced. However, in the last three years there has been a sharp increase in the stock of job-searchers who are not unemployed. This should produce an inward shift in the T_vU-curve for the total labour market, ceteris paribus, but no such shift can be traced for these years. On the surface there seems to have occurred an additional deterioration in hiring efficiency since 1982.

However, the series on registered job-searchers has hardly been used for analytical purposes yet and its properties are not well known. There is some evidence that in recent years the registered job search of the unemployed has increased more than corresponds to the Labour Force Survey figures, because more people have had reason to 'indicate' unemployment status without really searching for a new job. Whether there is some recent systematic trend also in the remaining part of the registered stock of job searchers we do not know; the published figures are too crude to allow any investigation of the issue. We prefer to be prudent and just conclude that by also taking the on-the-job search

process into account, we do not find any evidence in favour of a better development of hiring efficiency in Sweden in recent years than what is indicated by the T_vU-relation.

Summary and Concluding Comments

In this paper we have demonstrated that the relation between the stocks of unemployment and of vacancies is not stable at unchanged degree of hiring (labour market) efficiency as has traditionally been perceived. By exploiting the notion of unemployment and vacancies forming interacting stochastic processes - which need not be in equilibrium - we have shown that hiring is a function of vacancy and unemployment stocks in a production function sense. A stable relation between the stocks is but an isoquant of this hiring production function.

If the interacting processes have such properties as to produce a model of the type that was proposed by Charles Holt in his seminal contributions, it is a relation between vacancy stocks and unemployment durations or between unemployment stocks and vacancy durations that is stable in the face of unchanged hiring efficiency. If the processes are not as efficient as in the Holt model in producing new hires (presumably because of heterogeneities that have not been controlled for) a relation between the durations of unemployment and of vacancies may be a better - or at least a complementary - indicator of changes in efficiency.

If, finally, the labour market has been constantly depressed or overheated for some time, hiring may be a function of only the vacancy or the unemploy-

ment stock, respectively. There is no interaction on the margin between the processes, and hiring efficiency is reflected in either the vacancy duration (the depressed case) or the unemployment duration (the overheated case).

The results of the theoretical analysis have been applied to Swedish labour market data. The investigation reveals very clearly that there occurred a marked deterioration in Swedish hiring efficiency in the late sixties, which has not yet been compensated. This is a new discovery, which is not possible to trace with the help of traditional UV-curve analysis.

It is indeed justified to suggest that the labour markets of other countries, the hiring efficiency of which has for a long time been evaluated by an erroneous UV-relation, should also be made subject to investigations of the same kind as far as the availability and quality of data permit. Let us point to just one interesting piece of evidence, given in Klau and Mittelstädt (1985). In our introduction we quote these authors as they describe the outward shifts of the UV-curve in several countries since the late sixties; we omitted the end of their sentence, which reads '... most visibly in the case of the United States'. Of course, it is counterintuitive to think of the U.S. as having the worst development of hiring efficiency among the OECD countries! The answer to this seeming paradox is found in the following lines: 'In selected European countries there has been a trend decline in hirings ... In contrast, in the United States a rising trend in layoffs was outweighed by a rising trend in hirings ...' (ibid.). On the basis of the ana-

lytical results of the present paper, the conjecture is of course that the outward shifting UV-curve in the U.S. reflects increased hiring flows and not decreased hiring efficiency.

Let us end this paper by pointing to a more far-reaching, albeit speculative, possible consequence of our reinterpretation of the UV-curve. The stability of this curve became a maintained hypothesis as it was perceived as a prerequisite for a stable Phillips curve. Now we have seen that under stable efficiency conditions there is instead a stable relation between the unemployment stock and the duration of vacancies. A few years ago I argued on fairly intuitive grounds that the duration of vacancies should be a good indicator of excess demand in the labour market and consequently a good explanatory variable in a nominal wage increase equation; I managed to show that wage drift in Sweden was indeed best explained by this measure (Schager (1981)).

Most important in retrospect is perhaps the fact that a shift in wage drift behaviour in the late sixties, left unexplained by the unemployment variable, is taken care of by the vacancy duration variable! It might be so that the durations of vacancies and, perhaps, unemployment are more crucial to money wage dynamics than the volume of the stocks and that even the celebrated Phillips curve is a reflection of this causal structure during periods of stable hiring efficiency conditions. This important and challinging issue I hope to be able to address in a subsequent study.

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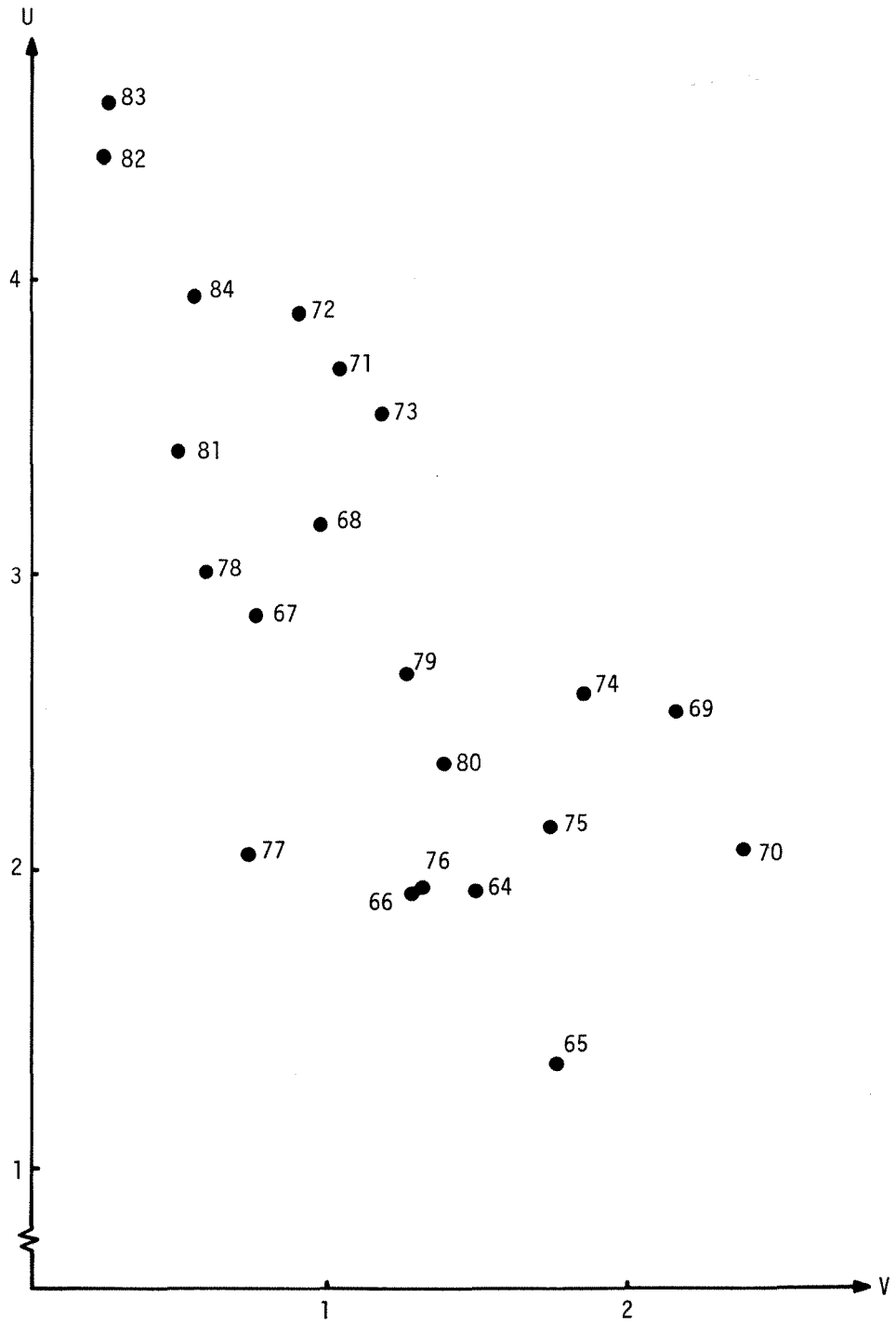
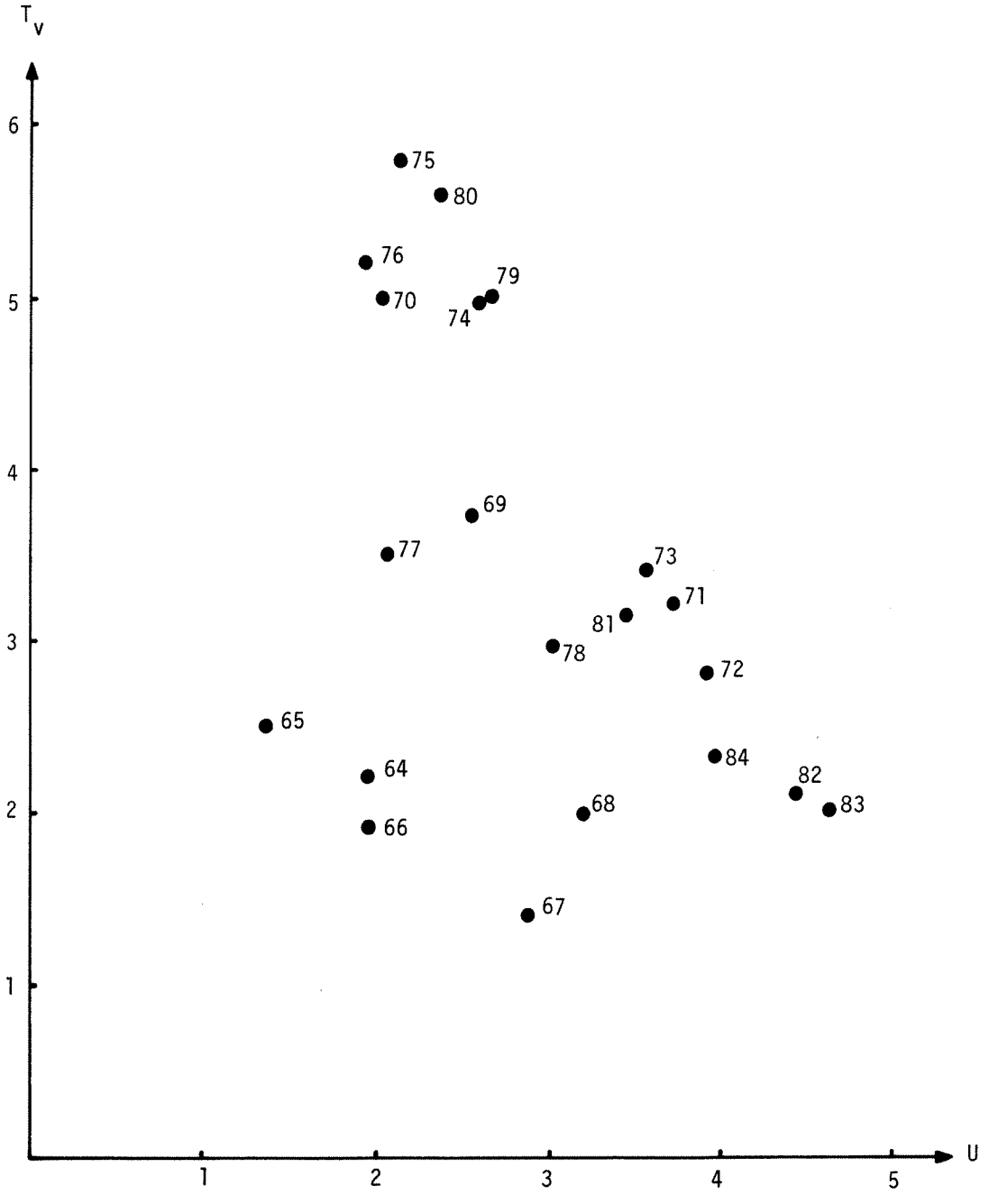
Figure 1 Vacancies (V) and unemployment (U) in manufacturing occupations, percent, 1964-84



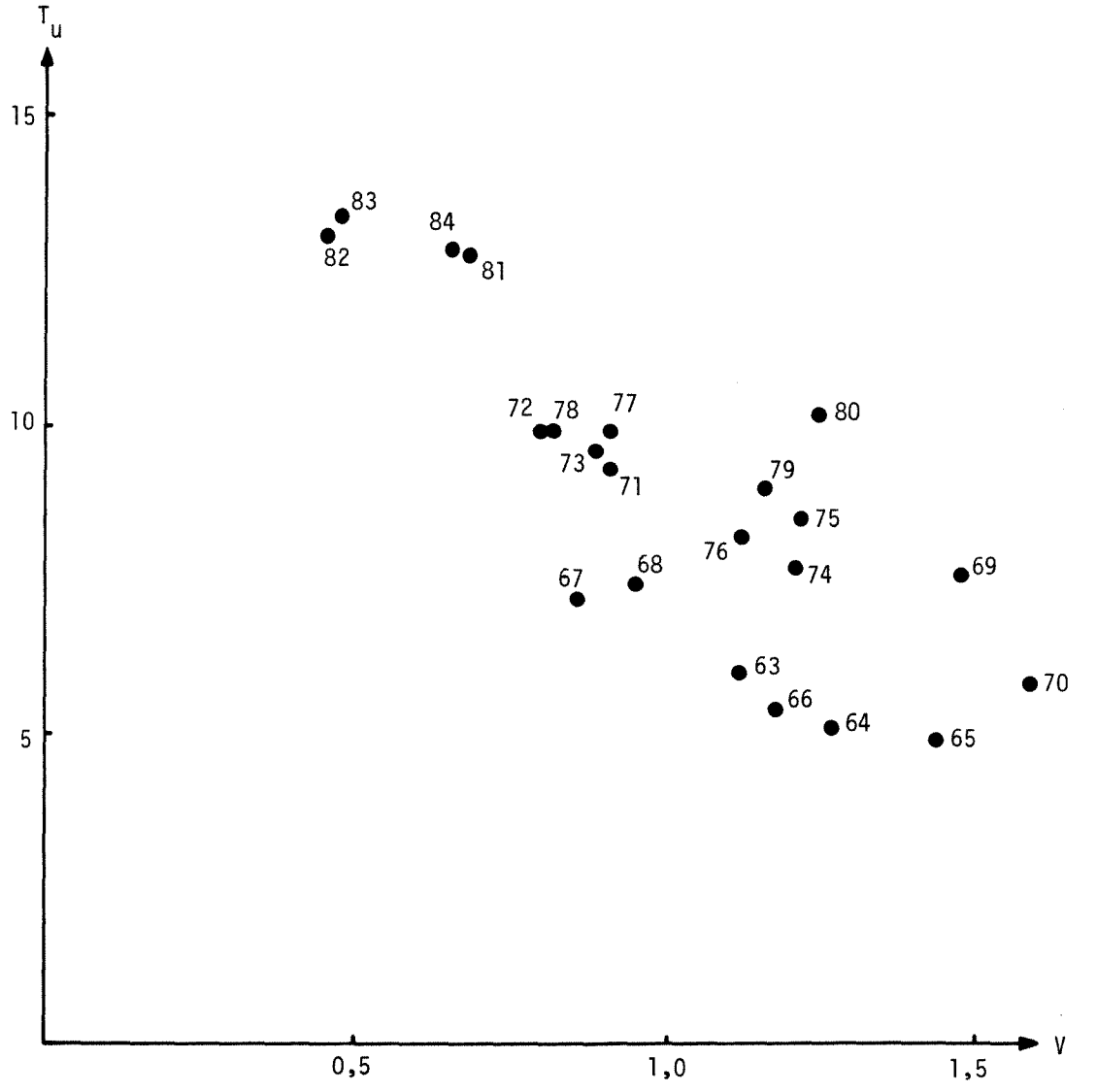
Source: See Table 1.

Figure 2 Duration of vacancies (T_v), weeks, and rate of unemployment (U), percent, manufacturing occupations 1964-84



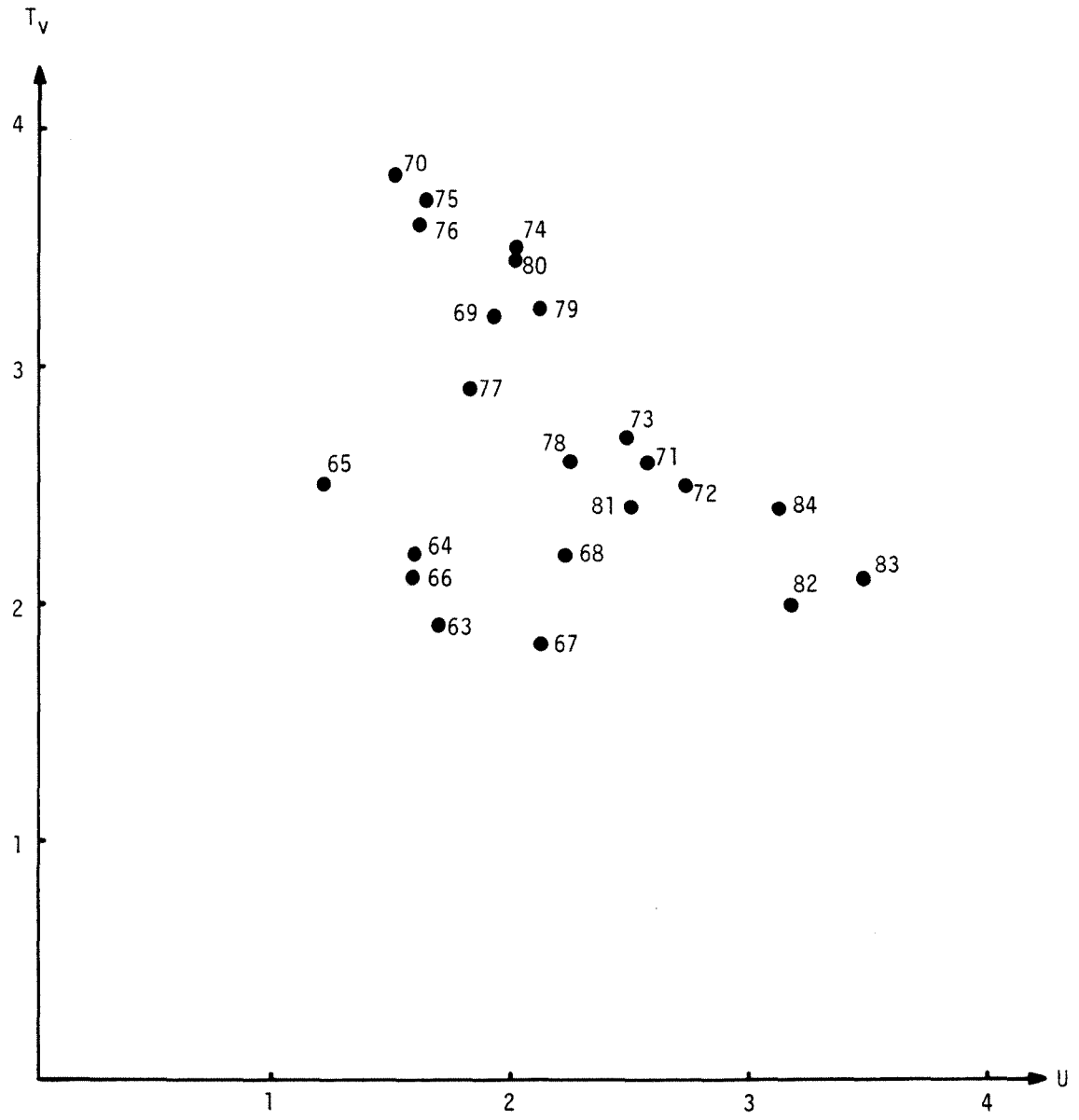
Source: See Table 1.

Figure 3 Duration of unemployment (T_u), weeks, and rate of vacancies (V), percent, total labour market 1963-84



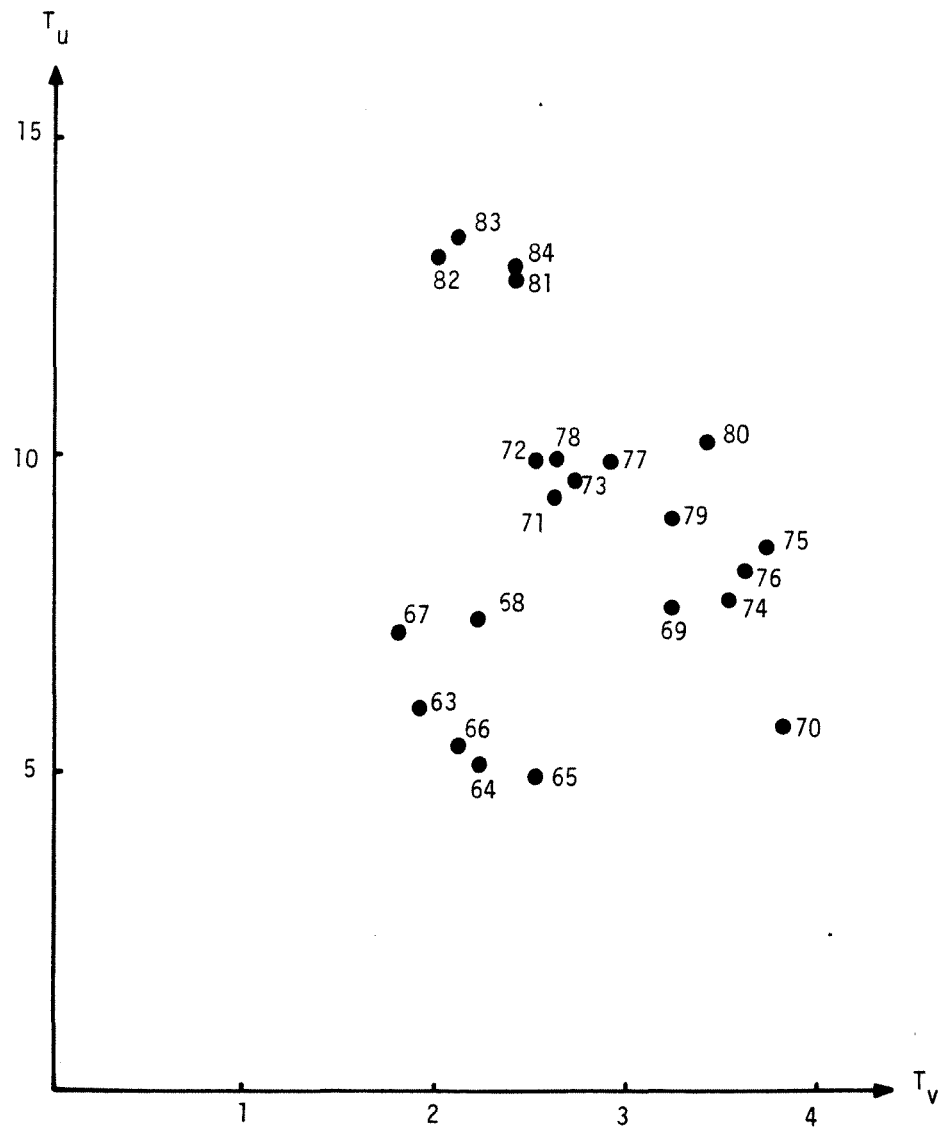
Source: See Table 2.

Figure 4 **Duration of vacancies (T_v), weeks, and rate of unemployment (U), percent, total labour market 1963-84**



Source: See Table 2.

Figure 5 Duration of unemployment (T_u), weeks, and duration of vacancies (T_v), weeks, total labour market 1963-84



Source: See Table 2.

Table 1 Manufacturing occupations

	T_V, weeks	V, %	U, %
1964	2,2	1,49	1,92
1965	2,5	1,76	1,34
1966	1,9	1,28	1,92
1967	1,4	0,76	2,86
1968	2,0	0,98	3,17
1969	3,7	2,16	2,53
1970	5,0	2,39	2,07
1971	3,2	1,04	3,70
1972	2,8	0,90	3,88
1973	3,4	1,19	3,54
1974	5,0	1,85	2,59
1975	5,8	1,74	2,13
1976	5,2	1,31	1,93
1977	3,5	0,73	2,05
1978	3,0	0,60	3,01
1979	5,0	1,26	2,66
1980	5,6	1,39	2,35
1981	3,1	0,50	3,42
1982	2,0	0,25	4,41
1983	2,0	0,27	4,59
1984	2,3	0,55	3,94

T_V = Duration of vacancies, based on monthly calculations of the outflow probability.

V = Reported stocks of vacancies as a ratio to labour force. Source: Labour Market Statistics, Labour Market Board.

U = Reported stocks of unemployment as a ratio to labour force. Source: Labour Force Surveys, Central Bureau of Statistics.

Table 2 Total labour market

	T_v, weeks	T_u^M, weeks	T_u^Y, weeks	V, %	U, %
1963	1,9		6,0	1,12	1,66
1964	2,2		5,1	1,27	1,56
1965	2,5		4,9	1,44	1,18
1966	2,1		5,4	1,18	1,56
1967	1,8		7,2	0,86	2,11
1968	2,2		7,4	0,95	2,22
1969	3,2		7,6	1,48	1,89
1970	3,8	5,7	(5,8)	1,59	1,51
1971	2,6	9,3	(8,5)	0,99	2,54
1972	2,5	9,9	(10,0)	0,80	2,70
1973	2,7	9,6	(10,1)	0,89	2,46
1974	3,5	7,7	(8,4)	1,21	1,99
1975	3,7	8,5	(8,6)	1,22	1,63
1976	3,6	8,2	(8,4)	1,12	1,60
1977	2,9	9,9	(9,4)	0,91	1,80
1978	2,6	9,9	(9,6)	0,82	2,93
1979	3,2	9,0	(9,6)	1,16	2,07
1980	3,4	10,2	(9,7)	1,25	1,98
1981	2,4	12,8	(11,6)	0,69	2,48
1982	2,0	13,1	(13,2)	0,46	3,15
1983	2,1	13,4	(13,1)	0,48	3,46
1984	2,4	12,9	(13,3)	0,66	3,09

Definitions of T_v, V and U: see Table 1.

T_u^M = Duration of unemployment, based on monthly calculations of the outflow probability.

T_u^Y = Duration of unemployment, based on a yearly average calculation of the outflow probability.

Table 3 Registered job-searchers

	Unemployed, thousands	Not unemployed, thousands
1976	72.9	61.0
1977	81.7	64.2
1978	102.6	76.0
1979	98.7	76.1
1980	94.6	66.2
1981	123.0	69.2
1982	161.3	80.3
1983	178.3	95.4
1984	159.3	111.1

Unemployed = registered job-searchers in 'category 1' according to Labour Market Board definitions.

Not employed = all registered job-searchers except those in 'category 1'

Source: Labour Market Statistics, Labour Market Board.

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