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On-the-Job Search and the Beveridge Curve

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Abstract

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This paper presents a theoretical and empirical investigation of the role on-the-job search plays in explaining shifts of the unemployment-vacancies relationship (the Beveridge curve). We show that the direction of the shift depends on the parameters of the matching model, regardless of the assumptions made on the relative search effectiveness of employed and unemployed searchers. We estimate a Beveridge Curve equation with a panel of British regions controlling for unobserved aggregate unemployment effects. We find evidence that the rise in on-the-job search in the 1980s has shifted the Beveridge Curve outwards.

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[1] Work on this paper started when Andrés Fuentes was at the Institute of Economics and Statistics, Wolfson College and Oriel College in the University of Oxford (U.K). The paper benefited from comments by Stephen Bond, Andrew Feltenstein, and Stephen Nickell. Maritza Morán expertly and patiently edited an initially unwieldy document. All errors remain the author's.

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I. INTRODUCTION

Empirical investigations of the steady state unemployment-vacancies relationship (the Beveridge curve) have played an important role in attempts to explain the variation in unemployment in developed countries over time. These studies (for example, Bleakley and Fuhrer 1997, Blanchard and Diamond, 1989, Pissarides, 1986) have interpreted increases in unemployment at given vacancies (outward shifts of the Beveridge curve) as increases in the equilibrium level of unemployment but have had limited success in explaining what causes the Beveridge curve to shift. Time dummy or trend variables pick up a substantial proportion of observed shifts in the Beveridge curve, and these effects are attributed to changes in the search effectiveness of the unemployed. This interpretation has in turn influenced policy recommendations on how best to reduce unemployment. The studies quoted above have left aside how changes in the mobility of workers between jobs may affect the Beveridge curve.

On the basis of a matching model of the labor market in which both employed and unemployed job searchers are matched to vacant jobs, Section II of this paper shows how changes in on-the-job search affect the Beveridge curve in theory. Section IV takes the issue up empirically on the basis of British data. As the diagram below shows, Britain has witnessed a dramatic increase in on-the-job search in the 1980s. We present an econometric investigation of the Beveridge curve in Britain, producing evidence that on-the-job search has contributed to shifting the Beveridge curve outwards. This is preceded by a description of the data in Section III.

The aim of this study is not to uncover all factors shifting the Beveridge curve, but to explore, for the first time, the role of on-the-job search in these shifts. This disaggregation of the data to the regional level will allow us to control for unobserved aggregate effects, such as changes in aggregate hiring efficiency. This makes the estimated effect of on-the-job search more reliable.
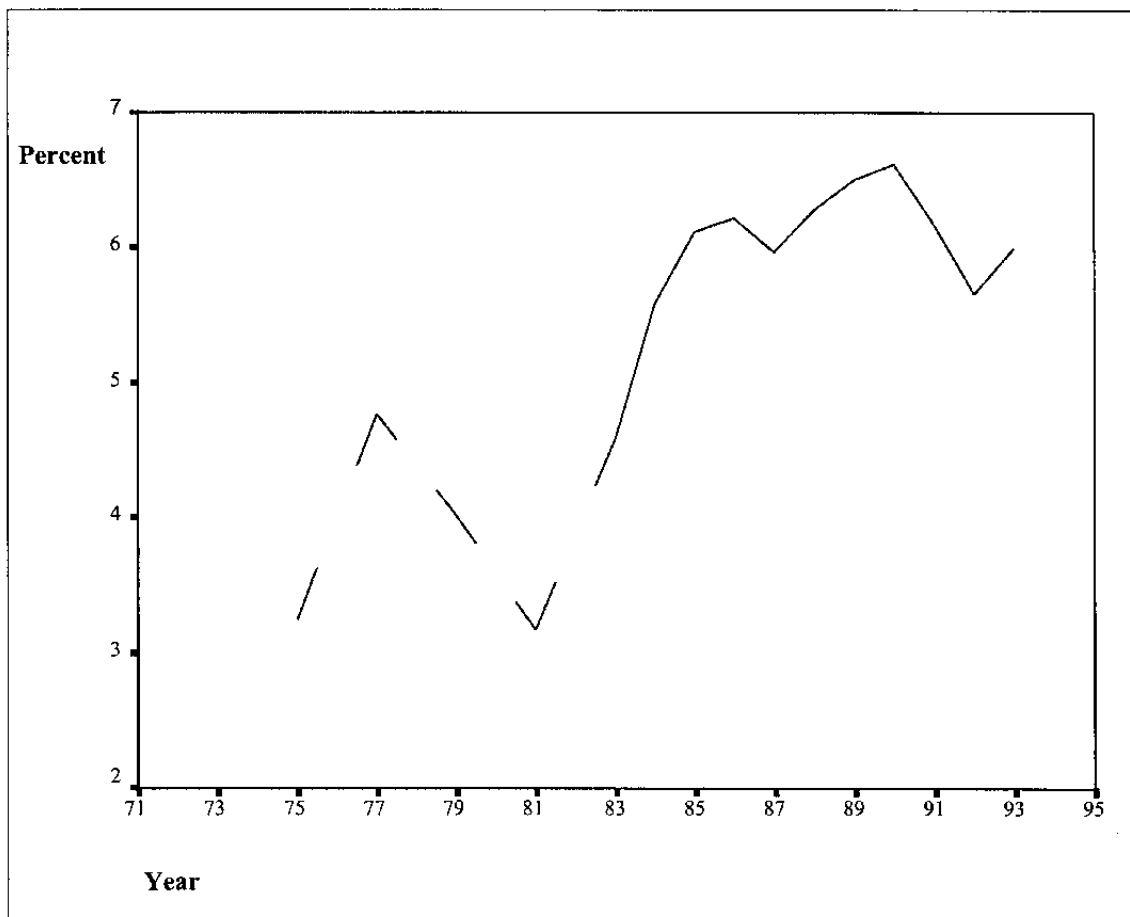
II. A MATCHING MODEL OF THE LABOR MARKET WITH ON-THE-JOB SEARCH

Some attention has been paid to endogenous on-the-job search, that is, to its responsiveness to labor market tightness, where labor market tightness is captured by the levels of unemployment and vacancies. Burgess (1993), in particular, investigates the implications of the responsiveness of on-the-job search to labor market tightness for the behavior of labor market flows. However, the responsiveness of on-the-job search to labor market tightness does not have any implications for the location of the Beveridge curve.

We are interested in the effects of those shifts in on-the-job search on the locus of the Beveridge curve which are caused by reasons other than labor market tightness. A vast search-theoretical literature on the determinants of a decision to search on-the-job points to such variables affecting on-the-job search (see, for example, Mortensen, 1986 and Burgess, 1992, 1993). Cross-section empirical investigations (Pissarides and Wadsworth, 1994; Hughes and McCormick; 1984 and Black, 1981) show that a range of demographic variables

and job characteristics affect the probability of an employed person engaging in job search. These include the level of education, age, job tenure, and deviations of individuals' wages from the expected wage, given qualifications and experience. Our own findings (Fuentes, 1998) suggest that the dramatic increase in wage dispersion in Britain may have contributed to increasing on-the-job search.

Figure 1. On-the-Job Search

Source: U.K. Labour Force Survey, own computations.

In order to focus on the implications of on-the-job search for turnover, unemployment and vacancies, we use a discrete time matching model of the labor market, similar to the time-continuous model proposed by Blanchard and Diamond (1989). The purpose of the discrete time framework is to allow for interactions between different types of labor market turnover which do not exist in a time-continuous matching model. In particular, we can allow the number of voluntary quits to influence the number of redundancies and therefore the inflow

into unemployment. This turns out to be important for the effect of on-the-job search on the location of the Beveridge curve.

We adopt two alternative extreme assumptions as to the employability of on-the-job searchers relative to unemployed job searchers. First, we assume that all searchers are perfectly substitutable so employers do not discriminate between applicants on the basis of their employment status. Second, we assume that employers who receive applications from both employed and unemployed job searchers always prefer the former to the latter. We refer to this as the ranking assumption. The idea of ranking of employed and unemployed searchers was first proposed by Anderson and Burgess (1995).

Ranking may result from incomplete information on the part of employers about the productivity of workers, giving employers incentives to screen applicants by employment status. The effects of screening may however not go so far as to render unemployed searchers completely non-competitive vis-à-vis their employed counterparts. Hence both polar assumptions of perfect substitutability and ranking will be investigated below.

In both the ranking and the perfect substitutability case, we make the underlying assumption that employed and unemployed job searchers apply for the same vacancies. Therefore, a larger number of employed job searchers always makes it harder, ceteris paribus, for an unemployed searcher to be hired. By the same token, if searchers of both types are perfectly substitutable, a larger number of unemployed searchers also makes it harder for an employed searcher to be hired, but this is not the case under the ranking assumption.

The number of jobs, J_t, is exogenous but not fixed. This assumption will serve our purpose, which is to investigate the effect of on-the-job search on the locus of the Beveridge curve through the interaction of labor market flows. Different levels of J_t are associated with different unemployment-vacancies combinations on any one Beveridge curve. We will also adopt this approach in the empirical analysis, where we regress unemployment on vacancies and variables shifting the curve.

Jobs can either be occupied or vacant:

$$J_t = E_t + V_t \tag{1}$$

where E_t and V_t denote employment and vacancies at the end of period t, respectively.

A fixed proportion, μ, of all the jobs (occupied and vacant) is destroyed and the same number of jobs is created in every period of time, holding the number of jobs constant. All newly created jobs are opened up as vacancies. The number of newly created jobs is given by:

$$N_t = \mu J_t \tag{2}$$

Employers and job seekers have to engage in costly search to find a match. It is assumed that this matching process can be summarized by an aggregate matching function as follows:

$$M_t = m(JS_{t-1}, V_{t-1})_t \quad \text{where} \quad JS_t = OJS_t + U_t \tag{3}$$

where M_t is the number of job matches per period and where OJS_t and U_t denote the number of employed and unemployed job searchers, respectively. Matches of workers to jobs in period t are a positive function of both the number of job searchers and the number of vacancies at the end of period t-1. Once a vacancy has been matched to a job searcher, we assume the probability that the match will be accepted by the searcher and the employer to be exogenous, and without further loss of generality we set it to one. By virtue of equation (3) all empty job slots are advertised at the end of period t-1 and therefore enter the matching process in period t.

However, a proportion μ of the matches involve vacancies which become unproductive in period t. Since the model is in discrete time, matching and job destruction can take place on the same time interval. Hires of matched workers take effect at the end of period t when previously unemployed workers change status or previously employed workers change jobs. In order to exclude the possibility that a worker, at the end of period t, is hired on a job slot which has been destroyed in period t it is assumed that no hires are made on vacancies which are destroyed in the same period. This makes sure that employed searchers who are matched to a vacant job slot in period t only quit their job if their new job is not destroyed before they can start working on it. As a result, only a proportion 1-μ of the matches are actually turned into hires:

$$H_t = h(JS_{t-1}, V_{t-1}) = (1 - \mu)M_t \tag{4}$$

The last assumption we make is that the number of on-the-job searchers is an exogenous proportion of employment:

$$OJS_t = \phi E_t \tag{5}$$

Hires can be made from the pool of the employed and the unemployed job seekers. There is no quitting into unemployment. The number of hires is therefore equivalent to the sum of quits and the flow out of unemployment:

$$H_t = Q_t + X_t \tag{6}$$

A. Perfect Substitutability Between Employed and Unemployed Job Searchers

The number of quits is the number of hires going to on-the-job searchers. If all job searchers are perfectly substitutable in the matching process, hires are allocated to employed and unemployed job searchers, respectively, according to the size of each group. If β is the proportion of on-the-job searchers among all searchers, quits are determined by:

$$Q_t = \beta_{t-1}H_t = \beta_{t-1}(1-\mu)M_t \tag{7}$$

where β_t is defined as

$$\beta_t = \frac{OJS_t}{OJS_t + U_t} = \frac{\phi(L_t - U_t)}{\phi(L_t - U_t) + U_t} = \frac{1}{1 + \dfrac{U_t}{\phi(L_t - U_t) + U_t}} \tag{8}$$

β_t is a function of the labor force L_t, unemployment U_t, and the proportion of on-the-job searchers, ϕ.

The stock of vacancies at the end of period t is given by

$$V_t = (1-\mu)V_{t-1} + N_t - (1-\mu)M_t + (1-\mu)Q_t \tag{9}$$

The number of vacancies in period t is thus determined as the sum of the vacant job slots remaining productive taken over from the previous period and the number of new job slots opening up (N_t). The number of vacancies is reduced through hiring, but new vacancies are opened as a result of quits of employed job seekers. However, only a proportion $(1-\mu)$ of the jobs they leave remain productive. For a proportion μ of jobs abandoned by quitters, no vacancies will be posted because the jobs become unproductive. Therefore, not all workers on jobs which become unproductive move into unemployment: Those who would have quitted anyway move to another job. The model thus allows for the inflow into unemployment to be affected by the number of quits:

$$I_t = \mu E_t - \mu Q_t = \mu E_t - \mu \beta_{t-1}(1-\mu)M_t \tag{10}$$

where I_t denotes the inflow into unemployment. It is worth noting that the effect of quits on the unemployment inflow arises because job destruction and quits can coincide. That is to say, firms which want to reduce employment need to make fewer employees redundant the more workers quit voluntarily. As will become apparent below, the effect of quits on the

unemployment inflow is crucial for determining the effect of on-the-job search on the Beveridge curve.

In steady state, $V_t - V_{t-1} = 0$. Substituting equations (3) and (7) in (9) and setting $V_t - V_{t-1} = 0$, equation (9) becomes

$$N - [1 - (1 - \mu)\beta](1 - \mu)m(JS, V) - \mu V = 0 \qquad (11)$$

where time subscripts are omitted to denote steady state values.

Taking into account that

$$N - \mu V = \mu(J - V) = \mu(L - U) \qquad (12)$$

Equation (11) can be rewritten as follows:

$$\mu(L - U) = [1 - (1 - \mu)\beta](1 - \mu)m(JS, V) \qquad (13)$$

Equation (13) can be used to derive the negative slope of the Beveridge curve.

In order to show how on-the-job search shifts the Beveridge curve we compute the partial derivative of V with respect to ϕ, holding unemployment fixed. If vacancies rise as the proportion of on-the-job searchers increases, holding unemployment constant, the Beveridge curve shifts outwards in response to a rise in on-the-job search.

Differentiating equation (13) with respect to ϕ, holding unemployment fixed, and substituting

$$\frac{\partial \beta}{\partial \phi} = \frac{(L - U)U}{JS^2} \quad \text{and} \quad \frac{U}{JS} = 1 - \beta \qquad (14)$$

yields

$$\frac{\partial V}{\partial \phi} = \frac{L - U}{\frac{\partial M}{\partial V}} \left(\frac{(1 - \mu)(1 - \beta)}{[1 - (1 - \mu)\beta]} \frac{M}{JS} - \frac{\partial M}{\partial JS} \right) \qquad (15)$$

Rearranging the term in brackets it is easy to show that the derivative of V with respect to ϕ is positive if and only if the following condition holds:

$$\eta_{H,JS} < 1 - \frac{\mu}{1-(1-\mu)\beta} \qquad (16)$$

where $\eta_{H,JS}$ is the elasticity of hires with respect to the number of job searchers. If this condition is met, an increase in the proportion of workers searching on-the-job shifts the Beveridge curve outwards. The expression on the right-hand-side of this inequality is smaller than one. Thus, even imposing the condition that the elasticity of hires with respect to the number of job searchers be smaller than one does not yield an unambiguous sign for the effect of shifts in on-the-job search on the Beveridge curve. Shifts in on-the-job search change the location of the Beveridge curve when both groups of searchers are perfectly substitutable but the direction of the change cannot be established.[2]

The Beveridge curve is more likely to move outwards in response to increases in on-the-job search the smaller the rate of job turnover, μ. The intuition of this results is as follows: If job turnover is low, relatively few job-to-job quitters leave jobs which become unproductive, thus mitigating the negative effect job-to-job quits have on the unemployment inflow, whereas relatively many job-to-job quitters leave vacant jobs behind, thus increasing friction in the labor market.

On-the-job search is also more likely to shift the Beveridge curve outwards the smaller the elasticity of hires with respect to job searchers and the smaller the number of on-the-job searchers relative to the number of unemployed searchers.

B. Ranking

We contrast our assumption of perfect substitutability of searchers with the assumption at the other extreme of relative search effectiveness, namely that employers strictly prefer employed to unemployed searchers. The ranking rule we adopt is akin to Blanchard's and Diamond's (1994) model in which employers rank the unemployed according to the duration of their unemployment spells.

We assume that any vacancy can receive several applications and that employed and unemployed searchers make the same search effort. If a vacancy receives applications from

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[2] In Pissarides' (1994) model of labor market turnover shifts in on-the-job search unambiguously shift the Beveridge curve outwards because his model assumes an exogenous inflow into unemployment and hence does not allow for quits to have an effect on the number of dismissals).

employed and unemployed searchers, employers will always hire an employed job searcher. However, if a vacancy only receives applications from unemployed searchers the employer does not wait for an employed searcher to arrive in a later period, and an unemployed searcher gets the job. Thus, the ranking rule does not affect the total number of hires made, only the composition of hires. The matching function of equation (3) still applies.

On-the-job searchers do not compete with the unemployed for jobs. As a result of ranking, the presence of unemployed searchers is irrelevant for the number of matches made from the pool of on-the-job searchers. The number of matches involving on-the-job searchers is therefore given by evaluating the matching function at the number of on-the-job searchers, $m(OJS^*_{t-1}, V_{t-1})$, where OJS^*_{t-1} indicates the value at which the matching function is evaluated (that is, at $JS_{t-1}=OJS^*_{t-1}$). The total number of matches is determined by the value of the matching function at the total number of job searchers, $m(JS^*_{t-1}, V_{t-1})$. Matches of unemployed searchers are the matches not taken up by their employed counterparts, $m(JS^*_{t-1}, V_{t-1})-m(OJS^*_{t-1}, V_{t-1})$. Quits, then, are determined as follows:

$$Q_t = (1-\mu)m(OJS^*_{t-1}, V_{t-1}) \qquad (17)$$

and vacancies are given by

$$V_t = (1-\mu)V_{t-1} + N_t - (1-\mu)m(JS^*_{t-1}, V_{t-1}) + (1-\mu)^2 m(OJS^*_{t-1}, V_{t-1}) \qquad (18)$$

This expression is identical to equation (9), with the last two terms reflecting the ranking assumption. Note that, here too, not all quits lead to vacancy openings, because some quitters leave jobs behind which become unproductive and therefore need not be filled again.

Setting $V_t - V_{t-1} = 0$, differentiating with respect to the proportion of on-the-job searchers, ϕ, and solving for the partial derivative of steady-state vacancies with respect to ϕ (holding unemployment constant) now yields

$$\frac{\partial V}{\partial \phi} = \frac{\left[(1-\mu)\frac{\partial M}{\partial JS}\big|_{JS = OJS^*} - \frac{\partial M}{\partial JS}\big|_{JS = JS^*}\right](L-U)}{\frac{\partial M}{\partial V}\big|_{JS = JS^*} - (1-\mu)\frac{\partial M}{\partial V}\big|_{JS = OJS^*}}. \qquad (19)$$

The denominator is unambiguously positive if

$$\frac{\partial M}{\partial V}\big|_{JS = JS^*} \geq \frac{\partial M}{\partial V}\big|_{JS = OJS^*} \qquad (20)$$

which is the case if we assume that the cross second order derivatives are positive. The numerator, however, again does not have an unambiguous sign even if we assume (as is usually done for matching functions) that the second order derivative with respect to the number of job searchers is negative. Once more the ambiguity of the sign of this expression stems from the effect of quits on the unemployment inflow. Thus, the direction in which on-the-job search shifts the Beveridge curve remains an issue for empirical investigation regardless of the assumptions on search effectiveness.

III. THE DATA

The data consist of a panel for the 10 British standard regions covering the years from 1979 till 1993. This will allow us to control for region specific fixed effects as well as for time specific aggregate fixed effects.

Most data are taken from the U.K. Labour Force Survey. Over the sample period the surveys were conducted between March and June. A detailed description of the data is available from the author on request. Changes in the U.K. Labour Force Survey in 1983, 1984, and 1987 affected employment and unemployment figures. We have obtained a nearly fully consistent data series for employment since 1979. This, however, requires changes to the definition of employment in the raw survey data from 1983 onwards.

The survey question dealing with on-the-job search has been the same in all years in which the survey has been conducted. Respondents are asked whether they were looking for a different or additional job in the reference week (usually the week before the interview). Not all the inconsistencies affecting unemployment can be removed. Up to 1986, people without a job were only coded as unemployed if they had done some search in the reference week or the week before. Since 1987, the requirement has been for some search activity in the four weeks preceding the interview. This has slightly increased the unemployment count. In the econometric analysis below on-the-job search will be instrumented with the proportion of professional and managerial workers in the labor force. This variable is based on the occupational classifications of the Labor Force Survey. The Labor Force Survey not only provides information on the current occupation of employed workers' jobs but also on the occupations of the unemployed in their last job before becoming unemployed. First-time unemployed entrants into the labor force were excluded in the calculation of this variable.

Data on the vacancy rate (constructed by dividing by employment) are based on the number of vacancies notified to job centers. They were obtained from the Department of Employment Gazette and were adjusted to correct for changes over time in the proportion of vacancies which were notified. The replacement ratio is computed by dividing the standard personal unemployment benefit rate (including earnings related supplement when applicable) by gross male full-time earnings.

IV. EMPIRICAL EVIDENCE

The theoretical model above predicts that, in steady state, the proportion of employed workers engaged in job search may increase or decrease unemployment for a given number of vacancies, depending on some structural features of the labor market. To shed more light on the issue we regress unemployment on vacancies, the proportion of employed workers searching on-the-job and additional variables that may shift the Beveridge curve as well as on fixed region and time effects.[3] To allow for the fact that unemployment and vacancies are not in steady state, we include a lagged dependent variable in the list of regressors.

Among the variables proposed in the empirical literature to account for the outward shift of the Beveridge curve in the 1970s and 1980s, sectoral mismatch between unemployed job seekers and employers and the replacement ratio have been prime candidates. Neither has received empirical support, see for example, Burgess 1993, Nickell, Layard, and Jackman 1991 (Chapter 6), Layard and Nickell 1986, Pissarides 1986.

In order to take account of the fact that most unemployed people's potential earnings are well below average earnings, we use the ten percentile of male full-time earnings as the denominator of the replacement ratio. Given the increase in wage dispersion in the last thirty years, this makes some difference to its behavior over time.

Another explanation for outward shifts of the Beveridge curve is "duration dependence." According to this hypothesis, an unemployed individual's reemployment probability declines as their unemployment spell grows longer because of demotivation, skill loss, or because employers use the duration of applicants' unemployment spells as a screening device.

In contrast to Budd et al (1988), and Jackman Layard and Nickell (1991, Chapter 5), Pissarides (1986) does not find a significant negative impact of the proportion of the long-term unemployed on the unemployment outflow rate, a result he relates to the fact that, in his data based on benefit entitlement, much of the unemployment outflow was into early retirement rather than into employment. Burgess (1993) and Burgess and Attfield (1990) provide conflicting evidence using similar data as Pissarides.

While studies of duration-specific exit rates from unemployment to employment potentially provide more insight into duration dependence, they have to cope with the difficulty of distinguishing between unobserved heterogeneity and "pure" duration dependence: Lower exit rates at long unemployment duration may result from the most employable searchers finding jobs more quickly than less employable searchers rather than from individuals becoming less employable as their unemployment spell becomes longer. To identify the "pure" duration dependence effect, strong assumptions on the functional form are made in

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[3] The choice of unemployment as the dependent variable and vacancies as an independent variable is arbitrary and follows common practice.

the equation relating exit rates to "pure" duration dependence and heterogeneity. Most studies on the U.K. find evidence of negative duration dependence (for example, Burgess and Turon, 2000, see Machin and Manning, 1999, for a review of the earlier literature).

Bleakley and Fuhrer (1997) suggest that flows into and out of the labor force as well as job turnover have contributed to the observed shifts in the U.S. Beveridge curve. Further potentially important variables for explaining shifts of the Beveridge curve are employment security legislation and the eligibility to benefits. These are likely to have similar effects nationwide and we will therefore control for these effects with time dummies.

A. Identification

Burgess (1993) notes that the optimal search decision of an employed worker depends on the rate of arrival of job offers, and therefore on the tightness of the labor market. Hence it is necessary to instrument on-the-job search in the Beveridge curve equation. We use the proportion of workers in the labor force with professional or managerial jobs as instruments. By using the skill composition of the labor force we "iron out" cyclical influences on the skill composition of employment in order to attain a higher degree of exogeneity for this instrument. We instrument the replacement ratio with its lag. The vacancy rate on the right-hand-side is predetermined.

As noted above, a lagged dependent variable needs to be included in the estimated equation, rendering the fixed effects estimator inconsistent. The vacancy rate, too, is a predetermined but not strictly exogenous variable by construction. Therefore, estimation was conducted in first differences following Anderson and Hsiao (see Hsiao, 1986) and Arellano and Bond (1991). Anderson and Hsiao suggest using the dependent variable lagged twice or its first difference lagged twice as instrument for the lagged dependent variable. Generalized methods of moments estimation suggested by Arellano and Bond is asymptotically more efficient than the Anderson-Hsiao estimator. Since our number of observations is relatively small, we cannot use the full range of instruments of the Arellano and Bond estimator, so we combined it with the Anderson-Hsiao estimator. For the lags of the vacancy rate and the replacement rate in the instrument set we followed Anderson and Hsiao. For the lagged dependent variable, we used the instruments suggested by Arellano and Bond. In addition we limited the maximum number of lags to three. Since robust standard errors of coefficients are consistent in the presence of heteroscedasticity only if the number of cross-sections approaches infinity, we present t-statistics based on conventional and robust standard errors.

Generalized least squares was performed, incorporating the assumption of an MA(1) error term in the differenced equation. The presence of first-order and second-order serial correlation was tested and found to be consistent with the MA(1) assumption.

B. Results

Our results confirm the existence of the negative relationship between unemployment and vacancies posited by the Beveridge curve. The replacement ratio proved to be significant at the ten percent level only if inference is based on non-robust standard errors (see Table 1). The proportion of those unemployed for more than two years was not significant at the 10 percent level, and was therefore dropped.

The finding of a only marginally significant and small effect of the replacement ratio on the Beveridge curve is in line with the findings in other studies of the unemployment vacancies relationship. It is also consistent with the findings of microeconometric studies using data on individual unemployment spells which estimate positive but small effects of the replacement ratio on unemployment duration (see for example, Narendranathan and Nickell 1985).

However, the result of an insignificant impact of the proportion of long-term unemployed workers appears to be at odds with the presence of duration dependence in unemployment in the UK. However, if duration dependence leads to reduced search effort, long-term unemployed workers may decide to give up searching altogether in which case they drop out of the Labour Force Survey unemployment count. Our findings are therefore not inconsistent with the duration dependence found in U.K. unemployment data.

The presence of duration dependence in unemployment suggests a further transmission mechanism through which on-the-job search may increase the equilibrium unemployment rate, in addition to the job competition effect described in the theoretical section of this paper: On-the-job search reduces the unemployment outflow rate, and therefore the average duration of unemployment spells, which in the presence of duration dependence increases the total unemployment stock.

On-the-job search has a statistically significant effect on the Beveridge curve at the 5 percent level no matter whether inference is based on non-robust or on robust standard errors. Our results thus lend support to the hypothesis that on-the-job search matters for the location of the Beveridge curve, shifting it outwards.

This study has focused on the effect of on-the-job search on the Beveridge curve, taking into account effects of the replacement ratio and the duration composition of unemployment. It does, of course, not deny the relevance of other factors. These are likely to be aggregate effects, captured by the time dummies.

Table 1. The Beveridge Curve: First Differences Instrumental Variables

Generalized Method of Moments. Dependent Variable: Unemployment Rate

	Coefficient	t-Statistic		Descriptives	
		Non-Robust	Robust	Mean	Standard Deviation
Unemployment (-1)	0.29	2.56	2.83	2.16	0.35
Vacancies	-0.40	-5.16	-8.44	0.49	0.36
On-the-job search	0.14	2.65	1.95	5.31	1.23
Replacement ratio	0.06	1.88	1.52	26.91	1.34
Time dummies		Yes			
1st order serial correlation		-4.30		-2.37	
2nd order serial correlation		0.62		0.60	

Notes:
Number of observations: 140; sample period: 1980–1993.
Mean of dependent variable:2.18; standard deviation of dependent variable: 0.33.
Instruments: dependent variable lagged twice and three times, lagged vacancies, proportion of professional and managerial workers of the labor force, replacement ratio lagged twice. The unemployment and vacancies variables are rates obtained by dividing by the labor force and by employment, respectively. They are in logs. The number of on-the-job searchers is divided by employment.

V. CONCLUSIONS

The observation that increases in unemployment in OECD countries have coincided with outward shifts in the Beveridge curve and increases in unemployment duration has given rise to the conjecture that the causes of high unemployment must be sought in the search behavior of the unemployed and in institutions that reduce their search effectiveness. This paper demonstrates, however, that search behavior of employed workers also matters for the Beveridge curve and hence for equilibrium unemployment.[4] On-the-job search shifts the Beveridge curve inwards or outwards depending on a range of structural features of the labor market highlighted by our model. In particular, a low degree of job turnover and a small elasticity of hires with respect to the number of job searchers make an outward shifting effect of on-the-job search more likely. Our empirical results suggest that, in Britain, on-the-job search shifts the Beveridge curve outwards.

This study has focused on the interactions of worker flows between jobs, employment and unemployment, leaving issues such as the determination of wages and of job offer acceptance rates aside. Hence policy conclusions cannot be based on this study alone. Exploring the role of on-the-job search in the determination of equilibrium unemployment in more countries is a fruitful avenue for future research, given the availability of data on on-the-job search in the European Union's Labour Force Survey.

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[4] The point that on-the-job search matters for explaining unemployment dynamics has been made forcefully by Burgess and Turon (2000).

References

Anderson, P. M. and S. M. Burgess, 1995, Empirical Matching Functions: Estimation and Interpretation Using Disaggregate Data, *National Bureau of Economic Research*, Working Paper No. 5001.

Arellano, M. and S. Bond, 1991, "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," *Review of Economic Studies*, Vol. 58, pp. 277–297.

Black, M., 1981, "An Empirical Test of the Theory of On-the-Job Search, *Journal of Human Resources*, Vol. 16, pp. 141–151.

Blanchard, O. J. and P. Diamond, 1994, "Ranking, Unemployment Duration, and Wages," *Review of Economic Studies*, Vol. 61, 417–434.

Blanchard, O. J. and P. Diamond, 1989, "The Beveridge Curve," *Brookings Papers on Economic Activity 1989*, Vol. 1, pp. 1–60.

Bleakley, H. and J.C. Fuhrer, 1997, "Shifts in the Beveridge Cure, Job Matching, and Labor Market Dynamics," *New England Economic Review*, Vol. Sept.–Oct. 1997.

Budd, A., P. Levine, and P. Smith, 1988, Unemployment, Vacancies and the Long-term Unemployed," *Economic Journal,* Vol. 98, pp. 1071–91.

Burgess, S.M., 1993, "A Model of Competition Between Unemployed and Employed Job Searchers: An Application to the Unemployment Outflow Rate in Britain," *Economic Journal*, Vol. 103, pp. 1190–1204.

S. M. Burgess, 1992, "A Search Model with Job Changing Costs: Eurosclerosis and Unemployment," *Oxford Economic Papers*, Vol. 44, pp. 75–88.

Burgess, S.M. and C.L.F Attfield, 1990, "A model of Job Matching and of Job Competition," *University of Bristol Department of Economics, mimeo.*

Burgess, S. M. and H. Turon, 2000, "Unemployment Dynamics, Duration and Equilibrium: Evidence from Britain," *Centre for Economic Performance, London School of Economics, mimeo.*

Fuentes, A., 1998, "The Determinants of On-the-Job Search, A time series analysis for Britain", *Institute of Economics and Statistics, University of Oxford, mimeo.*

Hsiao, C., 1986, "Analysis of Panel Data," *Cambridge University Press*, Cambridge.

Hughes, J.A. and B. McCormick, 1984, "An Empirical Analysis of On-the-Job Search and Job Mobility," *Manchester School*, Vol. 52, pp. 76–95.

Jackman, R., R. Layard, and C. Pissarides, 1989, "On Vacancies," *Oxford Bulletin of Economics and Statistics*, Vol. 51, pp. 377–94.

Layard, R., S. Nickell, and R. Jackman, 1991, "Unemployment, Macroeconomic Performance and the Labour Market," *Oxford University Press, Oxford.*

Machin, S. and A. Manning, 1999, "The Causes and Consequences of Long-Term Unemployment in Europe," in *Handbook of Labor Economics vol. 3C*, O. Ashenfelter and D. Card, eds (Amsterdam, The Netherlands: North Holland).

Narendranathan, W. and S. J. Nickell (1985), "Modeling the Process of Job Search", *Journal of Econometrics*, Vol. 28, pp. 29-49.

Pissarides, C. A., 1994, "Search Unemployment with On-the-Job Search," *Review of Economic Studies*, Vol. 61, pp. 457–475.

Pissarides, C. A., 1986, "Unemployment and Vacancies in Britain," *Economic Policy*, Vol. 3, pp. 500–40.

Pissarides, C. A. and J. Wadsworth, 1994, "On-the-Job Search, Some Empirical Evidence From Britain," *European Economic Review*, Vol. 38, pp. 385–401.