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Vacancy Dynamics and Labor Market Efficiency in the Dutch Labor Market

CEES GORTER, PETER NIJKAMP, ERIC PELS

ABSTRACT This paper focuses on cyclical and regional variations in vacancy dynamics in labor markets with persistent imbalances between demand and supply. In particular the so-called matching approach is used to investigate labor market efficiency across regions and over the business cycle. In this matching approach the relationship between the flow of filled vacancies and regional stocks of unemployed job seekers and vacant jobs is specified in a "search production" function. The matching approach is applied to the Dutch labor market, which is characterized by strong disequilibria and persistent regional differences in unemployment and vacancy rates. To explore the development of these regional imbalances from a demand side perspective, the dynamic structure of regional data on vacancies is analyzed over the business cycle. The movements of vacancy duration and the change in the vacancy stock over time appear to be similar across Dutch regions. Moreover, an investigation of the structural causes of regional variations in vacancy duration via shift-share analysis makes clear that regional differences in sectoral composition of unfilled vacancies do not contribute to regional differences in vacancy duration in the period 1989-93. Estimation results of a matching model reveal that there are no region-specific differences in labor market efficiency to produce filled vacancies. The ratio of vacancies to unemployment appears to be the critical determinant of the matching process in the Dutch regions. Another general (non region-specific) finding is that the estimated labor market efficiency increases during recessionary and recovery periods while it decreases during an economic boom.

Issues in Spatial Labor Market Research

Most labor markets in Europe are showing signs of strong and persistent disequilibria. The consequences of these structural disequilibria (in particular, the high level of unemployment) are far-reaching for national economies in terms of productivity and welfare losses. In the last decade, the

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Dutch labor market is characterized by a high level of economic inactivity, which is reflected in an absolutely high number of unemployed and disabled people and—in comparison with other European countries—relatively low participation rates (especially for women). Despite this continuous state of excess supply, employers faced difficulties in filling vacant jobs when employment expanded substantially during the period 1985-1992. In other words, the Dutch labor market was confronted with a qualitative mismatch of supply and demand. Another important feature of the Dutch labor market is found in persistent regional differences in the level of unemployment and vacancies. A persistent unequal regional distribution of unemployment and vacancies and an increasing mismatch of people seeking work and vacant jobs to be filled calls for comprehensive research into the functioning of regional labor markets in general and the dynamics of regional unemployment and vacancies in particular (see also Gorter 1991).

In analyzing the dynamics of regional unemployment, two important phenomena have received much attention in the literature. First, in many publications the focus has been on *the cyclical sensitivity of regional economies* by comparing regional and national trends in unemployment. One of the main explanations for persistent differences in regional unemployment rates was usually found in the industrial structure of the regional economy (see Fischer and Nijkamp 1987). In particular, the dominance of certain firms in a region appeared to play a major role in the functioning of the local labor market (see for example, Lever 1981). Studies of the dynamics in spatial variations in unemployment revealed that regional unemployment rates tend to converge if the economy is entering a recession and to diverge if the economy is leaving a state of recession (see Gleave 1987). Besides adding empirical evidence to the hypothesis that regional unemployment rates converge when, *ceteris paribus*, national rates increase (and diverge when national rates decrease), Gleave also stresses the relevance of capital formation and rigidities in regional housing markets in analyses of labor market dynamics. In addition, he argues that the impact of technical change and product and process innovations should also be taken into account in studies on the matching of supply and demand in (regional) labor markets.

A second main topic in the field of the dynamics of regional unemployment concerns *the distribution of the unemployment inflow and average unemployment duration* (which is the result of the flow out of unemployment). A decomposition of the unemployment stock into the unemployment inflow and the average duration of unemployment can be used to examine the dynamic structure of regional unemployment. In this way, one obtains a better insight into the causes of regional unemployment (high inflow, high mean duration, or both). For example, Gorter (1991) found for the Dutch labor market that regions with the same level of unemployment show divergent

combinations of inflow and duration. Such a finding gives rise to the development of a different remedial policy, which should focus either on the reduction of inflows, or the reduction of duration (or both). Such practices can be found now in many European countries.

Spatial labor market research into the determinants of the demand side of the labor market is, however, much less developed (see also Fischer and Nijkamp 1987). In most spatial labor demand studies, attention has been devoted to the role of production technologies at the demand side. In this respect, Rietveld and Nijkamp (1987) conclude that "technological development has far reaching consequences for the size of labor demand and its composition according to skills and region."

Only recently, spatial aspects of filling vacant jobs have been examined in studies on vacancy duration at the firm's level (see Gorter 1991). Moreover, the spatial distribution of new employees hired by firms was analyzed by Russo et al. (1996). In recent years, employers' recruitment behavior has also been studied in order to reveal the determinants of vacancy duration without paying attention to spatial aspects (see, for example, Roper 1988; Russo et al. 1994; Van Ours 1989, 1990; Van Ours and Ridder 1992, 1993; Gorter et al. 1996; Gorter and Van Ommeren 1996), while Van Ours and Ridder (1991) focused on the cyclical variation in vacancy duration and flows of newly created vacancies (also referred to as vacancy inflows). It is interesting to mention that the latter study shows that the cyclical pattern of vacancy inflows and vacancy duration differs between educational levels, but is similar when comparing different occupational groups (namely, clerical/business and technical). Gorter (1991) examined regional variations in the dynamic components of the stock of vacancies for the year 1986. The results of this analysis make clear that additional information can be gained from this decomposition, since certain regions with similar vacancy rates appear to exhibit strongly opposite outcomes for vacancy inflow and duration. It can be concluded that empirical research into the dynamics of vacancies from a spatial perspective is almost absent or at best underdeveloped.

Ideally, one would like to investigate the functioning of the (regional) labor market by using an integrated approach in which the matching process is the final outcome of the search behavior of (unemployed) job seekers, U , and employers with vacant jobs, V . At the aggregated level, this means that the focus is not on stocks (traditional UV-analysis), but on labor market flows ("flow-approach").¹ In particular, a matching or "search production" function specifies the relationship between the flow of filled job vacancies and the stocks of job seekers and job vacancies in which the constant term reflects the efficiency of the labor market. This approach stems originally from the study of Holt and David (1966), but has only recently become very popular in empirical work (see for example, Blanchard and Diamond 1989, 1992;

Jackman et al. 1989). In a recent study for Dutch regional labor markets, Gorter and Van Ours (1994) use the matching approach to identify to what extent the differences in unemployment and vacancy rates are due to differences in regional labor market efficiency. They find that regional differences in efficiency appear to be small for most regions (during 1980-88), suggesting that a reduction in regional unemployment should be achieved by stimulating regional labor demand.

The main purpose of this paper is to investigate spatial and cyclical variations in labor market performance (or efficiency) in a matching framework for the Dutch labor market. Our empirical investigation of this matching relationship is based on regional (provincial) data for the Netherlands on vacancy duration for the period 1980-1993. For the last five years of this period, data on the occupational-duration composition of vacancies will also be used. Hence, this analysis consists of two building blocks.

First, the "richer" data for the period 1989-1993 is explored to test whether regional differences in vacancy duration are due to the regional distribution of the vacancy stock over the occupational groups. If this is not the case, other regional causes can be held responsible for the observed differences. This test is carried out by a shift-share analysis.

Second, pooled cross-section time series data on vacancy duration, vacancy, and unemployment stock are used in a matching framework in order to identify the effects on the matching process of (i) unemployment and vacancies, (ii) region-specific effects in labor market effectiveness, and (iii) variations in labor market efficiency over time. The first factor would indicate that regional differences in the level of unemployment and vacancies are responsible for regional differences in the matching intensity, while the second implies that regions differ with respect to their ability to produce successful contacts (matches) between job seekers and employers with vacant jobs. The last factor would point at the general (non-regional specific) impact of the business cycle on labor market efficiency.

Developments in Dutch Regional Labor Markets (1980-93)

It will be shown in this section that the Dutch labor market is characterized by enormous discrepancies between supply and demand since the beginning of the 1980s. To elucidate this phenomenon, the pattern of unemployment, vacancies and matches (flow of filled vacancies) is presented during 1980-93 in Figure 1.

A huge rise of unemployment is observed during the major recession at the beginning of the 80s. Afterwards, the level of unemployment remains high with only a gradual decline during the recovery period during the mid 80s. It should be noted that the sharp decrease in 1989 is mainly due to a change in definition of unemployment (which causes a drop of about 45 percent).

Figure 1. Unemployment, vacancies, and matches (1980-93) in the Dutch labor market.

The number of vacancies decreased sharply at the beginning of the 80s (there are hardly any vacancies left in the economy). During the period of economic recovery (with high employment growth) in the mid-80s a growing number of vacancies are also observed. A high peak in the number of vacancies occurs at the end of the 80s (1989-1990), but there appears to be a rapid decline afterwards (to the level of 1981).

The flow of filled vacancies increased considerably during the 80s and reached its maximum level in 1987-1988, then it rapidly declined in 1989-1990 and reached a second peak in 1991. At the end of the observation period (1991-93), it fell back, however, to the low level of the beginning of the 80s.²

When the pattern of regional unemployment and vacancies is examined, it is interesting that similar movements over time for all regions can be observed. The level of unemployment and vacancies is, however, remarkably different across regions. In particular, the northern (peripheral) regions suffer from high unemployment rates and low vacancy rates, whereas the core regions usually show high vacancy rates and moderate unemployment levels.

Moreover, when the degree of regional (provincial) mismatch between unemployment and vacancies shown in Figure 2,³ is examined, it becomes clear that this is extremely low in the Netherlands (given a maximum value of 2). Also, during the major recession (at the beginning of the 80s) the regional mismatch decreases even further because there is excess supply in all regions. When the economy moves towards a peak (1990) the regional mismatch increases somewhat, but still remains very low. The same conclusion can be drawn with respect to interprovincial migration rates. For example, in 1985 the interprovincial migration rate was only 1.3 percent of total labor force (see Evers 1987). Interprovincial commuting rates appear to be somewhat higher,

Figure 2. Regional (provincial) mismatch in the Netherlands (1980-93)

but are still small (i.e., less than 6 percent during the beginning of the eighties, see also Evers 1987). In this respect, it is also noteworthy that Dutch workers are, on average, more willing to commute than to migrate (for more details on this “substitution” migration behavior, see Evers 1989). Commuting distances are, however, also quite low (only about 15 km on average for the Netherlands as a whole, see Netherlands Central Bureau of Statistics 1993).

Regional Variations in Vacancy Dynamics

In this section, regional differences in vacancies will be explored by looking at dynamic components of the vacancy stock across regions and over time. The demarcation of spatial labor markets to be used in empirical analysis is strongly influenced by the availability of data. In particular, the lack of spatially disaggregated data on vacancy duration forces regional labor markets to be defined on the basis of administrative entities (Dutch provinces). The use of provincial data raises the question whether provinces may be considered as “closed” labor market areas, i.e., areas within which most people both work and live. The appropriateness of the assumption that provinces are “closed” labor markets was already investigated (partly based on migration and commuting rates) in a previous study on the functioning of Dutch regional labor markets (see Gorter and Van Ours 1994). They conclude that although “there is a degree of interprovincial matching in The Netherlands ..., in general it seems reasonable to assume that people will find jobs in the province where they live.” In addition, it was shown in the previous section that provincial

mismatch between unemployment and vacancies is almost absent, inter-regional migration rates are low and commuting distances are rather short. Taking these facts together, it may safely be concluded that spatial adjustment mechanisms are of minor importance in the functioning of provincial labor markets in the Netherlands.⁴

Another limitation of this data on vacancies is the fact that it is collected on an annual basis. When using (yearly collected) discrete data on the stock of vacancies to investigate vacancy dynamics, one necessarily disregards the fluctuations within the observation period (for example, seasonal variations).

Let us now consider the development of regional (provincial) vacancies over the business cycle, starting with the recession at the beginning of the 80s and ending with the downfall after the boom of 1989-1990.

First of all, how regional differences fluctuate over the business cycle is investigated by looking at the degree of regional disparity in vacancy duration (via the standard deviation) over time. Table 1 shows that the spread in regional vacancy duration decreases when entering the *first* major recession and increases when entering the boom of 1990. It seems therefore, that not only the (national) vacancy duration reacts procyclicly, but also the regional variation. This can be illustrated further by noticing that the correlation coefficient between the level and the regional variation (standard deviation) is equal to 0.5. This statistical finding is in contrast with the results usually found for unemployment; that is, when unemployment increases, regional inequality is reduced. On the other hand, the general conclusion is that when labor market conditions worsen (unemployment increases, the vacancy stock decreases), regional differences in labor market indicators diminish. A possible explanation for this convergence tendency during recessions could be that the provincial labor markets do—to some extent—interact with each other during recessions due to the enlargement of search areas by job seekers (and maybe also by employers). A minor increase in commuting or migration between provinces may be sufficient to reduce the regional variation in vacancy duration considerably (as is clearly observed in the recession years 1983-84, but not (yet) at the start of the second recession in 1993).⁵

Table 1 also shows that peripheral regions in the North (Groningen and Friesland) which are characterized by a persistently high level of unemployment also have both a long vacancy duration and variation. For large core regions (in particular Noord-Holland and Zuid-Holland), much smaller variations in vacancy duration are observed over time.

Second, the decomposition of the regional vacant stock into the vacancy inflow rate (defined as the flow of newly created vacancies I_v divided by the number of employed E) and the average vacancy duration (T_v) will now be used in order to examine the dynamic structure of regional vacancies, both in a recession (1983) and in a boom (1990) period. In Figures 3 and 4, an iso-

TABLE 1. REGIONAL MEAN AND VARIATION OF VACANCY DURATION*

Year	Mean	St.dev	province	Mean	St. dev.
1980	4.0	1.2	Groningen	2.9	2.1
1981	2.3	0.9	Friesland	2.1	2.0
1982	1.5	0.9	Drenthe	1.9	1.3
1983	1.3	0.6	Overijssel	2.5	1.5
1984	1.2	0.5	Gelderland	2.6	1.6
1986	1.7	0.7	Utrecht	2.6	1.4
1987	1.7	0.8	Noord-Holland	2.6	1.2
1988	2.0	1.0	Zuid-Holland	2.9	1.5
1989	3.4	0.9	Zeeland	2.6	1.8
1990	6.6	1.0	Noord-Brabant	2.6	1.9
1991	2.4	1.0	Limburg	2.7	1.3
1992	2.3	0.4			
1993	2.6	0.8			

*Vacancy duration is in months for each year: columns 2 and 3; and mean and variation of vacancy duration (in months) over time for each region: columns 5 and 6.

vacancy curve is drawn through the national point, representing all combinations of inflow and duration with the same level as the national vacancy-rate (defined as the number of vacancies divided by the number of employed people: V/E). It can be seen that in 1983 many provinces come close to the national level. The northern provinces Groningen and Friesland appear to lose their relatively "favorable" position of 1983 in 1990.

In the third place, the relationship between vacancy duration and a change in the vacancy stock in the business cycle will be considered by plotting the so-called change-duration curves (cf. Schettkat 1992). In an "ideal" labor market (homogeneous labor with no mismatch), clockwise loops in the *rate of change of vacancies-duration* graph will arise over the cycle (see Figure 5).

To clarify this pattern, follow Schettkat (1992). Start at point 1 in a recession. Due to a high number of unemployed and a low number of vacancies a low vacancy duration is expected. During an expansion the number of vacancies rises and as a result vacancy duration is also expected to rise. However, as long as there is unemployment, vacancy duration will not rise that much; there are more than enough suitable applicants. At some point (i.e., point 2, in an ideal labor market at zero unemployment) it will become more difficult for an employer to find suitable applicants; vacancy duration will rise more. When the growth of the vacancy stock decreases (point 3), vacancy duration will continue to rise until the growth in the vacancy stock becomes negative (a decline in the demand for labor), viz. at point 4. At some

Figure 3. Vacancy dynamics for Dutch regions in a recession (1983)

Figure 4. Vacancy dynamics for Dutch regions in a boom (1990)

Figure 5. Change-Duration Curve (source: Schettkat, 1992)

point (5) this decline will be accompanied by rising unemployment. The number of suitable applicants increases and vacancy duration decreases. When the (still negative) growth in the vacancy stock increases again vacancy duration continues to decrease and the economy returns to point 1.

There are two ways in which a movement along the curve can be replaced by a movement of the curve. First, it is possible to end in, for example, point 7 where vacancy duration is high compared to the vacancy stock. This might occur when unemployment remains constant and labor supply decreases. For the economy as a whole this is unlikely, but it might happen in some segments of labor markets (such as industries, occupations, or regions). Second, changes in labor market efficiency can change the position of the curve. If, given the number of vacancies and unemployed, vacancy duration rises, contacts between employers and applicants do not result in as many jobs as before; the labor market has become less efficient.

Summing up, if the malfunctioning of the labor market increases over time, the loops of the change-duration curve tend to move to the right. A horizontal movement during an upswing in the cycle indicates that it becomes more difficult to fill vacancies (e.g., due to a mismatch or a lack of effective supply).

Here the duration-cycle of the province of Zuid-Holland is presented (see Figure 6) which is one of the most influential core regions. The curves of most other provinces are quite similar to the one of Zuid-Holland (except for Limburg, a relatively small southern province). For the Dutch provinces, the cycle starts in 1981 with a "medium" value for the vacancy duration and a negative rate of growth of the stock of vacancies. Then vacancy duration declines and the rate of growth of the stock of vacancies increases. The rate of growth reaches its maximum in 1986 and decreases rapidly in 1987 when vacancy duration decreases only a little or not at all. In 1990 (and sometimes also already in 1989) vacancy duration shows an enormous increase, whereas the decline in the rate of growth of the vacancy stock is less spectacular. In the following year the fall in vacancy duration is just as enormous as the rise in the preceding (two) years, and the rate of growth becomes negative again. In many provinces the values of 1993 approach those of 1981.

Next, results for the Dutch regions are compared with the theoretical change-duration curve in more detail. 1981 starts with a recession. In 1993, after a period of expansion the curves return more or less to their starting values of 1981. But the curves do not make the nice round theoretical circle. Most particularly, the "ideal-typical" figure is flawed by the values for 1987 and 1988. The years 1987 and 1988 show a rapid decline in the rate of change. In 1988 the vacancy duration even increased in some regions while the vacancy stock declined. Although unemployment declined in these years, total unemployment remained high; so there were apparently more than enough

Figure 6. Change-Duration Curve for Zuid-Holland

suitable applicants. Therefore labor market efficiency was expected to decline in the second half of the 1980s. Another interpretation of the “inward movement” in 1987-1988 is that the cycle (which started in 1981) was completed in 1987 or 1988, and that a new cycle with a different shape and location started in 1988 or 1989. In this case labor market efficiency was expected to be lower during the second cycle, since during almost the entire cycle vacancy duration was much higher than in the first cycle, while the spread in the rate of growth of the vacancy stock was smaller. This conjecture will be formally tested by estimating a matching model.

When the locus of the change-duration curves is considered, large (core) provinces are found to have higher vacancy durations in the early 1980s. All provinces (except for Limburg) have curves that begin and end with medium values for the rate of change and vacancy duration. A final conclusion that can be drawn is that there appears to be an almost *equal* timing of the business cycle in the Dutch regions. As a consequence, none of the regions are leading or lagging with respect to other regions.

A Shift-Share Analysis of Average Vacancy Duration, 1989-93

In this section potential regional differences in vacancy duration caused by regional differences in sectoral composition of the vacancy stock will be analyzed. Each vacancy has its own characteristics (for example, educational demands, experience, age, geographical location) which influence its duration. Consequently, regional differences in the composition of the vacancy stock (for example, due to differences in educational demands) may cause regional differences in regional vacancy duration. The effect of educational require-

ments, unfortunately, cannot be investigated due to lack of data on the number of vacancies and on search periods subdivided in groups according to the level of education required. As an alternative the (different) sectoral composition of the vacant stock across regions was chosen as a possible source of regional differences in vacancy duration. Gorter (1991) concludes that vacant jobs in the quaternary sector (governmental and non-profit organizations) have higher vacancy durations than jobs in other sectors. These higher durations are caused by longer selection periods and/or originate from difficulties in finding applicants with work experience or proper education in this sector.

The impact of sectoral composition of the vacant stock is examined by means of a so-called shift-share analysis. In this analysis, the national distribution of the vacant stock according to different sectors is applied to the Dutch regions in order to arrive at an estimate of regional vacancy duration caused by sectoral composition.⁶ Let us now introduce some notation. Tv^p is the (mean) vacancy duration in a given province:

$$Tv^p = \sum_s V_s^p \cdot Tv_s^p / \sum_s V_s^p$$

in which V_s^p is the provincial vacancy stock in a sector and Tv_s^p is the corresponding (mean) vacancy duration. Tv^n is the national (mean) vacancy duration:

$$Tv^n = \sum_s V_s^n \cdot Tv_s^n / \sum_s V_s^n$$

in which V_s^n is the national vacancy stock in a sector and Tv_s^n is the corresponding (mean) vacancy duration.

Tv^{pn} is the (mean) vacancy duration in a province, based on the sectoral composition of the vacant stock in the region and the relation between sectoral composition and vacancy duration at the national level:

$$Tv^{pn} = \sum_s V_s^p \cdot Tv_s^n / \sum_s V_s^p$$

If we write $Tv^p = (T_v^p - T_v^{pn}) + (Tv^{pn} - Tv^n) + Tv^n$, then $(Tv^{pn} - Tv^n)$ is the so-called structural component. If $(Tv^{pn} - Tv^n)$ is positive, province p has more vacancies in a sector where the vacancy duration is higher than the average. $(T_v^p - Tv^{pn})$ is the difference caused by other than structural factors (i.e., region-specific factors).

The results of the analysis for the years 1989-93 are presented in Table 2. Some provinces had to be omitted from the analysis due to missing data. The structural component seems to have little influence. The region-specific

component explains most of the difference between T_v^p and T_v^n . It may be concluded that the sectoral composition of provinces cannot be held responsible for differences in provincial vacancy duration. The question remains whether the same result would have been obtained if the impact of composition according to educational level could have been examined or if more detailed sectoral data had been used.

A Matching Model, 1980-93

In this section a matching model is used to investigate differences in the effectiveness to match demand and supply on the labor market across regions and over time (for more details on this theoretical concept, see Blanchard and Diamond 1989 and 1992). The matching concept was used in previous empirical studies on the Dutch labor market by Van Ours (1991) and Gorter and Van Ours (1994). Van Ours (1991) studied the relation between unemployment duration and vacancy duration, while Gorter and van Ours studied regional patterns in the flows of filled vacancies. Jackman et al. (1989) used the matching concept to study the relation between unemployment duration and vacancy duration for the British labor market.

The basis of the matching model is a Cobb-Douglas type function which describes the number of contacts between employers and applicants per period (C) as a function of the number of vacancies (V), the number of unemployed (U) and the number of employed job-seekers (S) per period and the average time between contacts (T_m):⁷

$$C = \frac{(U + S)^\alpha V^\beta}{T_m} \quad (1)$$

Define P_c as the chance that a contact between an employer and an applicant results in a "match". Now the flow of filled vacancies, F_v , can be calculated as $C \cdot P_c$. From a total of C contacts a fraction P_c results in a match. Let k , a parameter describing labor-market efficiency, be defined as P_c/T_m . The labor market is more efficient if, given U and V , the flow of filled vacancies F_v is higher. A higher chance that a contact results in a job (P_c) and/or a shorter average period between contacts (T_m) means a more efficient labor market. Equation (1) now can be rewritten to the "matching" (or search) production function:

$$F_v = k(U + S)^\alpha V^\beta \quad (2)$$

TABLE 2. DECOMPOSITION OF THE DIFFERENCE BETWEEN REGIONAL AND NATIONAL (MEAN) VACANCY DURATION BY MEANS OF A SHIFT-SHARE ANALYSIS.

year	province	Tv^p	$Tv^p - Tv^{pn}$	$Tv^{pn} - Tv^n$	Tv^n
1989	overijssel	4.875	1.340	0.140	3.395
	gelderland	3.428	-0.062	0.096	3.395
	utrecht	3.024	-0.266	-0.104	3.395
	noord-holland	3.529	0.187	-0.052	3.395
	zuid-holland	2.571	-0.741	-0.083	3.395
	noord-brabant	6.651	3.161	0.096	3.395
	limburg	5.793	2.278	0.121	3.395
1990	overijssel	7.811	1.257	-0.021	6.575
	gelderland	5.429	-1.179	0.033	6.575
	utrecht	8.257	1.759	-0.077	6.575
	noord-holland	6.465	-0.053	-0.056	6.575
	zuid-holland	6.907	0.410	-0.078	6.575
	noord-brabant	8.068	1.366	0.127	6.575
	limburg	5.497	-1.190	0.112	6.575
1991	overijssel	2.167	-0.324	0.074	2.417
	gelderland	2.141	-0.275	-0.000	2.417
	utrecht	2.172	-0.200	-0.045	2.417
	noord-holland	2.311	-0.018	-0.088	2.417
	zuid-holland	2.709	0.316	-0.023	2.417
	noord-brabant	2.657	0.126	0.114	2.417
	limburg	—	—	—	2.417
1992	overijssel	2.284	-0.263	0.098	2.449
	gelderland	2.261	-0.247	0.059	2.449
	utrecht	2.132	-0.292	-0.026	2.449
	noord-holland	2.397	0.024	-0.077	2.449
	zuid-holland	2.776	0.353	-0.027	2.449
	noord-brabant	2.792	0.297	0.046	2.449
	limburg	2.063	-0.467	0.080	2.449
1993	overijssel	2.000	-1.284	-0.020	3.303
	gelderland	2.500	-0.816	0.012	3.303
	utrecht	3.567	0.231	0.032	3.303
	noord-holland	3.369	0.058	0.008	3.303
	zuid-holland	4.591	1.285	0.003	3.303
	noord-brabant	2.904	-0.373	-0.026	3.303
	limburg	2.857	-0.421	-0.025	3.303

If $\alpha + \beta < 1$, there are decreasing returns to scale; an increase in the size of labor market stocks leads to a less than proportional increase in the flow of filled vacancies. When there are increasing returns to scale ($\alpha + \beta > 1$), the increase in labor market stocks leads to a more than proportional increase in the flow of filled vacancies. When $\alpha + \beta = 1$, meaning constant returns to scale, the flow of filled vacancies is proportional to the labor market stocks. In other words, with a constant returns to scale search-production function, scale (regional size) does not matter.

Equation (2) specifically assumes U and V to be homogeneous. To control for heterogeneity the model is extended (multiplicatively) with two types of mismatch variables. H_1 is added to account for *functional* mismatch; because of heterogeneity in current U and V , the number of matches might be not as high as it could be. Second, H_2 is added to account for *structural* mismatch. Suppose that over a longer period for some (unobserved) reason the labor market fails to generate a substantial number of matches. Because of heterogeneity in past U and V , the flow of filled vacancies in the current period may be relatively low. Therefore H_2 is added to account for this lasting malperformance of the labor market (this variable could be interpreted as some kind of hysteresis effect). Another aspect of regional heterogeneity is related to the question to which extent regions interact with each other in the matching process (e.g., reflected by the magnitude of cross-regional commuting flows; see also the previous section). Unfortunately, data on commuting (at the provincial level) are not completely available for the period 1980-93. Moreover, the (limited) figures on commuting show ample variation over time (see e.g., Evers 1989) and hence this variable would strongly correlate with the regional dummies (i.e., give rise to multicollinearity problems). This problem would also arise when a provincial migration variable is included in our model.

Consequently, the matching function is rewritten as:

$$F_v = k(U + S)^\alpha V^\beta H_1^\gamma H_2^\delta \quad (3)$$

To estimate this matching function pooled cross-section time series data on vacancy duration, vacancy, and unemployment stock were used for the period 1980-93. Data on the regional unemployment and vacancy stock are directly available from the Netherlands Central Bureau of Statistics (there is, however, a change in definition of unemployment from 1989 onwards).

However, direct information on the flow of filled vacancies in the Dutch labor market is not available. To solve this problem, aggregated (annual) data on the number of vacancies ("stock" data) cross-classified by region (province) and by elapsed duration groups are used in order to calculate mean completed vacancy duration for each region (and for each year in the period 1980-93) in the following way. First, a non-parametric (Kaplan-Meier) method is applied

to evaluate the so-called survivor function S for filling vacancies at different lengths of elapsed duration.⁸ Second, mean vacancy duration can be computed on the basis of the estimated survivor function (for details, see Gorter and Van Ours 1994). So information on the duration composition of the vacancy stock is used to obtain an unbiased estimate of average (completed) vacancy duration (see also, e.g., Baker and Trivedi 1985).

After dividing both sides of equation (3) by V (and taking the inverse of F_v/V), we obtain

$$T_v = \frac{1}{k} (U + S)^{-\alpha} V^{(1-\beta)} H_1^\gamma H_2^\delta \quad (4)$$

with T_v defined as mean vacancy duration (and equal to V/F_v when a steady state labor market is assumed).

Equation (4) cannot be estimated, since there is not data on S . Since the main interest is in regional patterns in labor market efficiency and the development of efficiency over the years, we have to be content with the assumption that the ratio U/S is stable. If U/S is constant across regions and over time, the effect of S is absorbed in the constant term and the regional efficiency indicators remain unchanged (see also Gorter and Van Ours 1994). The sensitivity of these results with respect to this assumption will be explored later.

Finally equation (4) is put into a linear form from which the parameters of interest can easily be estimated:

$$\ln T_v = -\ln k - \alpha \ln U + (1-\beta) \ln V - \gamma \ln H_1 - \delta \ln H_2 \quad (5)$$

In this model, the intercept $(-\ln k)$ is a parameter of labor market efficiency, α is the unemployment elasticity of the flow of filled vacancies F_v and $(1-\beta)$ is the vacancy elasticity of the flow of filled vacancies F_v (see also equation (2) and (3)).

For H_1 it would be desirable to use an indicator that measures to what extent U and V are heterogeneous across regions. Gorter and Van Ours (1994) used a variable describing the occupational mismatch between unemployment and vacancies (i.e., an indication to what extent job seekers and employers "do not find one another" because they operate on different occupational sub-markets). The calculation of this variable was based on the regional difference in the composition of the unemployment and vacancy stock with respect to occupational groups. Unfortunately the data on U needed to calculate this mismatch indicator are only available until 1986. During the period 1980-86, the effect of occupational mismatch on the flow of filled vacancies appears to be insignificant (see also Gorter and Van Ours 1994). Instead of occupational

mismatch, long-term unemployment L (i.e., the number of people with an unemployment duration of a year or more), was used as an indicator of functional mismatch.⁹ In the Netherlands long-term unemployed have great difficulties finding jobs because employers consider them as less appropriate or they have become discouraged and search less intensively (Gorter 1991). Hence, L is expected to have a negative impact on the number of filled vacancies: the higher long-term unemployment in a region, the less likely that vacancies get filled in that region.

For H_2 , vacancy duration lagged with one period ($T_{v,t-1}$) is a natural choice since this variable is, according to our model, a compound indicator of lagged U and V . It approximates the degree of labor market tightness and also gives rise to a dynamic specification of our model. From this dynamic specification the long run equilibrium value of α (and β)¹⁰ can be derived.

Since T_v can also influence the vacancy stock (V), V might become an endogenous variable in our model (i.e., it might be correlated with the disturbance term).¹¹ Therefore the exogeneity of V will be tested. Labor market efficiency (k) will be allowed to fluctuate between provinces by using dummy-variables (D_p). Zuid-Holland (ZH, one of the core provinces) is used as the reference province. Alternatively, k will be allowed to fluctuate over time by using dummy-variables (D_t) with 1980 as the reference year. The basic models to be estimated are:

$$\ln T_v = c_0 + \sum_{p=1}^{10} \tau_p D_p - \alpha \ln U + (1 - \beta) \ln V - \gamma \ln L - \delta \ln T_{v,t-1} \quad (6a)$$

$$\ln T_v = c_0 + \sum_{t=81}^{93} \tau_t D_t - \alpha \ln U + (1 - \beta) \ln V - \gamma \ln L - \delta \ln T_{v,t-1} \quad (6b)$$

The estimated parameter for $\ln U$ ($-\alpha$) is expected to be negative. The estimated parameters for $\ln V$ ($1-\beta$), $\ln L$ ($-\gamma$) and $\ln T_{v,t-1}$ ($-\delta$) are expected to be positive.¹²

The results of the estimation of equations (6a) and (6b) are shown in Table 3; see Model I and Model II respectively.¹³ The results for Model I show that regional differences in labor market efficiency do not play an important role. None of the regional dummies were significant (relative to Zuid-Holland). When these differences are examined in more detail by calculating regional efficiency levels and their 95 percent-confidence intervals (relative to the province of Zuid-Holland for which efficiency is normalized and set equal to 1), it becomes clear that the confidence intervals are large and overlapping for all regions. In conclusion, regions with a significant higher labor market efficiency than other regions cannot be identified during the period 1980-93.

TABLE 3. ESTIMATION RESULTS FOR THE MATCHING MODEL (T-VALUES BETWEEN 'OPEN' BRACKETS (.); CRITICAL VALUES OF TEST-STATISTICS BETWEEN 'CLOSED' BRACKETS [.]).

MODEL	I		II		III		IV	
constant	-3.26	(-0.80)	1.23	(1.28)	0.32	(0.63)	1.13	(4.91)
lnU	0.64	(1.06)	-0.44	(-1.17)	-0.03	(-0.80)	0.14	-
lnV	0.42	(4.33)	0.16	(2.02)	0.12	(1.69)	0.14	(2.09)
lnL	-0.67	(-2.12)	0.34	(1.11)	-	-	-	-
lnTv _{t-1}	0.10	(1.19)	0.25	(2.95)	0.27	(3.14)	0.30	(3.53)
regions:								
groningen	0.86	(0.37)	-	-	-	-	-	-
friesland	0.46	(0.71)	-	-	-	-	-	-
drenthe	0.58	(0.72)	-	-	-	-	-	-
overijssel	0.38	(0.88)	-	-	-	-	-	-
gelderland	0.29	(0.99)	-	-	-	-	-	-
utrecht	0.26	(0.53)	-	-	-	-	-	-
noord-holland	0.11	(-0.55)	-	-	-	-	-	-
zuid-holland	-	-	-	-	-	-	-	-
zeeland	0.73	(0.80)	-	-	-	-	-	-
noord-brabant	0.01	(0.07)	-	-	-	-	-	-
limburg	0.54	(1.25)	-	-	-	-	-	-
years:								
1980	-	-	-	-	-	-	-	-
1981	-	-	-0.46	(-2.62)	-0.44	(-2.53)	-0.37	(-2.16)
1982	-	-	-0.79	(-3.40)	-0.68	(-3.22)	-0.55	(-2.74)
1983	-	-	-0.97	(-3.13)	-0.74	(-3.20)	-0.56	(-2.66)
1984	-	-	-1.07	(-3.12)	-0.78	(-3.50)	-0.61	(-2.98)
1986	-	-	-0.81	(-2.38)	-0.51	(-2.45)	-0.37	(-1.88)
1987	-	-	-0.89	(-2.67)	-0.59	(-3.04)	-0.46	(-2.53)
1988	-	-	-0.70	(-2.16)	-0.41	(-2.13)	-0.28	(-1.56)
1989 ¹	-	-	-0.33	(-0.89)	0.03	(0.18)	0.08	(0.45)
1990	-	-	0.20	(0.52)	0.58	(3.55)	0.60	(3.61)
1991	0.53	(2.21)	-1.00	(-2.85)	-0.65	(-4.12)	-0.66	(-4.16)
1992	-	-	-0.64	(-1.92)	-0.32	(-1.91)	-0.28	(-1.69)
1993	-	-	-0.41	(-1.39)	-0.15	(-0.83)	-0.07	(-0.42)
R ² _{adj}	0.48	-	0.65	-	0.65	-	0.64	-
SSR	25.16	-	16.74	-	16.91	-	17.35	-
n	143	-	143	-	143	-	143	-
LM(SC)	0.69	[3.84]	2.79	[3.84]	2.69	[3.84]	3.19	[3.84]
LM(H)-regns	17.18	[18.3]	15.59	[18.3]	16.79	[18.3]	16.36	[18.3]
LM(H)-yrs	28.85	[21.0]	20.15	[21.0]	18.60	[21.0]	18.12	[21.0]
χ ² (E)	0.04	[3.84]	0.38	[3.84]	0.66	[3.84]	-	-
χ ² (V)	10.11	[3.84]	0.07	[3.84]	0.08	[3.84]	-	-
F-test	-	-	-	-	-	-	3.30	[3.84]

1. Note that we include a dummy-variable for the period 1989-93 in this model to control for the change in definition of unemployment in 1989. (Regns means Regions, yrs means years.)

This finding does not exclude the possibility that in certain phases of the cycle (e.g. during a recession) some regions perform more efficiently than others. For example, previous research has shown (see Van Ours 1992; Gorter 1991) that the northern regions have a higher efficiency level than core regions during 1980-88. Apparently, these regions perform relatively poorly in a tight labor market (1989-1990) and this breaks down their relative advantage displayed in the period before (1980-88).¹⁴

A comparison of the results for Models I and II reveals that the fit of model II is much better than that of model I. Moreover, evidence of misspecification due to heteroscedasticity in model I is detected (see the test-statistic for LM(H)-years) and the hypothesis on the validity of the instruments is also rejected. In contrast, none of the specification tests reject model II (in particular, the null-hypothesis of V being exogenous is not rejected).

The results for model-specification II show insignificant effects of U and L. If L is omitted, we arrive at model III, in which α is insignificant and β is only weakly significant (at 10 percent). If the "constant return to scale" restriction $\alpha + \beta = 1$ is imposed, model IV is obtained. Again, none of the specification tests rejects this model, and the F-test shows that the explanatory power of the model is not significantly improved when the restriction of constant returns to scale is released. From the results of the final model (model IV), it is concluded that the elasticities of the flow of filled vacancies with respect to unemployment and vacancies are 0.14 and 0.86, respectively. The long run elasticity with respect to unemployment is equal to 0.2 (calculated as $0.14/(1-0.3)$). This long-term value for α does not differ much from that of 0.25 estimated by Gorter and Van Ours (1994). It is also of the same order as found by Blanchard and Diamond (1989) and Anderson and Burgess (1994) for the U.S. labor market.¹⁵ In short, these outcomes point at the dominance of V in the matching process, while the size of U plays a less important role.

Although the level and the variation over time in the annual dummies is somewhat different across the model specifications presented in Table 3 (II, III and IV), the basic pattern is more or less the same. This cyclical pattern of labor market efficiency will be examined next. The efficiency-parameter k is estimated by using the results for the constant term (c_0) and the parameters of the time-dummies (D_t). Using the estimates of model IV we get

$$k = \exp(-1.13 - \sum_{t=80}^{93} \tau_t D_t) \quad (7)$$

The value for k is shown in Figure 7. There is a sharp decrease in labor market efficiency in 1989. This could be due to a "genuine" fall in efficiency for that period or due to a statistical effect, i.e., the influence of the change in

definition of unemployment on our estimates. Therefore, the extent to which the new definition of unemployment causes a decrease in labor market efficiency will be assessed. Suppose U is unemployment using the old definition and U^* is unemployment using the new definition. The relationship between these two values is $U^* = \mu U$, as the change in the definition reduces unemployment with a fraction $(1-\mu)$. Our data series on unemployment (U) consists, in fact, of a combination of U and U^* . So in later years the term $\alpha \text{Ln} U$ becomes $\alpha \text{Ln} U^* = \alpha \text{Ln} \mu U = \alpha \text{Ln} \mu + \alpha \text{Ln} U$ in which μ is a constant.¹⁶ The value of μ is difficult to determine because $U(89)$ is not observed. We compute μ as $U_{\text{NL}}^*(89)/U_{\text{NL}}(88)$ which makes $\alpha \text{Ln} \mu$ equal to 0.09 (with $\alpha=0.14$). Since there are no regional variations in μ , this is the most straightforward choice. The “adjusted” labor market efficiency k can now easily be calculated for the period 1988-93 as

$$k_{adj} = \exp(-1.13 + 0.09 - \sum_{t=88}^{93} \tau_t D_t) \quad (8)$$

In Figure 7, observe that the “corrected” decline in labor market efficiency in 1989 is quite significant. Hence, the decline in labor market efficiency coincides with the rapid increase in vacancy duration during 1989-90. In sum, it is concluded from these estimates that labor market efficiency is rising in the recession (1980-83) and also during the recovery period (1984-88), is falling dramatically when entering a boom (1989-90), and is increasing dramatically in 1991. In 1991-93, k returns to about its initial level of the beginning of the 80s. The latter observation implies that regional labor markets are at least as efficient as they were more than a decade ago¹⁷. The rise in efficiency when the economy moves into the major recession of 1980-83 may be explained by the notion that in a recession unemployed job seekers probably increase their search intensity (to prohibit long-term unemployed spells). In addition, the large flux of short-term unemployed persons are likely to be more attractive to employers (because being unemployed is no longer considered as a failure of the individual but as a consequence of general labor market conditions). So, unemployed job seekers and employers are more inclined to accept each other in times of a recession (and as a result, efficiency goes up). Another striking peak in efficiency is observed in 1991 (just after the minimum level observed in 1990). Possibly, job seekers tend to accept vacant jobs more quickly because they anticipate the emergence of a new recession (the large number of vacancies has started to shrink).

Finally, the robustness of these results is investigated with respect to the assumption made on S , namely that the ratio of U/S is stable. Of course, these estimates might be biased if this assumption does not hold. To test the

Figure 7. Labor Market Efficiency over the Business Cycle in The Netherlands, 1980-93.

sensitivity of the estimates for α and k , another specification of the matching model in which there is no assumption on S is considered. Instead, assume a constant returns to scale matching function and equality of T_u and T_s , where T_u is the average duration of unemployment and T_s is the average duration of job searching of an employed job seeker. Under these assumptions, the following matching model can be derived, wherein vacancy duration is expressed as a function of labor market efficiency and unemployment duration, (see Appendix A):

$$\ln T_v = -\frac{1}{1-\alpha} \ln k - \frac{\alpha}{1-\alpha} \ln T_u \quad (9)$$

This equation is estimated including $\ln T_v$ lagged with one period and the usual annual dummies (as included in model II, III and IV). The estimated coefficient for $\ln T_u$ ($-\alpha/(1-\alpha)$) is 0.05, so that α is also about -0.05.¹⁸ Although α has the wrong sign, it is clearly insignificant. This means that β is not significantly different from 1 which corresponds to our earlier conclusion on the dominance of vacancies in the matching relation. The pattern of labor market efficiency over the business cycle (k) in this alternative matching model reveals a similar movement as in the previous estimations based on the model presented in equation (6b).

Conclusions

In this paper, the focus was on the dynamics of vacancies in regional labor markets in general, and the spatial and cyclical variations of labor market efficiency in particular. This type of "spatial-dynamic" labor market research is of interest when one is confronted with a labor market in which (besides persistent mismatches between supply and demand) regional variations in the creation of jobs (vacancies) are observed. This "spatial-dynamic" approach to analyze the functioning of labor markets is applied to the Dutch labor market (which is—like many other European countries—in a continuous state of disequilibrium).

This paper started with an exploration of the dynamic structure of regional Dutch data on vacancies over time. Interestingly, the variations over time (business cycle) in both vacancy duration and vacancy stock appeared to be quite similar among regions. In contrast, it was found that vacancy duration varies considerably across regions (and also over time). A shift-share analysis of vacancy duration revealed that the sectoral composition of the regional stock of vacancies could not be held responsible for regional variations in the duration of vacancies. In the analytical part of this paper, the matching (or flow) approach to the Dutch labor market was used to investigate regional and cyclical variations in labor market efficiency. To this end, annual data on vacancy duration, vacancy and unemployment stock for the period 1980-93 were used.

The estimation results showed that differences in labor market efficiency across regions could not be identified when size effects (of unemployment and vacancies) and structural/functional mismatches in this model of vacancy duration were controlled for. It was found that regional variations in the stocks of unemployment and vacancies are strongly related to regional differences in vacancy duration (or the flow of filled vacancies). More in particular, a constant returns-to-scale matching function with coefficients of 0.14 on unemployment and 0.86 on vacancies was found. This finding confirms the dominance of vacancies in the matching relationship, as also found in other empirical studies for different countries so far (in particular, the United States and the Netherlands). So, if one would like to improve regional labor market conditions as reflected by excess regional supply, the most straightforward policy option is to stimulate the creation of new jobs in that region (vacancies), since regional labor markets appear to achieve similar efficiency levels when generating matches between supply and demand. As regards the general (non region-specific) pattern of labor market efficiency over the period considered (business cycle), the estimates of this model made clear that the efficiency improved during the first recession (1981-83), continued to be high during the recovery period (1984-88), dropped significantly in the boom (1989-90), and finally returned in the second (major) recession (1993) to the level reached

during the previous recession. Three important conclusions can be drawn from this finding. First, a (relatively) high level of efficiency during a period of (rapid) employment growth indicates that a large pool of potential employees (unemployed and (re)-entrants) was available. Second, the functioning of the labor market is at least as efficient in 1993 as it was more than a decade ago (covering about two cycles). Third, and most interestingly, the substantial improvement of efficiency in a major recession period may at first sight be somewhat surprising. However, this finding of an increased ability to produce matches between unemployed job seekers and vacancies is remarkably consistent with the observation (at the aggregated level) that in many industrialized countries (e.g., the United States, Germany, and the Netherlands) the flow from unemployment to employment increases in a recession (see Blanchard and Diamond 1994). In addition, recent research on the filling of vacancies at the micro level (see Burda and Wyplosz 1994; Russo, Gorter, and Schettkat 1996, and Schettkat 1996) has also confirmed that when there is an excess supply on the labor market, employers are more likely to hire unemployed candidates (than employed workers).

Summing up, the flow-approach to study labor market imbalances is able to produce new insights which are useful to develop effective labor market policies. Moreover, a spatial perspective can be fruitfully incorporated within this new stream of labor market research and this will pinpoint the underlying region-specific or general causes of regional variations in labor market disequilibria.

NOTES

1. The emphasis on flows in labor market research is also found in recent studies on (i) job and worker flows (see, for example, Davis and Haltiwanger 1992; Burda and Wyplosz 1994) and (ii) migration flows (see, for example, Plane and Rogerson 1986; Jackman and Savouri 1992).
2. It is noteworthy that traditional UV-analysis cannot be used to determine labor market efficiency since the flow of filled vacancies is not stable over time.
3. This mismatch indicator, "the proportion to which unemployment is higher than it could be given vacancies" (see Layard et al. 1991), is calculated as $MM_p = 2[1 - \sum_p (V_p/V)^\beta (U_p/U)^{1-\beta}]$. For β we make the usual choice of 0.5 (see also Blanchard and Diamond 1989) and summation takes over all provinces (p).
4. Additional evidence of a local orientation of job seekers and employers in the Dutch labor market can be found in Russo et al. (1996) who find that hiring new employees usually takes place on short distances from the firm (in particular, the average hiring distance is, dependent on the level of education required, between 14 and 24 kilometres).
5. We owe this point to an anonymous referee.

6. The five sectors distinguished are (i) manufacturing industries, (ii) construction industry, (iii) wholesale, retail, hotels and restaurants, (iv) commercial services, and (v) other services. Note also that the usual assumption is made that the relationship between sector and vacancy duration is the same for all regions.
7. In this formulation it is implicitly assumed that unemployed and employed job seekers are equally productive in making contacts. On the one hand unemployed job seekers may be more productive because they can spend time and effort to search more intensively. On the other hand, it is well-known that employed job seekers may obtain information on new job opportunities more easily (see e.g., Blau and Robins 1990), since they are part of a social network that consists of other employed people (and employers). Here, these effects are thus assumed to cancel out.
8. The survivor function $S(t)$ is estimated (at $t=1,3,6$ months) by the number of jobs that are vacant for more than t months $N(t)$ relative to the total number of vacant jobs in the stock N (the ratio of $N(t)/N$).
9. Since long term unemployment can rise while total unemployment remains constant both L and U can be used as explanatory variables in our model.
10. In previous empirical studies on matching a lagged dependent variable is often included for statistical reasons (see e.g. Jackman et al. 1989, Layard et al. 1991, van Ours 1991).
11. Note however, that the data on vacancies gathered by the CBS only includes open positions in the firm that employers actually intend to fill immediately or as soon as possible. Therefore, it is very unlikely that the vacant jobs reported by the employers to the CBS are intentionally kept open which would cause both high duration and a high number of vacancies (i.e., an endogenous relationship of vacancy duration to the vacancy stock by construction).
12. Note that when the matching function is assumed to have constant returns to scale ($\alpha+\beta=1$) equation (6) is obtained, with $-\alpha\ln U+(1-\beta)\ln V$ equal to $\alpha\ln(V/U)$.
13. In this Table, R^2_{adj} is corrected for the degrees of freedom. SSR is the sum of squared residuals. N is the number of observations. LM(SC) is an LM-test (Breusch-Godfrey) for serial correlation. $LM(SC)\sim\chi^2(1)$ under the null hypothesis. LM(H) is the Breusch-Pagan test for heteroscedasticity among regions or years. Since 10 regional and 13 years dummies were used in these tests, we have $LM(H)\text{-regions}\sim\chi^2(10)$ and $LM(H)\text{-years}\sim\chi^2(13)$, respectively. $\chi^2(E)$ is the Hausman-Wu test for exogeneity of V (instruments used are lagged vacancies (V_{-1}) and Gross Regional Product (GRP)) with one degree of freedom. $\chi^2(V)$ is the Sargan validity of instruments test with one degree of freedom. Finally, F is the F-test on the restrictions imposed in specification IV (versus II). Coefficients marked * are significant (at 5%).
14. Given the limited cross-sectional variation in the data (eleven regions), it is not feasible to estimate a model which also allows for annual differences in regional efficiency (i.e., include interaction terms between regional and time dummies: $D_p \times D_t$)

15. For the United Kingdom, several authors have estimated matching functions with the outflow from unemployment as the dependent variable (see e.g., Layard et al. 1991 and Pissarides 1986). These studies have shown - in contrast to these results - rather high values on unemployment (about 0.7) and low values on vacancies (about 0.3).
16. It is implicitly assumed that the change in definition only affects the absolute size of unemployment, an assumption which seems justified because the correction in the unemployment data is mainly a matter of excluding incorrect registrations (see for more details on the differences in composition of the "biased" and "unbiased" stock, Gorter 1991, pp. 158-159).
17. This was also the first impression when the change-duration curves of vacancies were analyzed in the section on Regional Variation in Vacancy Dynamics.
18. We also test for exogeneity of unemployment duration in this model and find that the null hypothesis of exogeneity cannot be rejected.
19. In a steady state labor market the inflow into the stock is equal to outflow out of the stock. This means the stock is equal to the product of flow and average duration; $S = F_u * T_u$, $U = F_v * T_v$ and $V = F_v * T_v$, F is flow and T is duration.

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APPENDIX A

Another matching model, based on vacancy duration data, that enables us to investigate the parameters of interest (and in particular labor market efficiency k) can be derived as follows (for convenience we skip H_1 and H_2 in the derivation). We have to assume a steady state labor market and constant returns to scale ($\alpha + \beta = 1$). Suppose $T_u = T_s$. Now we can write $(U+S)$ as $F_s T_s + F_u T_u = (F_s + F_u) T_u = F_v T_u$ since $F_u + F_s = F_v$ by definition.¹⁹ The matching model (see equation 2) can be rewritten as:

$$F_v = (F_v T_u)^\alpha (F_v T_v)^{1-\alpha} \quad (A1)$$

or

$$1 = k T_u^\alpha T_v^{1-\alpha} \quad (A2)$$

This can be rearranged as

$$(1 - \alpha) \ln T_v = - \ln k - \alpha \ln T_u \quad (A3)$$

and, finally leads to the following matching model in terms of vacancy duration

$$\ln T_v = -\frac{1}{1-\alpha} \ln k - \frac{\alpha}{1-\alpha} \ln T_u \quad (\text{A4})$$

Equation (A4) specifies vacancy duration as a function of an efficiency parameter (estimated as the constant) and the duration of unemployment.