Helsinki Center of Economic Research

Discussion Papers

Increased Difficulties in the Labor Market Matching Process: Econometric Evidence from Finland

Heidi Soininen
The Swedish School of Economics and Business Administration and HECER

Discussion Paper No. 29
November 2004

ISSN 1795-0562

HECER – Helsinki Center of Economic Research, P.O. Box 17 (Arkadiankatu 7), FI-00014 University of Helsinki, FINLAND, Tel +358-9-191-28780, Fax +358-9-191-28781,
E-mail info-hecer@helsinki.fi, Internet www.hecer.fi

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Increased Difficulties in the Labor Market Matching Process: Econometric Evidence from Finland*

Abstract

This paper models the matching process at the Finnish labor market for the period 1982:-2002:8. Theoretical matching relationships are tested as cointegrating relation within the framework. The data is, due to non-stable parameters, split into two periods, one consisting of the years prior to the economic crisis in the beginning of the 90's, and one of the years after. For the pre-crisis-period a uv-curve is found as the long-run relationship, indicating straightforward matching. The post-crisis period is dominated by a vacancy-driven homogenous-of-degree-one relationship. These findings suggest that the matching process has changed significantly following structural break and increased openness in the economy.

JEL Classification: J41, J64

Keywords: Matching, Beveridge Curve, Openness, Structural break, Cointegration.

Heidi Soininen

Department of Economics,
P.O. Box 479
The Swedish School of Economics and
Business Administration
FI-00101 Helsinki
FINLAND

e-mail: heidi.soininen@hanken.fi

* Rune Stenbacka and Erkki Koskela deserve my special thanks for all their ideas, helpful comments and support. I also want to thank Mikael Juselius for invaluable assistance and Heikki Kauppi for helpful comments to an earlier draft. Financial support from the Academy of Finland is gratefully acknowledged.

1 Introduction

In the beginning of the 1990s Finland experienced a very serious economic crisis. The crisis followed financial deregulation and increased foreign trade, but also the ERM collapse and the fall of the Soviet Union affected the outcome. The Finnish economy consequently experienced a strong structural break. As other economic indicators, such as GDP growth, recovered rapidly from the crisis, the unemployment rate refused to fall to earlier levels. The proportion of long-term unemployed increased from 10% to 30% and remained at that level. The Beveridge curve shifted out drastically and has since failed to shift back in a similar manner [Honkapohja and Koskela, 1999].

In this paper I investigate if the persistent unemployment prevalent in Finland can be a consequence of changes in the matching process due to structural break. I start by estimating a simple indicative OLS-framework in order to make comparisons with earlier work in the field easy. This first step is followed by a modelling of vacancies, unemployment and hirings using cointegrated VAR-analysis. In the cointegrated VAR-estimations I seek to establish whether the theoretical relationships, the matching function and the Beveridge curve, can be found as long-term relations in the data. I also separate for long- and short-term unemployment in the analysis and formally test for structural breaks.

Interesting results are found using monthly Finnish data for the period 1982:1-2002:8. When formally testing for a structural break the estimated date was 1988:4. Fot this reason and because of non-stable parameters for the whole period the data is split into two periods, one pre-crisis period (1982:1-1988:1) and one post-crisis period (1992:1-2002:8). This talks very strongly for a structural break or some sort of policy shift in the beginning of the 90's. The main findings are that for the 80's a very significant one-to-one Beveridge curve can be distinguished while for the 90's a corresponding Cobb-Douglas constant returns to scale matching function is found. When separating for long- and short-term unemployment in the post-crisis period, long-term unemployment is found to have a strong negative influence on matching.

The implications of the findings are the following: The whole matching process has changed thoroughly, indicating two different regimes. The labor market matching has evolved from a very simple structure into a much more complicated matching process with substantial matching problems. This helps to explain the persistence of Finnish unemployment during the whole 90's and to date. The strong negative effect on matching coming from long-term unemployment sheds additional light on the unemployment persistence. The radical change in matching in combination with the formally estimated break date and the impossibility to model the whole period as one period strongly evidence of a policy shift or structural break.

A vast amount of empirical studies have been conducted in the field, most of which are based on OLS-analysis. Examples are Blanchard and Diamond [1989], who have used US data, Pissarides [1986], Layard et al. [1994] and Coles and Smith [1996], who have studied British data and Burda and Wyplosz [1994], who have utilized data for many continental European countries. Most earlier international studies find evidence of constant returns to scale in the matching function, for example Blanchard and Diamond [1989] and Petrongolo and Pissarides [2001]. There are also other studies like Edin and Holmlund [1991] and Anderson and Burgess [1995] which indicate that there would be decreasing or increasing return to scale. When using aggregate data the estimated functions usually satisfy constant returns to scale while disaggregate data mostly evidences mildly increasing returns to scale. Generally, studies using hirings instead of unemployment outflow as the third variable tend to have a larger coefficient for vacancies than otherwise. For an excellent overview of earlier studies see Petrongolo and Pissarides [2001].

Related issues have been studied using Finnish data by Koskela and Uusitalo [2003], Pesola [2002] and Ilmakunnas and Pesola [2003]. Ilmakunnas and Pesola [2003] find evidence for both constant returns to scale and increasing returns to scale using 2 different methods on Finnish disaggregate data.

Albaek and Hansen [2004] is an exception in the literature, as they utilize cointegrated VAR-analysis on matching issues using Danish data between 1974 and 1988. They find evidence for both a Beveridge curve and a matching function, which is homogenous of degree one, when they model shifts in the Beveridge curve and the matching function as smooth transition functions. They suggest that mismatch as opposed to reallocation is the cause of the outward shift of the Beveridge curve.

The main contribution of the present paper is that I analyze what happens to the matching framework when a structural break hits the economy and when the economy is made increasingly vulnerable through expanded openness. Finland is an excellent study object for this purpose. The cointegrated VAR-method used also sheds some additional light on the matching process adding to the line of research of Albaek and Hansen [2004]. I formally test for structural breaks and I separate unemployment into long-term and short-term unemployment. The very differing matching patterns evolving in the two periods serve as evidence of increased complications in the matching process following increased openness and structural break. The strong negative influence from long-term unemployment on matching amplify the evidence of increased complications.

The remainder of the paper is organized as follows. Chapter 2 gives a brief presentation of the Finnish economy. In section 3 the theoretical framework is presented and in chapter 4 the data and some first indicative estimates are given. Chapter 5 gives an overview of the statistical model and in chapter 6 the empirical estimations are presented. Chapter 7 concludes.

2 The Finnish economy 1982-2002

The Finnish economy is unconventional by Western European standards. It was, as most economies, still a closed market in the beginning of the eighties. However, while most other European economies suffered from high unemployment during the eighties, the Finnish unemployment rate remained at 5%. Finland heavily relied on trade with the Soviet Union and can be considered to have been even more closed and protected than other Western European countries due to the bilateral trade agreements with the Soviet Union. One result of the bilateral trade agreements was, for example, that the oil shocks did not hit the Finnish economy as hard as they hit many other economies. This was because an increase in the prices of Soviet goods led to an corresponding increase in demand for Finnish goods [Koskela and Uusitalo, 2003].

During the 80's the economy started to open up. The financial markets were deregulated and the international trade expanded, leading to an increased openness of the economy. In the end of the 80's the economy was booming and the future looked promising. However, as most European countries, the Finnish economy underwent a very serious crisis in the beginning of the 90's. The

Finnish crisis was the deepest one in a western economy after the second world war and between 1991 and 1993 GDP fell by 13% and the employment level fell by 18%. This extreme crisis was the result of a combination of many things; the fall of the Soviet Union, the collapse of the ERM and the deregulation of the financial markets in combination with extensive borrowing. Finland devalued twice during the early 90's and after that the Finnish markka floated freely [Honkapohja and Koskela, 1999]. The Finnish economy, however, recovered quite fast from the crisis. The only serious problem that remained was the extensive and persistent unemployment. A slow decline in the unemployment rate has taken place, but only recently has the unemployment rate fallen below 10%.

The reasons for this extremely persistent unemployment have been extensively discussed and there are many explanations at hand. For the European unemployment problem both aggregate demand and aggregate supply shocks along with real wage rigidity have been suggested as possible causes [Blanchard and Summers, 1986]. Unemployment benefits and structural changes can both be seen as aggregate supply shocks in this framework. Ljungqvist and Sargent [2002] point at the generous benefit system along with other aspects, while Lindbeck and Snower [1985] emphasize Insiders-Outsider theories. In the Finnish case most observers agree that a severe restructuring of the economy has taken place, which has played an important role for the unemployment developments. Also, in line with previous research, rigid labor market institutions, strict labor laws and strong labor unions pushing up wages are generally viewed as explanations for the high and persistent Finnish unemployment.

3 The theoretical matching framework

The simple matching framework utilized in this section is based on the model described in Pissarides [2000]. The matching function is a well behaved function that gives the number of formed jobs as a function of the number of vacancies and the number of unemployed. In its simplest form it can be written as

$$M = m(V, U), \tag{1}$$

where M is the number of hirings or matches during the period, V is job vacancies during the period and U is the number of unemployed during the period. The matching function is assumed to be increasing in both its arguments, concave and in most cases homogenous of degree one. Homogeneity, or constant returns to scale, implies a proportional increase in hirings given a change in vacancies or unemployment. The functional form usually used is the Cobb-Douglas form

$$M_t = \delta V_t^{\theta} U_t^{1-\theta}, \tag{2}$$

where

$$0 < \theta < 1. \tag{3}$$

The Cobb-Douglas functional form is very popular in empirical applications, but has been critizied because there are no microfoundations for it in the existing litterature. Alternative specifications suggested are e.g. translog and CES functional forms. The matching function describes how the actual match between vacancies and job-seekers takes place at each moment in time. If there are no frictions in the matching process, i.e. if unemployed and vacancies are instantaneously matched, this number is the minimum of vacancies and unemployed. Obviously if there are frictions, the number of matches will be lower [Petrongolo and Pissarides, 2001]. Increased inefficiency in the matching process means less matches at the same level of vacancies.

The process that matches the unemployed to available vacancies is often graphically described as a convex Beveridge curve in the vacancy-unemployment space. The Beveridge curve slopes downward if the outflow from unemployment is described by equation 1. The steady state Beveridge relationship can easily be derived from equation 1. Let U be the number of unemployed and V the number of vacancies and N and L the level of employment and the labor force. The unemployment rate is given by $u = U/L$ and the vacancy rate is in Pissarides [2000] given by $v = V/N$, but is also frequently given by $v = V/L$ as is done is the empirical part of this paper. Assume that the job separation rate is λ and total separations are given by $S = \lambda N$. Imposing constant returns to scale on $m(.)$ the Beveridge curve is given by

$$\lambda = m[(u/1 - u), v]. \tag{4}$$

Given the separation rate λ, there is a negative steady state relationship between the unemployment rate and the vacancy rate [Petrongolo and Pissarides, 2001]. The further away from the origin the curve is the less effective is the process matching jobs and unemployed.

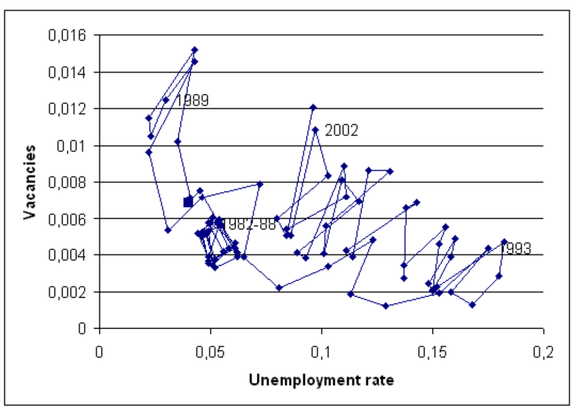

Figure 1: The Finnish Beveridge Curve for the period 1982:1-2002:3

The Finnish Beveridge curve for the period 1982-2002 slopes downward but has shifted out and the slope has also changed over time (see Figure 1), as is the case for most European countries (see for example Layard et al. [1994]). When looking at the curve there seems to be three different stages; The 80s, the turbulent years around 1990 and the period stretching from 1992 onwards. From 1982 to 1988 the Beveridge curve stayed practically in one place as can be seen in Figure 2, while after 1988 vacancies first rocketed after which the number of vacancies started to fall along with an enormous increase in unemployment. At the worst point unemployment exceeded 16 %.

Unemployment only begun to decrease again in 1993 when also the number of vacancies started

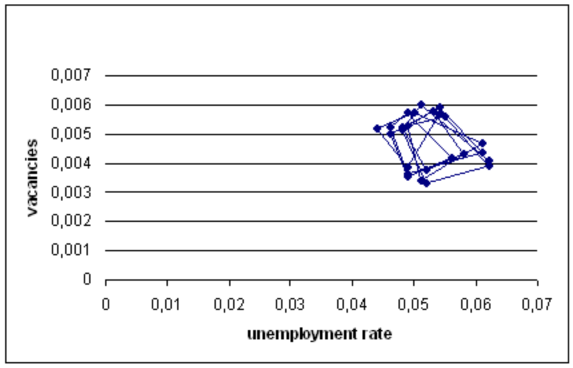

Figure 2: The Finnish Beveridge Curve for the period 1982:1-1988:1

to grow but in quite a fluctuating manner, as illustrated in Figure 4, but as to date the Finnish unemployment still ranges around 8 %. For the behavior of the Beveridge curve during the different periods see Figures 2, 3 and 4.

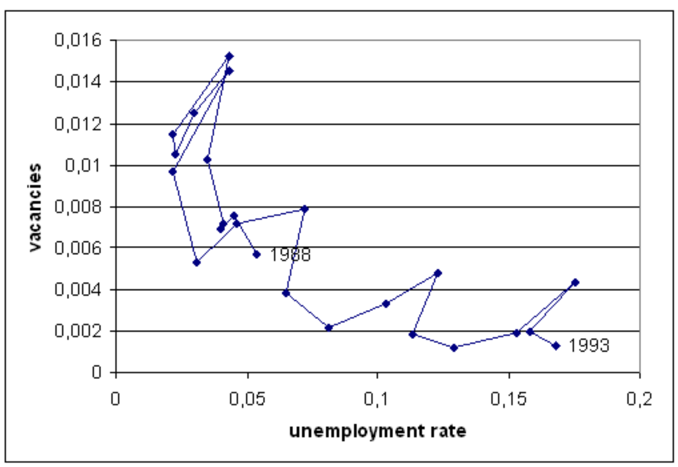

Figure 3: The Finnish Beveridge Curve for the period 1988:1-1993:1

An outward movement of the curve, as the one in the Finnish case, can be a sign of increased inefficiency of the matching process and structural change [Petrongolo and Pissarides, 2001]. Another explanation often mentioned concerning outward movements is hysteresis. Hysteresis can occur when a country is far down on its Beveridge curve as Finland was in 1993. At this point a movement along the curve can transform into an outward shift. The reason for this is that long periods of unemployment in itself can decrease the possibilities to find a job (for more on hysteresis, see Blanchard and Summers [1986]).

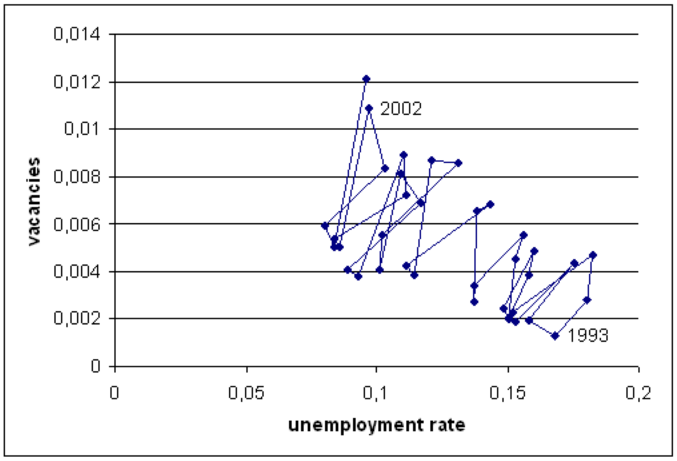

Figure 4: The Finnish Beveridge Curve for the period 1993:1-2002:3

4 Data and elementary estimates

4.1 Data

The data used in the analysis is Finnish monthly data spanning the period 1982:1 - 2002:8. The data was split into two parts; 1982:1-1988:1 and 1992:1-2002:8. The first period will hereafter be called *Period 1* or the *pre-crisis-period,* while the second will be called *Period 2* or the *post-crisis-period*. The reason for the split is that constant parameters could not be found for the whole period in the cointegrated VAR-analysis. This can in itself be seen as an indication of some kind of structural break in the data during the left out period or of that a part of the trends are not modelled by the interaction set.

The variables used are *unemployment* (the logarithm of the number of unemployed/work force), *vacancies* (the logarithm of the number of vacancies / work force) and *hirings* (the logarithm of the number of hirings/work force). The data which is from the Finnish Ministry of Labor is based on information reported by local workforce offices and therefore only includes unemployed, vacancies and hirings reported to the workforce offices. *Long-term* and *short-term unemployment* data for the period 1994:3-2002:3 is also used for additional analysis. Long-term unemployed are those that have been unemployed for more than 12 months. The series used are logarithms of long-term unemployment/labor force and of short-term unemployment/labor force. Also this data is from the Finnish Ministry of Labor.

Vacancies, hirings and unemployed reported to local workforce officies do, however, not include all vacancies, hirings and unemployed at the market. Quite a significant bulk of vacancies are never posted at workforce officies but are only posted in newspapers, on company websites or advertised through recruitment agancies, neither do all newly unemployed report unemployed to workforce officies. The general view is that high skill jobs are matched elsewhere than through workforce officies indicating a low-skill bias in the data.

This view is, however, challenged by the fact that most large Finnish coorporations and all governmental sectors report all their vacancies also through local workforce offices, so the bias towards lowskill jobs might not be that large in the data after all. As an example in July 2004 there were in total 33.900 vacancies available through workforce officies, 19.000 vacancies were filled during July and out of these only 8.900 where filled with applicants found through workforce offices. Roughly half of the vacancies are filled by workers not reported in any way to workforce officies. This is probably a result of vacancies being simultaneously posted in many different places and the applicants are then not only registered unemployed using information given by the workforce office but also workers conducting on-the-job-search and newly graduated. Hence it seems as if vacancies as well as hirings are quite extensively reported, it is the job applicants we know less about. However, the fact that not all jobs are reported and included in the data is a severe restriction of the study which needs to be taken into consideration when analyzing the results.

One aspect that also requires mentioning is that the labor force data, which originally comes from Statistics Finland, but which is also used by the Ministry of Labor, is in its basic form quarterly data reported as an average of the work force during the period. This average has been used as an observation for all months within each quarter. The fluctuation in work force is however very limited and therefore this action cannot be seen as something seriously affecting the results. The aspects of interest are the long-term fluctuations and not the variations within the quarter. The time series for vacancies, unemployment and hirings are presented in appendix 1.

4.2 OLS-estimates and test for structural break

In order to make the main results of this study as transparent and as comparable with earlier estimations as possible I proceed by first estimating a simple OLS framework with hirings as the dependent variable and vacancies and unemployment as the explanatory variables.

Table 1: Estimates of matching functions for unemployed workers in Finland, 1982:1-2002:8

	1982-2002	1982-1988	1992-2002
constant	**-1,1**	**-8,0**	**-1,4**
	(3,84)	(-2,66)	(-2,98)
unemployment rate	**0,08**	-0,67	-0,15
	(2,31)	(-1,17)	(-1,45)
vacancy rate	**0,7**	-0,16	**0,74**
	(16,5)	(-0,47)	(15,5)
R^2	0,91	0,81	0,96
Returns to scale	0,78	-0,83	0,59

Dependent variable: hirings. Data seasonally adjusted. Estimation method: OLS. t-values based on heteroscedasticity and autocorrelation consistent (HAC) standard errors reported in brackets.

This part is intended to be only indicative since the nonstationarity of the time series undermines the results from an OLS-analysis with non-differentiated time series. However, an OLS-analysis can serve as a good comparison with earlier studies and can also underline the differences between it and a cointegrated VAR-analysis and enhance the validity of the latter. In this section I also test for structural breaks in the model using Bruce Hansen's fixed regressor bootstrap.

The OLS-estimates are presented in table 1. Significant variables are printed in bold style. For the whole period a quite clear matching function with decreasing returns to scale is prevalent. The coefficient for vacancies is 0,7 and the one for unemployment is roughly 0,1. Hence the OLS-estimates evidence of decreasing returns to scale for the whole period. For the two subperiods no actual significant matching function can be found.

In order to verify that a structural change has indeed taken place during the cut out period Bruce Hansen's fixed regressor bootstrap test for structural change [Hansen, 2000] was estimated.[1] The break point in the period 1982:1-1996:12 was estimated to be 1988:4.[2] This estimate corresponds to the sudden jump in the Beveridge Curve shifting the curve away from the steady relationship of the eighties. When looking at the data series 1988:4 is exactly the observation when vacancies begun to increase dramatically as can be seen in figure 1. [3]

5 The statistical model

Most time series in macroeconomics are non-stationary, as all series used in this study, and unreliable results follow if this nonstationarity is ignored. Cointegrated VAR-analysis is especially suitable when dealing with the kind of data used here because it utilizes the non-stationary time series to find long-term relationships which are kept separate from short-term adjustments [Engle and Granger, 1987]. An additional advantage of the method is that no causality is imposed.

A short overview of the most fundamental aspects of the cointegrated VAR method is given here. Readers requesting a more thorough description of the model are advised to turn to Hendry and Juselius [2000] and Hendry and Juselius [2001] for a survey.

The baseline statistical model used is a p-dimensional cointegrated VAR-model with k lags, which in its error correcting form (ECM), assuming $X_t \sim I(1)$, is given by

$$\Delta X_t = \Pi X_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-i} + \mu + \Psi D_t + \epsilon_t, \quad (5)$$

$$\epsilon_t \sim N_p(0, \Sigma) \quad (6)$$

where the Π-matrix includes both the long-run relations, β, and the loadings to the long-run relations, α, such that $\Pi = \alpha\beta'$ if there exists cointegration. The Γ-matrix consists of the short term corrections. The vector process X_t is a p-dimensional vector assumed to be I(1). μ is a vector of constants and D_t consists of other deterministic components, including seasonal dummies.

[1] Available at Bruce Hansen's homepage www.ssc.wisc.edu/~bhansen/ as Gauss-code. I ran the program in Jürgen Doornik's OxGauss available at Doornik's homepage www.nuff.ox.ac.uk/Users/Doornik with the additional add-on m@ximize 1.0.

[2] When running the test on the whole data set another break point was found at 1996:10.

[3] The heterorscedasticity-corrected p-values for the SupF, ExpF and AveF were 0,065, 0,065 and 0,008. The Andrews-Ploberger exponentially weighted ExpF statistic is according to Hansen [2000] the most stable statistic with respect to structural change in the marginal equation. Based on these test-statistics the null-hypothesis of no structural break can be be boarderline rejected.

5.1 Linear restriction on the $\beta-$vectors

One of the main parts of the analysis is to test linear restrictions on the $\beta-$vectors. The aim of the testing is to identify empirically relevant relations. There are two main ways of imposing restrictions; simultaneously on all cointegrating relations or separately on the individual vectors. Given $\Pi = \alpha\beta'$ the same restrictions on all the vectors can be tested by the alternative hypothesis:

$$H_2 : \Pi = \alpha\phi' H' \tag{7}$$

that is $\beta = H\phi$, where H is a (p x s)-matrix with $r \leq s \leq p$. This alternative hypothesis defines the linear restrictions on β.

Restrictions on the individual vectors can again be formulated as

$$H_3 : \Pi = \alpha\beta' \tag{8}$$

where

$$\beta = \{H_1\phi_1, ..., H_r\phi_r\}$$

in which H_i is a (p x s_i) matrix restricting the individual vectors. Johansen [1995] derives an LR-test for testing the above hypotheses.

5.2 Weak exogeneity

Just as the β -vectors can be restricted, the α-vectors can be restricted. A special case is when one or more rows in α consist of nulls. A variable with a row of nulls in α is not adjusting to the long-run relations and can therefore be seen as a driving trend in the system and can be treated as weakly exogenous. For more on the topic see Hendry and Juselius [2000] and Hendry and Juselius [2001].

6 The empirical results

6.1 Dynamic long-run relations

In this section results from Period 1 and Period 2 are presented parallel for readability.

In order to investigate whether any long run properties exist in the model equation 5 was estimated for both periods with $X_t = [vac, une, hir]$, k=2 and a constant restricted to the cointegration space. The trace test which tests for reduced rank indicates that the rank in both periods should be set at 2 as can be seen in table 2. A rank of two indicates that there are two long run relations in the data in each period. These results are supported by the roots of companion matrix- test.

None of the variables are found to be stationary in neither period as reported in table 3. All variables are I(1) which means that if cointegrating relations can be found they will be I(0), i.e., stationary.

In Period 1 hirings are found to be excludable and weakly exogenous based on the tests reported in table 3. Despite these results the variable is kept in the analysis since these tests are not always

Table 2: Rank test

Period 1			Period 2		
Trace test	Trace value	Rank	Trace test	Trace value	Rank
62.2	31.88	0	73.03	31.88	0
18.62	17.79	1	34.28	17.79	1
5.63	7.5	2	3.07	7.5	2

Table 3: Tests for weak exogeneity, exclusion and stationarity

Period 1						
	Rank	χ^2	Hirings	Unemployment	Vacancies	Constant
Weak exogeneity (LR-test)	2	5.99	**1.61**	21.19	24.7	
Exclusion (LR-test)	2	5.99	**0.33**	19.56	26.7	25.8
Stationarity	2	5.99	10.67	10.73	10.56	

Period 2						
	Rank	χ^2	Hirings	Unemployment	Vacancies	Constant
Weak exogeneity (LR-test)	2	5.99	24.25	32.82	3.86	
Exclusion (LR-test)	2	5.99	34.61	30.08	31.1	28.26
Stationarity	2	5.99	27.76	27	28	

fully reliable. The results, however, show that hirings do not influence the long run patterns much in the period.

In Period 2 vacancies was found to be weakly exogenous. This is a highly interesting result since it implies that vacancies, or shocks entering through the vacancy-variable, drive the system in Period 2. This result is in line with Albaek and Hansen [2004] who also find vacancies to be the driving force in the system. I will return to this result later in the paper. At this point it is however important to see the differences between the two periods.

In order to remove extreme observations dummies were added to the models. In Period 1 dummies were added for *1982:3, 1982:8, 1986:5, 1986:6, 1987:1* and *1988:1.* The two first dummies correspond to the two devaluations in 1982 while the dummy for 1988 can be tied to the revaluation the same year. Since high frequency data is used more dummies are needed than when using less frequent observations which results in that not all dummies can be given an economic interpretation. In Period 2 the following dummies were added: *1993:4, 1993:7, 1993:8, 1994:7, 1995:7, 1997:3, 2000:2, 2000:7, 2002:4* and *2002:6.* The dummies for 1993 can be seen as adjustment dummies due to imbalance in the economy.

The rank test evidences that there should be two long-run relationships in each period. A natural first hypothesis to test for is whether there is a long run relationship describing the theoretical Cobb-Douglas matching function with constant returns to scale. This is done by testing for long run homogeneity.

For **Period 1** a very low p-value of 0.02 indicates that the Cobb-Douglas matching function

Table 4: Unrestricted β-vectors

Period 1			Period 2		
	β_1	β_2		β_1	β_2
Hirings	1	-0.171	Hirings	1	-1.022
Unemployment	-23.136	1	Unemployment	0.433	1
Vacancies	-29.858	-0.901	Vacancies	-1	1.307
Constant	-224.379	-2.744	Constant	-1	-1.91

with constant returns to scale is not a very significant relationship in the period. On the other hand a long-term one-to-one relation between unemployment and vacancies, a u/v-curve, cannot be rejected (p-value 0.67) in Period 1. This is the only highly significant relationship found in the period. Since no other significant relationships could be found the u/v-curve and the matching function are chosen as the 2 long-run relations. The whole system for the first period, including both relationships the has a p-value of 0.05 and can therefore not be rejected.

The fact that only one very significant relationship is found can be interpreted as if the single most important relationship in the first period is the one-to-one relationship between vacancies and unemployment, a u/v-curve. This indicates an uncomplicated matching process; one more vacancy, one less unemployed. Hirings do not seem to influence much in this period, which coincides well with the earlier results of exclusion. This one-to-one relationship can be seen as a very simple form of Beveridge curve since it includes only vacancies and unemployment while the relationship between these two is negative as expected. This results goes quite well with the picture of the Beveridge curve for the period, which basically circulates around one spot for the whole period. Also Albaek and Hansen [2004] find a u/v-curve and a matching function in their study on Danish data for a period ending 1988. In other words, these results seem to indicate quite similar matching patterns in the two countries during the period up to 1988.

Table 5: The estimated $\alpha-$and $\beta-$ vectors

Period 1					Period 2				
	β_1	β_2	α_1	α_2		β_1	β_2	α_1	α_2
Hirings	1	*	-0.163	-0.255	Hirings	1	0.59	-0.369	-0.006
Unemployment	-0.097	1	-0.019	-0.307	Unemployment	-0.094	1	-0.006	-0.129
Vacancies	-0.903	1	0.101	-0.395	Vacancies	-0.906	*	0.204	-0.017
Constant	*	8.358	*	*	Constant	*	-2.141	*	*

In **Period 2** the same hypothesis of homogeneity of degree one was tested for but now the p-value was 0.21, which is very significant. The matching function is a significant long-term relation. In the second period the other long-term relation found to be significant was a negative unemployment-hirings relationship. The p-value for the relationship was 0.06, which is borderline accepted.This relationship decribes the basic connection between more hirings and lower unemployment. The p-value for the whole system was 0.21.

These results can in turn be interpreted as if the most important and significant long-term relationship found in Period 2 was the Cobb-Douglas matching function with constant returns to scale. The matching pattern in the post-crisis period can with other words be described by a homogenous of degree one matching function but not by a u/v-curve, while the reverse is true for the pre-crisis period. The normalized vectors are reported in table 5.

Even though the results in themselves are interesting, the most fascinating aspect is that very different results are found in the two periods. This evidences of two different regimes, which also gets support from visual inspection of the Beveridge curves and the formal test for structural break presented earlier. Visual inspection gives that a one-to-one relationship during Period 1 looks very plausible just as a Cobb-Douglas matching function in Period 2. The long-term relation in the post-crisis period, Period 2, is a matching function with Cobb-Douglas properties and with constant return to scale, while the dominant relation in the first period is a 1-to-1 u/v-curve. In the first period the matching process seems to have been very straightforward while the matching pattern in itself has become increasingly complicated in the second period. Hence, based on these results it seems as if structural break and increased openness affected the matching process radically.

6.1.1 Elasticities

The coefficient estimates for the Cobb-Douglas matching function were in both periods 0.9 for vacancies and 0.1 for unemployment, however, remember that the relation was quite insignificant in period 1. These elasticities are rather extreme but still quite in line with earlier OLS-estimations using hirings instead of unemployment outflow as the third variable in the system. Vacancies have recieved significantly more weight than earlier assumed, especially compared to Albaek and Hansen [2004], which also estimates long-run relationships with cointegrated VAR-analysis.

A possible explanation for the larger coefficient for vacancies in Finland compared to Denmark could be the rigid wage system. The centralized collective bargaining system parallel with a union coverage around 95% have created a wage system with long-term fixed wages which puts the price mechanism in the labor market out of order. More unemployed does not necessarily lead to lower wages and thereby more hirings since wages are regulated and set for long time periods in advance. The negative u/h-curve also indicates that the relationship between hirings and unemployment might not be that straightforward.

Another possible explanation for differing coefficient estimates in the studies are differences in data. As mentioned earlier the data used in this study is collected by local workforce offices. The general trend is that low-skill jobs and unemployed are registered at these offices, while high-skill labor is matched elsewhere, for example through advertisements, word of mouth and private agencies. The data used here is therefore biased towards the low skill segment of the labor market, which most probably influences the results.

6.1.2 Beta constancy

Parameter or beta constancy of the chosen vectors can be tested with a recursive test (for more on recursive tests see Hansen and Johansen [1993]). The parameters in both periods have some problems with constancy over the test periods. The reason for this is probably that all explanations for unemployment are not included in the analysis, which was not to be expected since I only included the variables used in the theoretical framework. In order to get constant parameters for the whole periods additional variables should be added to the system. This would then not only investigate the matching framework but a more general unemployment setting. The important lesson from this is that the matching framework seems to inadequately describe the situation. Further research is important in order to understand the problem.

6.2 The short-term structure of the model

The long run relations from the previous section are in the short-run analysis taken as given and they are named $ECM1$, $ECM2$ and $ECM3$. These are centered and normalized versions of $\hat{\beta}_1$and $\hat{\beta}_2$ in table 5. The Cobb-Douglas matching function is in both periods named $ECM1$, while the one-to one relationship in Period 1 is named $ECM2$ and the u/h-curve in Period 2 is named $ECM3$. The short run structure is then estimated by

$$\Delta X_t = \Gamma \Delta X_{t-1} + \alpha ECM_{t-1} + \mu + \Psi D_t + \epsilon_t \quad (9)$$

where $X_t = [var, une, hir]$, Γ is a (3 x 3) matrix, α is a (3 x 2) matrix and ECM_t is a column vector with ecm_i as its elements.

Table 6: Misspecification tests

Period 1				Period 2			
Equation	AR 1-5	ARCH	Normalityχ^2	Equation	AR 1-5	ARCH	Normality χ^2
Δu	0.78	0.76	0.99	Δu	0.24	0.67	0.39
Δv	0.40	0.76	0.09	Δv	0.93	0.58	0.18
Δh	0.86	0.23	0.08	Δh	0.08	0.67	0.81

Misspecification tests for the short run structure are presented in table 6. There are no problems with autocorrelation, heteroscedasticity or normality in the model. The number of parameters in the model was reduced by running an F-test for exclusion. From the first period system $ECM1$ and D82a (with p-values 0.2479 and 0.6258) were excluded. From the second period only D00b was excluded (with p-value 0.1149).

The correlation between real and adjusted in period 1 was for Δu, 0.95802, for Δh, 0.93979 and for Δv, 0.95297. This correlation can be seen as the level of explanation of the equations. The probability-value of the LR-test for over-identification was 0.1679, which implies rejection of the hypothesis of over-identification.

In the second period the correlations between real and adjusted were 0.94213 for Δu, 0.92287 for Δh and 0.95472 for Δv. The probability-value for the LR-test of over-identification was 0.3787, which implies rejection of the hypothesis of overidentification.

The short-term relations are presented in table 7. Many of the variables (unemployment and hirings) correct themselves so that an increase in period t-1 corresponds to a decrease in period t. A cointegration vector is error correcting in a variable if the vector contains the variable with a positive sign and enters the equation of the variable with a negative sign. $ECM2$ (the one-to-one relation between vacancies and unemployment) in period 1 is error correcting in *both* vacancies and unemployment. This means that if there is an imbalance in the relationship described in the ECM both variables will start to change in order to restore equilibrium. In Period 2 hirings

Table 7: Short-run relations

Period 1				Period 2			
	Equation 1	Equation 2	Equation 3		Equation 1	Equation 2	Equation 3
	Δu	Δh	Δv		Δu	Δh	Δv
Δu_{-1}	-0.39918	*	*	Δu_{-1}	-0.20174	*	*
	(-3.829)	*	*		(-2.822)	*	*
Δh_{-1}	0.12444	*	*	Δh_{-1}	*	-0.11428	-0.21002
	(2.305)	*	*		*	(-1.591)	(-2.162)
$ECM2_{-1}$	-0.29706	*	-0.40888	Δv_{-1}	-0.038657	0.24393	0.29234
	(-3.481)	*	(-3.252)		(-1.078)	(2.967)	(2.629)
D82b	0.17021	*	*	$ECM2_{-1}$	-0.1284	*	*
D88	*	*	0.20753		(-5.537)	*	*
D86a	*	*	*	$ECM1_{-1}$	*	-0.36272	0.22429
D86b	*	0.56178	0.40946		*	(-4.52)	(2.066)
D87	0.14521	*	*	D97	*	-0.2438	*
Constant	-0.035721	*	-0.038126	D93a	0.098833	-0.24513	*
CSeasonal	0.16555	0.47402	0.16912	D93b	*	*	0.62373
CSeasonal1	*	0.37339	0.225	D93c	*	*	-0.57477
CSeasonal2	*	0.41517	0.33488	D94	0.14478	*	*
CSeasonal3	*	0.46268	0.37968	D95	0.21619	*	*
CSeasonal4	*	0.91846	0.43992	D00a	0.1196	*	*
CSeasonal5	*	0.40939	*	D02a	-0.12164	*	*
CSeasonal6	0.10669	*	0.15965	D02b	*	*	*
CSeasonal7	*	0.45623	0.29262	Constant	*	*	*
CSeasonal8	*	0.3756	*	CSeasonal	0.11559	0.30135	0.5548
CSeasonal9	0.16558	0.29242	*	CSeasonal 1	*	0.12934	0.51235
CSeasonal10	*	0.16635	*	Cseasonal 2	0.053319	0.41676	0.32534
				CSeasonal 3	0.061995	0.19764	*
				CSeasonal 4	0.22891	0.31873	0.15509
				CSeasonal 5	*	0.20282	*
				CSeasonal 6	-0.12754	*	-0.18313
				CSeasonal 7	*	0.22779	*
				CSeasonal 8	0.0646	*	*
				CSeasonal 9	0.062059	0.12833	*
				CSeasonal 10	0.039747	0.14121	*

and vacancies are both error correcting in $ECM1$(the Cobb-Douglas matching function), while unemployment is error correcting in $EMC3$ (the u/h-curve) .

6.3 Long-term unemployment

The matching function is usually assumed to be increasing in both its arguments. This assumption also generally holds in empirical applications. The effect from long-term unemployment is not, however, completely clear. Given that the proportion of long-term unemployed in Finland increased from 10% in the beginning of Period II to around 30% a few years later and stayed at that level thereafter, it is interesting to estimate how long- and short-term unemployment, as opposed to unemployment, affect hirings in the matching setup.

The separation between long-and short-term unemployment is here only done for the post-crisis period, since it was only after the crisis that long-term unemployment begun to rise and became a problem. When substituting long- and short-term unemployment series for the unemployment series in the cointegrated VAR-analysis intuitive results are found.

The rank of the system is chosen to be two, indicating two cointegrating long-run relations. All series are non-stationary and no series should be excluded from the analysis but short-term unemployment and vacancies are found to be weakly exogenous in the framework. The variables are however kept as regular variables in the analysis since restricting them to be weakly exogenous makes the cointegrating relations much less significant. Whether or not the weak exogeneity restriction is imposed does not affect the results in a more general manner.

Table 8: Rank test

Rank test		
r	**test statistic**	**5% critical value**
0	156,9	53,94
1	50,37	35,07
2	**19,20**	**20,16**
3	4,95	9,14

Since I am intrested in how the coefficient estimate for unemployment is divided between long- and short-term unemployment in the matching function the natural first hypothesis to test for is whether there is a long-run relationship describing the theoretical Cobb-Douglas matching function with constant returns to scale also when unemployment is split into short- and long-term unemployment. This relation is, however, found to be insignificant. Relaxing the restriction so that only the coefficients for vacancies and short-term unemployement are restricted to add up to one, but still also including long-term unemployment in the relation gives very significant and interesting results.

The relation is accepted with a p-value of 0,33 and gives the coefficient 0,52 for vacancies and 0,48 for short-term unemployment. Long-term unemployment has a negative coefficient of -0,68. Hence short-term unemployment has a very strong positive influence on matching and recieves much greater weight than just unemployment. Long-term unemployment, however, has a negative influence on matching. This negative effect sheds some light on why unemployment recieved

Table 9: Restricted beta-vectors

Restricted beta-vectors			**Stationarity**	**Weak exogeneity**	**Exlusion**
	$\hat{\beta}_1$	$\hat{\beta}_2$	**test statistic**	**test statistic**	**test statistic**
Hirings	1		17,07	19,36	14,29
Vacancies	-0,54		16,06	1,80	10,54
Short-term unemployment	-0,46	-1,55	17,81	56,03	15,79
Long-term unemployment	0,68	1	24,18	3,03	16,27
Constant		1,86			17,52

The values repported for stationarity, weak exogeneity and exclusion are based on the chosen rank of 2.The critical value for the stationarity, weak exogeneity and exclusion tests is 5,99.

such a small coefficient earlier in the study; The negative effect from long-term unemployment pulls down the positve influence from short-term unemployment. The second significant long-run relation found is a positive relation between long- and short-term unemployment and a constant. The p-value for the whole system is 0,56. Also this specification has beta-constancy problems.

These results suggest that it indeed is so that long- and short-term unemployment have very different effects on matching. Short-term unemployment fits the traditional matching setup in that it has a strong positive effect on matching; More short-term unemployed just as more vacancies leads to more matches. Long-term unemployment, however, has the opposite effect on matching.

The negative influence from long-term unemployment on matching could be due to skill mismatch following structural break; During a period of structural change old jobs disappear and new jobs, demanding new skills, are created. The unemployed do not neccessarily possess the skills demanded for the vacancies available. Some of the workers becoming unemployed fail to find suitable jobs for long spells of time. They become long-term unemployed with very small chances of finding a job corresponding to their skills. At the same time another effect, hysteresis, is at work; The longer you are unemployed the smaller are your chances of finding a new job [Blanchard and Summers, 1986]. In a situation like this there will be extensive long-term unemployment unless the unemployed acquire new skills.

6.4 Discussion of results

The results found in this study are in many ways appealing. The first interesting feature is that very different results are found for the two periods. I present empirical evidence of that jobs are formed, destroyed and filled in very different manners in the two periods. The second interesting feature is that despite the data was split into two periods the model still has robustness problems. I will in the following discuss these issues.

In Period 1 there seems to have been only one very significant long-term relation and another less significant one. The significant one was a functional Beveridge or u/v-curve. During this period, stretching from 1982 to 1988, matching was very straightforward and uncomplicated. The explanations for this can be found in that Finland was a quite closed economy at the time. Both the labor market and the economy as a whole were influenced by the bilateral trade agreements with the Soviet Union which protected the economy from external shocks. Specific knowledge was not demanded in the same extent as today for most jobs. The key to decreasing unemployment seems to have been an increased number of vacancies because no greater mismatch existed.

In Period 2, stretching from 1992 to 2002, there were two long-run relationships, a Cobb-Douglas matching function with constant returns to scale and a less significant u/h-curve. An interesting finding is, however, that vacancies in this period is weakly exogenous. This implies that vacancies drives the system and cannot be explained within it. The matching process has grown more specific from Period 1 to Period 2.

An explanation for the change of and the magnified complications in the matching process can be increased openness and structural changes. A structural break was estimated to take place in April 1988. A country opening up to the rest of the world faces a changed labor demand due to increased demand for specialisation. A *human capital* or *competence based matching* evolved, which underlines the importance of specific skills and education. Even though vacancies are weakly exogenous in the system in Period 2, the parallel increase in mismatch suggests that simply creating new jobs might not suffice in order to decrease unemployment since the skills required for the new jobs might not be possessed by the unemployed.

When separating unemployment into long- and short-term unemployment in the second period a very strong negative effect from long-term unemployment on matching is dominant. This result supports the view of human capital mismatch following structural break. The workers becoming unemployed during a period of structural change do not possess the skills neeeded for the new vacancies created, and hence they become long-term unemployed with very small chances of finding employment. The skill mismatch hypothesis explains quite well why long-term unemployment does not affect matching positively after a structural break. This explanation seems to fit the Finnish situation quite well.

The parameter constancy tests suggest that this model might not tell the whole story about formation of unemployment and therefore it is difficult to give policy suggestions based on the estimations. At a first glance it however looks as if simple stimulation policy might have been a better approach during the eighties than during the nineties. During the 90s a more broad-based macroeconomic policy was called for due to the more competence based labor demand that has evolved. Traditional jobs which did not demand any specific skills disappeared due to the structural change but also due to the increased openness. The importance of human capital increased due to a new competence based matching.

7 Conclusions

This paper has estimated what happens to theoretical matching relations when severe structural change and increased openness is added to the picture. This is done by applying cointegrated VAR-analysis to standard matching data consisting of Finnish monthly observations for the period 1982:1 - 2002:8. The main findings were that a very evidential change has taken place in the matching process during the past 20 years.

The matching process during the eighties can be described as a very simple functional Beveridge-relationship between unemployment and vacancies. Basically one more vacancy led to one less unemployed. No complicated mismatch existed. The reasons for this simplicity can most probably be found in that Finland was a quite closed economy at the time and furthermore the economy was protected from external shocks through the bilateral trade agreements with the Soviet Union.

During the second period, the post-crisis period beginning in 1992, the matching process cannot anymore be described by the same simple relation as in the previous period. Instead it is described by a vacancy-driven Cobb-Douglas matching function with constant returns to scale. This drastic change in matching patterns can be explained by a few different things. Firstly, the Finnish economy underwent a significant deregulation process during the eighties. This led to increased openness and also increased vulnerability. Secondly the fall of the Soviet Union might have played a role in the scenario just as well as the overall economic turbulence in the beginning of the nineties that culminated in the ERM collapse. All these things together with a structural change that followed led to a new type of economy. An economy that was much more dependent on the rest of the world and at the same time a lot more specialized. This specialization, which was an indirect consequence of increased openness, led to complications in the labor market. A competence based matching evolved, which was not well matched with the Finnish labor force which had not changed at the same pace as the demand. This skill mismatch seems to have played an important role in the development of Finnish unemployment and especially long-term unemployment.

The results in this study give strong support for the existence of a matching function in an open economy and for a simpler matching pattern in a closed economy. However, parameter constancy tests revealed that the robustness of the model was not very good, which implies that there might be some misspecification in the model. This means that the model does not capture all essential parts explaining unemployment.

The results received when using the cointegrated VAR-analysis differ significantly from the results received with OLS-analysis as the working tool. The OLS-estimates indicated decreasing returns to scale for the whole period and no significant matching relationships for the sub-periods, while the cointegrated VAR-analysis, taking into account the non-stationarity of tha data, found evidence of two different regimes and hence no long-run relationship for the whole period and a very strong Cobb-Douglas matching function with constant returns to scale with vacancies as the driving force in the second sub-period. These results emphasize the importance of using proper methods for the problem at hand. Relying on OLS-estimates in this setup would not only have biased the results but changed the whole analysis.

The intensified matching difficulties and the negative effects from long-term unemployment on matching following increased openness and structural change in the Finnish framework are remarkable. It would be interesting to know if other countries have undergone similar changes in labor market matching as Finland consequential to increased openness and structural break. In order to verify if this is a curiosity prevalent only in Finland or a more general phenomenon, formal testing for the effects of increased openness on the matching framework for a larger amount of countries is called for. This is an interesting topic for future research.

An interesting observation is however that the theoretical studies in the field have grown increasingly matching-related as opposed to Beveridge curve-centered during the 80's. This drift in research focus recieves strong support from the results in this study.

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Appendix 1

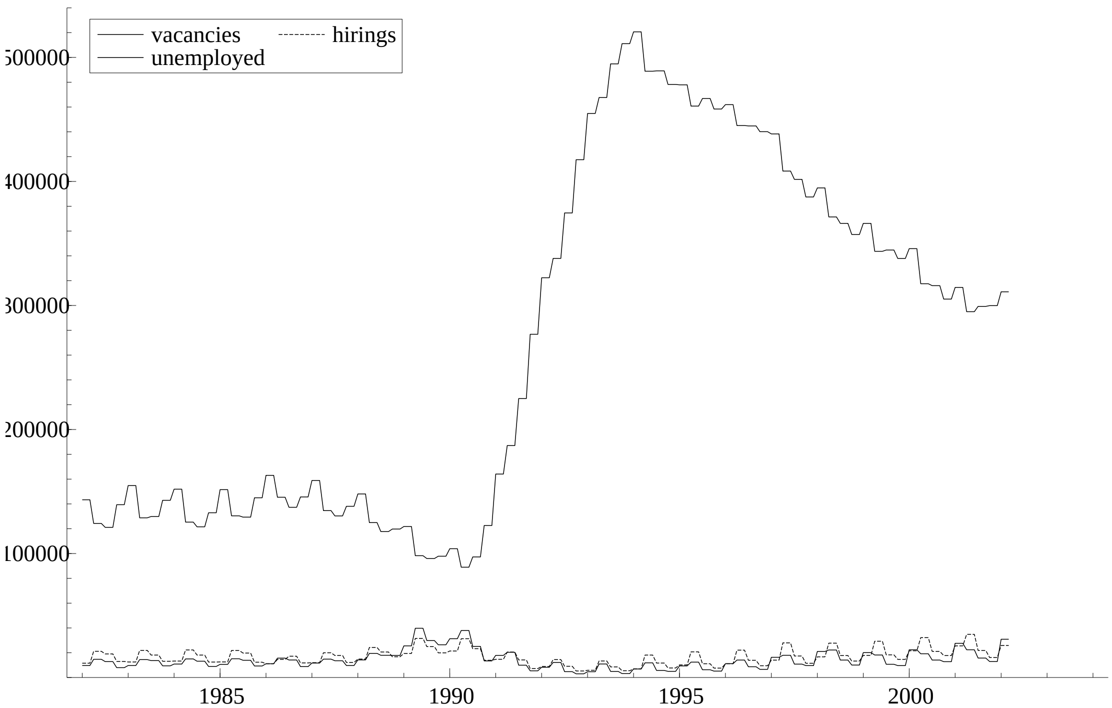

Figure 5: The time series for unemployed, vacancies and hirings, 1982:1-2002:3