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**Thünen-Series of Applied Economic Theory**  
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Working Paper No. 44

**On the Measurement of Mismatch**

by

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# On the Measurement of Mismatch

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## Abstract

This paper introduces and examines a definition of an equilibrium rate of unemployment that can be used as mismatch indicator, too. In contrast to existing indicators this measurement method is based directly on the Beveridge-Curve. An application of the indicator to nine OECD countries leads to diverging results. Most of the considered countries have experienced increasing mismatch in the seventies and decreasing mismatch in the nineties. The latter result is somewhat surprising, since mismatch was expected to be increasing in the nineties. However, the estimates for Germany are against this international trend, due to the fact that mismatch has increased steadily since the middle of the sixties.

**Keywords:** Mismatch, Beveridge-Curve, equilibrium unemployment

**JEL classification:** J41, J69, E24

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## INTRODUCTION

In several OECD countries the unemployment rate decreased in the nineties. Exceptions are, especially, Germany and France. One explanation for these different developments, among others, are different experiences with mismatch. Increasing mismatch describes a circumstance under which it will be more and more difficult to fill a vacancy or to get an adequate job, respectively. Therefore, on the one hand, rising mismatch may lead to an increase of the unemployment rates, like maybe in Germany and France. On the other hand, although the share of mismatch unemployment increases, the overall effect leads to decreasing unemployment rates. In this case other determinants of unemployment (particularly technical progress and international trade) are dominant. This could be the case for OECD countries with decreasing unemployment rates.

Several economists have stated that the Beveridge-Curve is an adequate concept to identify the change in mismatch. The aim of this paper is to find a measure of mismatch, which is directly connected with the Beveridge-Curve. This association enables estimates for both a mismatch indicator and the so called Beveridge equilibrium rate of unemployment at a given mismatch level. In doing so, it is possible to determine an unemployment rate which is compatible with full employment at a specific amount of mismatch. The advantage of this approach lies in the fact that for each actual unemployment rate both the mismatch level and the equilibrium rate of unemployment can be determined simultaneously.

This paper investigates the mismatch development of nine countries. The following three questions will be discussed: First, do Germany and France have a higher unemployment rate due to a high mismatch level? Second, does mismatch in general explain the differences in unemployment rates between industrialised countries? Third, is the mismatch level lower in more flexible labour markets?

To answer these questions, in addition to Germany and France other countries with different labour market experiences are needed for comparison. Austria is chosen, since it has had a stable and comparatively low unemployment rate over a long time. Apart from the nineties, that applies to Sweden too. Denmark and the Netherlands are EU countries, which experienced a distinct decline in unemployment rates in the nineties. The UK, Canada, and the USA are chosen, since they have a comparatively flexible labour market.

The approach is to estimate the Beveridge-Curve for each considered country. To account for a possibly non-linear mismatch development the estimates include a non-linear trend. On the

basis of the estimates, the Beveridge equilibrium rate of unemployment and a mismatch indicator are calculated for each considered country. The preferably precise identification of individual shifts in the Beveridge-Curve is of primary interest. Therefore, solely a qualitative explanation in the form of a non-linear trend is considered. This is the important difference to Nickell et al. (2002), who search for universal quantitative explanations of the shifts in the Beveridge-Curve, which do not necessarily capture a complete shift.

Main results of the estimates are the following: In the sixties and partly in the seventies the unemployment rates of most of the countries are near the equilibrium rate. Mismatch was rising during the seventies and the first half of the eighties. Afterwards, especially in the nineties, it was falling. Exceptions are Germany and Sweden. Full employment at the end of the nineties was reached only in the Netherlands.

The paper is organised as follows. Section I comprises a short survey of the general framework and of conventional mismatch indicators. Section II describes the new mismatch indicator and points out the relation between the indicator and the Beveridge equilibrium rate of unemployment. Section III comprises the model selection strategy and the data description. In section IV the estimation results are reported and discussed. Section V concludes.

## I. GENERAL FRAMEWORK AND CONVENTIONAL INDICATORS

In this section a short review of the theory underlying the Beveridge-Curve is given, followed by brief survey about conventional indicators. From an empirical standpoint the coexistence of unemployment and vacancies is undisputed. It is observable, that if vacancies increase, unemployment decreases and vice versa.<sup>1</sup> This trade off is diagrammed in figure 1.

In the labour market part of the picture labour supply ( $E^S$ ), for simplicity, is wage inelastic and labour demand ( $E^D$ ) is downward sloping.<sup>2</sup> This simple and well known model does not allow the phenomenon of mismatch. From this follows that only unemployment (for  $W > W^*$ ) or vacancies (for  $W < W^*$ ) exist on the labour market. To admit both, a third curve is required which is called here effective employment ( $E$ ). For each  $W^*$  it follows, that the distance between the equilibrium point and the effective employment curve equals the equilibrium rate of

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<sup>1</sup> For theoretical explanations and empirical investigations of the Beveridge-Curve see for example Blanchard and Diamond (1989), Börsch-Supan (1991), Bowden (1980), Christl (1992), Franz and Siebeck (1992), Hansen (1970) and Pissarides (2000).

<sup>2</sup> It doesn't matter whether the supply curve is wage inelastic or not. This model follows a standard approach for an analysis in the long run.

unemployment and vacancies of the Beveridge-Curve<sup>3</sup>, subsequently referred to as Beveridge equilibrium rate of unemployment (*BERU*).<sup>4</sup> If the Beveridge-Curve does not lie on the axes of  $v$  or  $u$ , it is clear that  $E$  exist for any given equilibrium on the labour market. That is to say, the *BERU* is equal to full employment with a certain level of unemployment.

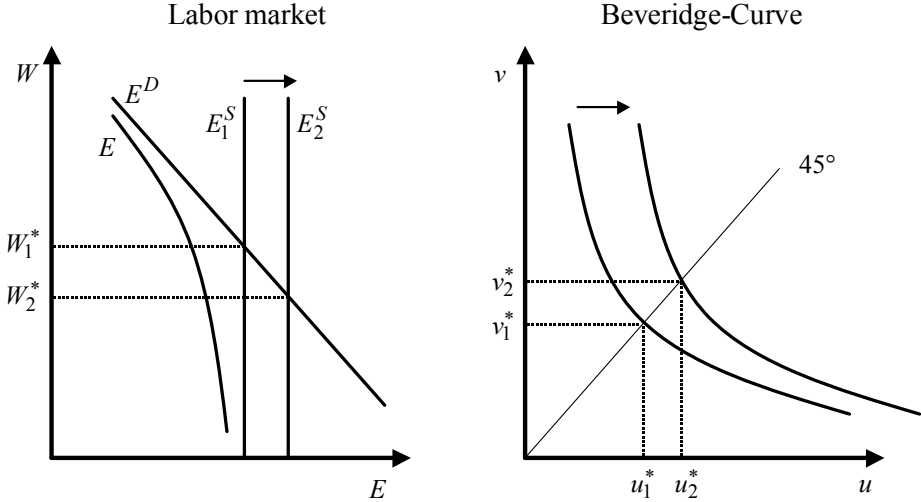


Figure 1: Labour market and Beveridge-Curve

If the labour supply curve shifts to the right, like in figure 1, the *BERU* increases and the Beveridge-Curve moves to the right too.<sup>5</sup> Causes of these shifts are, for example, different growth rates of supply and demand and/or skill-upgrading respectively.<sup>6</sup> With such a shift, the intersection of the 45-degree line and the Beveridge-Curve moves to the right too. That is, the distance along the 45-degree line increases. It is zero if the labour market is cleared, and it increases, with the decreasing matching efficiency on the labour market.

The definition of mismatch is vaster and comprises beside imperfect information and mobility also search duration, and the influence of macroeconomic performance and labour market institutions. Adapted from the brief review of the theory, desired properties of a mismatch indicator are the following: First, the theoretical relation between unemployment and vacancies should be considered, as is the case in the concept of the Beveridge-Curve. Second, the measure should allow statements for a certain group or region independent of others. In this case, a comparison of aggregated unemployment rates of different countries is possible with-

<sup>3</sup> Dow and Dicks-Mireaux (1958) called this relationship Beveridge-Curve, since the idea goes back to Beveridge (1944).  
<sup>4</sup> This equilibrium means, in quantitative sense demand equals supply. For a detailed discussion see for example Blanchard and Diamond (1989), Bleakley and Fuhrer (1997), Fuentes (2002), and Pissarides (2000).  
<sup>5</sup> It should be noted that all three curves could move to the right. Crucial is that the supply curve moves faster than the others.  
<sup>6</sup> The speed of skill-upgrading is an important point, since the unemployment rate of low skilled labour is much higher than the rate of high skilled labour. For this point see for example Nickel and Bell (1995) and Slaughter (1998).

out using disaggregated data. As we will see below, most of the existing indicators need disaggregated data (subdivided into regions, occupations, industries, etc.) to allow for an aggregated interpretation and, as a result, mismatch developments of regions or occupations can not be examined separately.

The following indicators will be analysed against the background of the desired properties. Jackman and Roper (1987) first use an indicator to measure mismatch. The starting point is the so-called matching function:

$$(1) \quad H = H(V, U)$$

In this equation  $H$  is the number of new contracts on the labour market,  $U$  symbolises unemployment, and  $V$  stands for vacancies. Based upon the matching function Jackman and Roper (1987) developed two indicators ( $m$ ) for occupational or regional mismatch.

$$(2) \quad m_1 = \frac{1}{2} \sum_i |u_i - v_i|$$

$$(3) \quad m_2 = 1 - \sum_i (u_i v_i)^{1/2}$$

The letters  $u_i$  and  $v_i$  denote respectively, shares of a respective occupational or regional group in the aggregated variable, where the former stands for unemployed persons and the latter for vacancies. That is, they do not denote unemployment rates and vacancy rates, respectively.

The first indicator has its origin in equation (1). Equation (3) has its origin in the matching function likewise. Unlike equation (2) the second indicator is based on a Cobb-Douglas specification of the matching function. The term  $1/2$  (partial elasticity of the Cobb-Douglas specification) is generally used in empirical applications. That is, the two partial elasticities are of the same size.

An application of these indicators allows only a general conclusion for the aggregate value. An analysis for a separate group (occupations or regions) is not possible, since each variable depends on the development of the associated aggregate variable. Therefore, mismatch could be constant for a certain group, but if the variables of other groups change, these indicators are not able to identify unchanged mismatch for the former group. Furthermore, an analysis of the aggregate value is possible only by using disaggregated information. In addition, the rates of unemployment and vacancy are not considered.

Another indicator is developed by Jackman, Layard and Savouri (1991). In this case,  $u$  is the aggregated unemployment rate and  $i$  identifies again different occupations or regions.

$$(4) \quad m_3 = \text{var}(u_i / u)$$

This indicator has its origin in a simple wage equation for each occupation or region, which solely has the corresponding unemployment rate as control variable. A big drawback is that vacancies are unaccounted for. Therefore, only one explanation of mismatch, namely unemployment, is considered. Beyond that, statements regarding a certain region or occupation are not possible.

A fourth indicator is developed by Sneessens and Shadman-Metha (1995). Again,  $u$  is the aggregated unemployment rate and  $u_H$  is the unemployment rate of high skilled labour.

$$(5) \quad m_4 = \frac{1 - u_H}{1 - u}$$

Equation (5) has its origin in an aggregated employment function, which takes account of labour supply to admit of skilled labour shortage. For  $u_H < u$  the ratio is bigger than one and mismatch is lower for high skilled labour. However, if both rates change in the same proportion, mismatch does not change. This is an apparent defect of this indicator. Furthermore, vacancies are unaccounted for.

A fifth indicator is the matching function with a Cobb-Douglas specification and a linear time trend, used for example by Entorf (1998).

$$(6) \quad H = Ae^{\beta T} V^\alpha U^{1-\alpha}$$

In this case, a time trend is used to allow for a varying matching efficiency. If  $\beta < 0$ , the matching efficiency decreases, if  $\beta > 0$ , the opposite is true. A big drawback is the fact, that this indicator is solely linear. Moreover, quantities instead of rates are used.

These indicators and minor modifications of them are applied in different studies.<sup>7</sup> Altogether, they arrive at the conclusion that no clear answer is given to the question, if mismatch is increasing or not in the past decades, even in the same observation period. One reason, among other things, is the methodical shortcoming, discussed here in a nutshell. In the next section an approach is provided, that overcome most of these criticism.

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<sup>7</sup> See for example Entorf (1998), Franz and Siebeck (1992), Jackman, Layard and Savouri (1991), Layard, Nickell and Jackman (1991) and Paqué (1999).



## II. SPECIFICATION OF THE MISMATCH INDICATOR

Several economists have stated that the Beveridge-Curve is an adequate concept to identify the change in mismatch.<sup>8</sup> However, a conceptual realisation has not been carried out so far. As aforementioned, the matching function is an implicit relation between the number of unemployed people and the number of vacancies. This bears some similarity to the Beveridge-Curve, which is a relation between the rates of unemployment and vacancy, and suggests to consider the following version of the matching function:

$$(7) \quad h = Av^\alpha u^{1-\alpha}$$

The lower case letters refer to employment as denominator. The advantage of doing so lies in the fact, that this allows statements about the *BERU* at a given mismatch level, as we will see below.

If we reorganise (7) with respect to the Beveridge-Curve and logarithm we receive

$$(8) \quad \log u = \frac{1}{1-\alpha} \log\left(\frac{h}{A}\right) - \frac{\alpha}{1-\alpha} \log v. \quad \text{with } \frac{\partial \log u}{\partial \log v} < 0$$

In this specification the elasticities ( $\alpha$  and  $1-\alpha$ ) and the efficiency parameter ( $A$ ) of the matching function are constant.<sup>9</sup> The hiring rate ( $h$ ) has the general disadvantage that data for a long time span are not available for every considered country. Beyond that, the data quality is sometimes not satisfactory, due to measurement errors.

As Entorf (1998) has shown, the consideration of a time trend in equation (6) comprises the advantage of a varying matching efficiency. In equation (8) a rise (fall) in  $A$  shifts the Beveridge-Curve to the left (right). Pissarides (2000) has shown that vacancies and matching efficiency are independent of the hiring rate. That is, both movements along the Beveridge-Curve, which could have their seeds in a change in job creation or job destruction, and shifts of the Beveridge-Curve, due to variations in  $A$ , are compatible with a constant  $h$ .

It should be noted, that a rise in  $h$  shifts the Beveridge-Curve to the right. However, it is important to distinguish between short run and long run shifts due to  $h$ . An explanation for a long term shift is a rise in the steady state of job creation and job destruction. If the Beveridge-Curve is expected to be permanent in steady state,  $h$  is equal to the exit rate from employment to unemployment. Under this assumption, Nickell et al. (2002) uses the latter as

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<sup>8</sup> For instance Calmfors (1993), Entorf (1998) and Solow (2000).

<sup>9</sup> The inverse specification, which has also been checked, approximates the Beveridge-Curve comparatively worse.

a proxy to identify if the change in  $h$  shifts the Beveridge-Curve. Although they found the expected positive relationship, the assumption of a permanent steady state and, therefore, the application of this proxy is unconvincing and appears to be very restrictive. The shift of the Beveridge-Curve due to a change in  $h$  for a short period is of minor importance here. Such a shift is equal to the well known counter clockwise loops around the Beveridge-Curve, which are unimportant for the approach given below.

A qualitative approach is chosen to capture all the shifts of the Beveridge-Curve. In this case we do not have to worry about unobserved variables and potential multicollinearity, e.g. among institutional variables. If the Beveridge-Curve moves with a consistent speed in one direction, we only need a linear trend. However, if the speed varies and the direction changes, it will be indicated to use a non-linear trend.<sup>10</sup> Hence, the following specification is chosen to capture a possible shift:

$$(9) \quad \frac{1}{1-\alpha} \log\left(\frac{h}{A}\right) \equiv \beta_0 + \sum_{i=2}^n \beta_i T^{i-1}$$

If, in sum, the term  $\sum_i \beta_i T^{i-1}$  is negative at a given point of time, the Beveridge-Curve has moved to the left. An important feature of this specification is the ability of the non-linear time trend to get both left side and right side shifts, respectively. If the curve does not move, the time trend is zero. The latter means, that mismatch does not change over time.

Upon substitution of equation (9) into equation (8) we obtain the following specification:

$$(10) \quad \log u = \beta_0 + \beta_1 \log v + \sum_{i=2}^n \beta_i T^{i-1}$$

In this equation  $\beta_1 = \alpha/(1-\alpha)$  is the elasticity of substitution between the vacancy rate and unemployment rate, and is expected to be negative. Nickell et al. (2002) choose a restricted version of equation (10), since they use a cubic trend. The specification of the trend used here is described in the next section.

As aforementioned, the *BERU* is defined as  $v^* = u^*$  and can be interpreted as a mismatch indicator. From (10) we get the following equilibrium definition:<sup>11</sup>

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<sup>10</sup> Earlier studies on the Beveridge-Curve use dummy variables to capture possible shifts. The general disadvantage of this approach is that changes in mismatch are only considered for a certain point of time.

<sup>11</sup> See Thisse and Zenou (2000) for a similar discussion.

$$(11) \quad u^* = e^{\frac{\beta_0 + \sum_{i=2}^n \beta_i T^{i-1}}{1 + \beta_1}}$$

The *BERU* is constant and mismatch does not change if the trend is zero. Using (11) it is possible, to identify the distance along the 45-degree line from the origin to the intersection point with the Beveridge-Curve for any given point of time. The length of the distance is an alternative mismatch indicator ( $\mu$ ).<sup>12</sup>

$$(12) \quad \mu = \sqrt{2 \left( e^{\frac{\beta_0 + \sum_{i=2}^n \beta_i T^{i-1}}{1 + \beta_1}} \right)^2} \quad \text{with } \mu \geq 0$$

By comparing (11) and (12) it is clear that the *BERU* and the alternative mismatch indicator are directly affiliated with each other, in a non-linear fashion though. The important difference between  $u^*$  and  $\mu$  is, that the former can be interpreted as a cardinal scale, but the latter as an ordinal scale. For  $\mu$  this means that the value 5 is superior to 10, but we cannot conclude that in the second case mismatch has doubled.

The *BERU* can be used for a careful division of the unemployment rate as is common practice with the non accelerating rate of unemployment (*NAIRU*). Full employment is reached at a given mismatch level, if the actual unemployment rate equals the *BERU*. Unemployment rates above (below) the *BERU* denote job (labour) shortage and tend to result in a moderate (accelerating) rise in wages and prices, respectively. In regard to the classical division of unemployment, the indicators measure the change in structural and frictional unemployment, while seasonal and cyclical unemployment lead to movements along the Beveridge-Curve.

### III. MODEL SELECTION AND DATA

The unemployment rates are standardised and taken from the Employment Outlook (OECD) and Layard et al. (1991). The data for vacancies are taken from the Main Economic Indicators (OECD) and Nickell et al. (2002). It should be mentioned that the official vacancy statistics report only a fraction of unfilled jobs in the economies and are not standardised. For Germany and the UK roughly 1/3 of the vacancies are reported.<sup>13</sup> This information is used for compari-

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<sup>12</sup> This formula based on the theorem of Pythagoras:  $a^2 + b^2 = c^2$ . In this case  $a$  and  $b$  are equal to  $u^*$  and  $c$  equals  $\mu$ .

<sup>13</sup> For Germany the Institute for Employment Research publishes the estimated share of official reported vacancies. For the UK this ratio is taken from Nickell (1998).

son. However, it is not possible to account for this problem for each country. Therefore, the interpretation of the estimates has to be done carefully and standardised vacancy rates are badly needed.

The equation

$$(13) \quad \log u_t = \hat{\beta}_0 + \hat{\beta}_1 \log v_t + \sum_{i=2}^n \hat{\beta}_i T^{i-1} + \varepsilon_t$$

will be estimated for the above-mentioned nine countries, with the time range 1960 to 1999. For Denmark the data are available since 1970 and for Canada since 1962. If we pool the data for panel estimation, we lose important country specific information. Hence, equation (13) is estimated for each country separately. To specify the trend polynomial, the iterative procedure starts with a polynomial trend of high order. This trend will be reduced until the information criterion (Schwarz and AIC) reach there minimum. To get more reliable estimates with respect to significant parameters, Newey and West (1987) standard errors are used, to control for autocorrelation and heteroscedasticity.<sup>14</sup>

To get reliable estimates the order of integration of the variables  $\log u$  and  $\log v$  is checked first. To test for a unit root in the data, the augmented Dickey-Fuller (ADF) test is used. The lag length ( $k$ ) of the differences is specified on the basis of the general to specific rule.<sup>15</sup> The results of the tests are displayed in table 1.

For Canada, Denmark, France, and UK the results are unambiguous, in the way that both variables are integrated of first order (I(1)). The data of the other countries lead to mixed results. A major difference to the above-mentioned countries is the order of integration of  $\ln v$ . For Austria and the USA the variable is I(0), whereas for Sweden  $\ln v$  is I(0) at the 5% probability value and I(1) at the 1% probability value. This can be explained by the empirical fact, that increasing mismatch leads to stationary vacancies but non-stationary unemployment.

The unemployment rate of the Netherlands is I(2).<sup>16</sup> This is possibly the result of a structural break in the data, for instance due to Dutch disease. Tests of structural breaks in the variable

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<sup>14</sup> In Ochsens (2004) both the Beveridge-Curve equation and a vector error correction model (VECM) are used to identify, if the unemployment and vacancy rates are cointegrated and to control for possible differences in the substitution elasticity. As a result, both the cointegration tests and the long run elasticities differ in certain cases markedly, due to the non-linearity in the mismatch trend. Because of theoretical implausible results in some of the VECM, the specification of the Beveridge-Curve equation is superior in this case.

<sup>15</sup> Hall (1994) proposed that  $k$  should have a preferably high value in the initial situation. It should be reduced subsequently, until the difference with the highest lag is significant.

<sup>16</sup> The significant second difference results are not reported here. Entorf (1998) also found I(2) for unemployment rates of other European countries.

are used to identify the break point. Unfortunately the different tests lead to different results. On this account none of the results is considered. The German variable  $\ln u$  is  $I(0)$  at the 5% probability value and  $I(1)$  at the 1% probability value. However, if we take into account the German unification as a structural break, the variable is only at the 10% level  $I(0)$ . All things considered, the variables of all countries (including the Netherlands) have more or less the same order of integration and could therefore be cointegrated.

Table 1: Results of the ADF-Test

	$\ln u$	$\Delta \ln u$	$\ln v$	$\Delta \ln v$	$\ln u$	$\Delta \ln u$	$\ln v$	$\Delta \ln v$
	<i>Austria</i>				<i>Canada</i>			
t-Statistic	-2.23	-4.980***	-2.802***	-3.831***	0.018	-4.085**	-3.328*	-4.464***
Model	c	a	a	a	a	c	c	a
$k$	1	1	1	1	1	5	1	1
	<i>Denmark</i>				<i>France</i>			
t-Statistic	-2.637*	-4.164**	-2.222	-4.151***	-2.106	-3.663***	-2.572	-4.340***
Model	b	c	b	a	b	b	b	a
$k$	1	1	1	1	1	1	9	1
	<i>Netherlands</i>				<i>Sweden</i>			
t-Statistic	-0.45	-2.446	-1.829	-4.960***	-3.156	-3.626***	-3.854**	6.344***
Model	a	c	a	a	c	a	c	a
$k$	1	8	2	1	1	5	4	1
	<i>UK</i>				<i>USA</i>			
t-Statistic	0.503	-5.677***	-1.407	-3.771***	-2.337	-4.778***	-4.122***	-5.606***
Model	a	a	a	a	b	a	b	a
$k$	2	1	2	5	1	1	1	1
	<i>Germany</i>				<i>Germany<sup>#</sup></i>			
t-Statistic	-3.702**	-4.100***	-1.187	-5.808***	-3.457*	-4.407***	-1.266	-5.726***
Model	c	a	a	a	c	a	a	a
$k$	1	1	2	1	1	1	2	1

Notes: Model: a = random walk, b = random walk with drift, c = random walk with drift and linear trend.  $k$  = Number of lags. \* = 10%, \*\* = 5% and \*\*\* = 1% probability values (MacKinnon critical values). # refers to the fact, that the German reunification is considered with a dummy.

#### IV. RESULTS

In this section the estimation results are discussed first. Afterwards the estimated parameters are used to calculate the  $BERU(u^*)$ . The alternative mismatch indicator ( $\mu$ ) is not reported, due to the fact that it provides no additional information.

The estimation results of equation (13) are displayed in table 2. With the exception of France all other countries show a significant elasticity between the unemployment rate and the va-

cancy rate. It is interesting, that the USA and Germany have nearly the same elasticity. That is, if the vacancy rates increase in both countries with the same rate, unemployment rates decrease with the same rate too. However, apart from that both labour markets extensively differ.<sup>17</sup>

Table 2: Estimation Results

	Austria	Canada	Denmark	France	Germany <sup>18</sup>	Netherlands	Sweden	UK	USA
$\hat{\beta}_0$	0.671 (8.181)	1.617 (53.131)	-0.599 (-8.281)	0.068 (0.574)	0.513 (4.200)	-0.310 (-2.115)	0.844 (15.315)	0.303 (4.273)	-0.561 (-3.609)
$\hat{\beta}_1$	-0.437 (-6.953)	-0.457 (-14.730)	-0.328 (-4.144)	-0.093 (-1.570)	-0.857 (-4.421)	-0.295 (-3.340)	-0.753 (-9.172)	-0.520 (-5.308)	-0.826 (-14.717)
$T$	0.091 (2.075)	-0.179 (-6.452)	-0.223 (-1.340)	-0.164 (-1.813)	-0.203 (-3.071)	-0.072 (-1.035)	-0.471 (-4.472)	-0.228 (-1.868)	0.059 (2.741)
$T^2$	-0.025 (-3.508)	0.036 (6.827)	0.226 (4.028)	0.072 (2.548)	0.041 (3.463)	0.024 (3.022)	0.168 (4.317)	0.102 (2.555)	-0.025 (-3.606)
$T^3$	1.91E-03 (3.987)	-2.12E-03 (-5.671)	-0.037 (-4.680)	-9.47E-03 (-2.617)	-0.002 (-3.255)	-9.62E-04 (-3.210)	-0.023 (-4.062)	-0.016 (-2.865)	3.53E-03 (4.472)
$T^4$	-5.38E-05 (-3.879)	5.28E-05 (4.684)	2.52E-03 (4.819)	6.65E-04 (2.857)	6.44E-05 (3.014)	1.08E-05 (3.016)	1.63E-03 (3.900)	1.21E-03 (3.134)	-1.93E-04 (-4.815)
$T^5$	5.14E-07 (3.575)	-4.87E-07 (-4.024)	-7.69E-05 (-4.803)	-2.52E-05 (-3.152)	-5.93E-07 (-2.774)		-5.99E-05 (-3.821)	-4.76E-05 (-3.300)	4.54E-06 (4.876)
$T^6$			8.69E-07 (4.734)	4.79E-07 (3.434)			1.11E-06 (3.793)	9.14E-07 (3.375)	-3.90E-08 (-4.825)
$T^7$				-3.58E-09 (-3.679)			-8.11E-09 (-3.789)	-6.82E-09 (-3.391)	
$\bar{R}^2$	0.955	0.967	0.937	0.991	0.971	0.959	0.945	0.965	0.957
DW	1.534	1.032	2.001	1.417	0.825	1.357	1.049	1.002	1.060
ADF	-4.383***	-4.188**	-4.144**	-5.345***	-4.533***	-5.446***	-5.601***	-4.535***	-5.105***
$N$	40	38	30	40	40	40	40	40	40

Notes:  $\beta_0$  = constant,  $\beta_1$  = long-term elasticity,  $T$  = trend,  $\bar{R}^2$  = adjusted coefficient of determination, DW = Durbin-Watson Statistic, ADF = augmented Dickey-Fuller test (Phillips and Ouliaris critical values) \*=10%, \*\*=5%, \*\*\*1%,  $N$  = observations, t-statistics based on Newey-West standard errors. Method: OLS.

All countries have in common the estimated non-linear time trends. A discussion of the trends will be more interesting by visualising those using (11) or (12), as we will do in the next step. The Durbin-Watson statistic for most of the countries lies between the lower and the upper

<sup>17</sup> For Germany and the UK further equations are estimated that contain official and nonofficial vacancies. Due to imprecise information about the share of nonofficial vacancies we presume a constant proportion (33% official unfilled jobs). The results are not reported, because only the constant in the estimates will change.

<sup>18</sup> The German equation is estimated with a unification dummy, too. Because of the insufficient significance of the corresponding parameter this specification is not considered.

value. This can be explained by the fact that a smoothed trend mostly lowers the Durbin-Watson statistic. The estimated standard errors are not affected by that point, due to the fact, that we use Newey and West standard errors. The most important result so far is, that all equations are cointegrated (Engle-Granger two step cointegration test). This result coincides with the findings of Entorf (1998), that the matching function, which is linked to the Beveridge-Curve, is cointegrated too.

Equation (11) can be derived from the estimates. The *BERU* is constant over time if and only if the Beveridge-Curve does remain at an unchanged locus. That is, the time trend is zero. However, if the trend is significant, any movement of the equilibrium point implies a movement of the Beveridge-Curve too. Consequently, the following pictures of each national *BERU* comprise all information about the Beveridge-Curve. For a better comparability, the actual unemployment rates are displayed too.

[FIGURE 2a – 2i about here]

The figures 2a – 2i display the country specific developments of the actual unemployment rate ( $u$ ) and the *BERU* ( $u^*$ ). The Austrian actual unemployment rate fluctuates around the equilibrium rate until the beginning of the eighties. Afterwards, both rates increase, whereas now the rates differ significantly. In comparison with the considered countries both rates are comparably low. The Canadian experience is a little bit different. First, the actual unemployment rate is permanently above the equilibrium rate. Second, the starting point of the rise in both rates is about ten years earlier, as well as the fall in the equilibrium rate. The development of both rates in Denmark are somewhat idiosyncratic, since the equilibrium rate undulates. With the first oil crisis the actual rate surges, whereas the equilibrium rate rises slowly till the beginning of the nineties. In the nineties both rates decline.

In France unemployment was in equilibrium until the first oil crisis. Afterwards both rates rise, although the actual rate rises faster and permanently. The equilibrium rate, however, declines substantially after the middle of the eighties. The equilibrium rate in France reaches the highest rate (6%) of all concerned countries. The German equilibrium rate rises steadily, since the middle of the sixties and is about 4% at the end of the time range (and 6% percent ( $u^* 2$ ), if we consider the nonofficial vacancies), which is relatively high compared with other countries. The actual rate shows the well known “course of stairs” picture. The experience of the Netherlands resembles that of France. The major difference is the development of the actual rate since the middle of the eighties. At the end of the time span, the unemployment rate of

the Netherlands reached the equilibrium level. The European Central Bank (2002) also arrived at the conclusion, that the Netherlands reached a full employment level at that time.

The different rates for Sweden clarify, that the actual rate fluctuates around a stable equilibrium rate until the well known macro shock in the nineties.<sup>19</sup> Beyond that, this shock has not much to do with a substantial shift in the Beveridge-Curve. Forslund (1995) and Holmlund (2003) draw the same conclusion. The unemployment rates of the UK bear resemblance to France and the Netherlands, particularly, if nonofficial vacancies are allowed for ( $u^*$ ). The full employment path was abandoned with the first oil crisis and the turnaround is in the middle of the eighties, too. However, the equilibrium rate is not reached yet. For the USA, finally, the equilibrium unemployment rate is more or less stable over time and extremely low.<sup>20</sup> The actual rate is far away from the equilibrium, although sometimes at a comparatively low level. The latter has its maximum at the beginning of the eighties. That is, the turnaround of the US Beveridge-Curve is five to ten years earlier than in other examined countries.

The comparison of the two equilibrium lines for Germany (figure 2e) and the UK (figure 2h) points up, that if the ratio of official to unofficial vacancies does not change, the shape of the equilibrium curve does change only minor. For Germany and the UK it is a fact that this ratio is more or less stable. If this is true for all other considered countries, a comparison of the national *BERU* developments makes sense, at least for the direction of the trend.

To make the differences of the national *BERU* developments more obvious, they are displayed together in one picture (figure 3). For Germany two lines are displayed. One is based on the estimates discussed above, and the second refers to data for West-Germany.<sup>21</sup> The estimation results of the latter are not reported here. However, they are similar to the above reported estimates.

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<sup>19</sup> Some authors take the long equilibrium period back to active labour market policy. See for example Christl (1992).

<sup>20</sup> Both in the USA and in Canada vacancies are measured with the help wanted index. Nickell et al. (2002) transformed the index to a number of vacancies. Since the data for Canada appear to be realistic, the transformation seems not to be the reason for the extremely low vacancies in the USA. See Archambault and Fortin (2001) for a critical discussion of the help wanted index. On the other hand, Entorf (1998) points out, that the search period in the USA is considerably less than in Europe. As a result, the Beveridge-Curve of the USA could be left to the Europeans curve, due to a lower vacancy rate.

<sup>21</sup> These data are taken from national statistics and differ from the international definition of unemployment. The reason is that the OECD do not report standardised unemployment rates for West-Germany after the German unification.



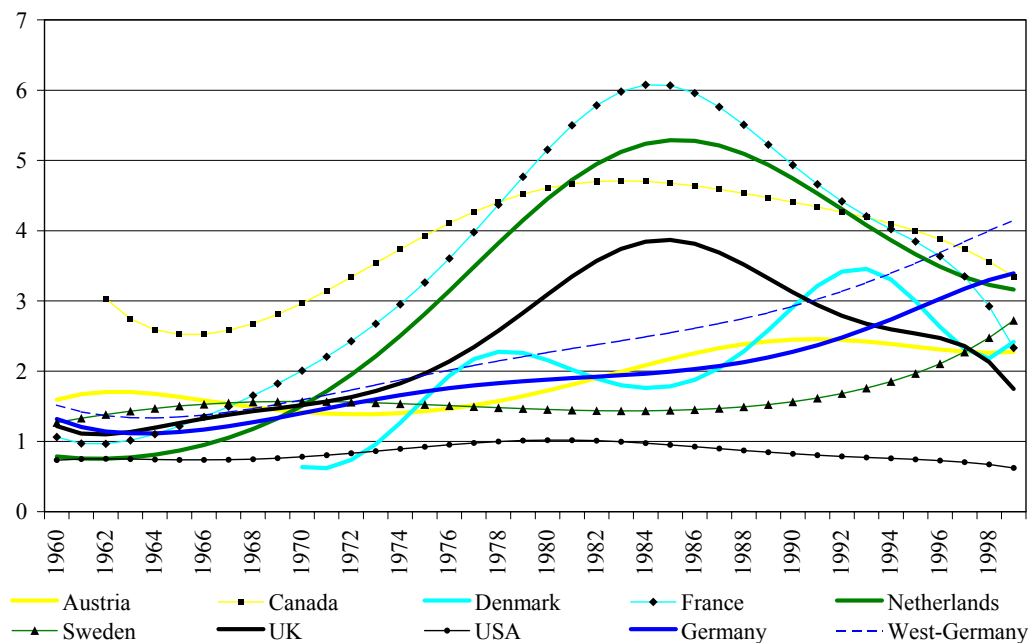


Figure 3: Mismatch (BERU) developments

With the beginning of the seventies most of the countries experience a rise in mismatch. Only the USA and Sweden have a nearly stable mismatch level. Whereas mismatch increases for the latter in the nineties, all other countries, except Germany, experienced a decline in mismatch in this period. Only for Germany, with or without the former East Germany, a steady rise in mismatch is identified. At the end of the time span, the German mismatch level is on a comparatively high international level. Unofficial vacancies are not considered here, due to a better comparability.

In figure 3 the two lines for Germany suggest that mismatch is more important for West-Germany than for Germany (including the former East). This conclusion is based on a visual delusion, as the following figure 4 clarifies. The rise of the West German (non-standardised) data is steeper between 1960 and 1990. That is, mismatch is accelerating stronger using national data, since in this time span Germany is equivalent to West Germany. Only the unemployment rates differ in this period due to different measurements. In this case, the dotted line should lie above the thick line after the German unification. However, the dotted remains under the thick line, which implies mismatch in former East Germany is higher than in West Germany.

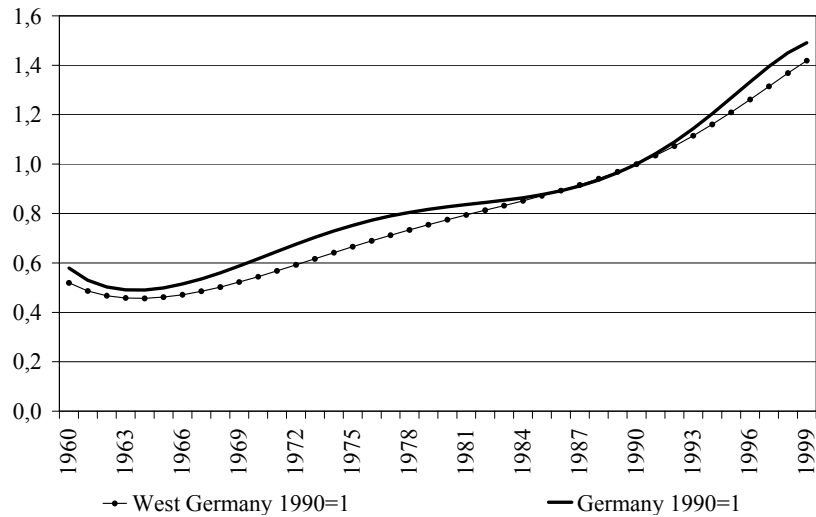


Figure 4: Relative mismatch developments in Germany and West-Germany

According to this, for Germany the standardised data bias the mismatch development and the *BERU* respectively downwards, compared to national statistics. Second, in figure 3 a standardised line for West Germany would lie under the thick German line in the nineties.

Due to the questions stated in the introduction, the following conclusion can be made: First, the increasing unemployment in Germany can partly be explained by increasing mismatch. However, for France this applies only until the middle of the eighties. This is an important difference in the developments in the nineties.

Second, roughly speaking, in most of the countries mismatch and unemployment increase simultaneously. Therefore, mismatch is one explanation for international differences in unemployment. However, since one characteristic of mismatch, especially in the nineties, is the often asserted increasingly inadequate supply of skilled labour, the results are a little bit astonishing. If this was a major driving force of mismatch, only Germany would have had an increasing problem with a lack of high skilled labour in the nineties. A possible explanation of this point are the findings of Manacorda and Petrongolo (1999) and the ECB (2002), whereby demand and supply of skilled labour was in agreement in the nineties in most of the OECD countries.

Third, although the USA have the lowest mismatch level, there is no evidence for the general conclusion, that countries with a more flexible labour market experienced a lower mismatch level. On the other hand, some of the countries that chose a more flexible labour market policy in the nineties, experienced decreasing mismatch.

## V. SUMMARY AND CONCLUSION

This paper has developed and examined a new mismatch indicator. The estimates display important international differences in mismatch. In spite of the limited data quality of vacancies, the results are robust at least in trend developments. The main conclusions can be summarised as follows:

- In the sixties and partly in the seventies the unemployment rates of the considered countries are near the *BERU*. Exceptions are Canada and the USA.
- At the end of the period under consideration only the unemployment rate of the Netherlands reached the *BERU*.
- During the seventies and the eighties mismatch rises in all considered countries.
- The turnaround of mismatch for most of the countries was in the eighties and appears in the USA first.
- In the nineties mismatch fell in all countries, with the exception of Germany and Sweden.
- Mismatch is higher in the former East Germany than in West Germany.
- With respect to the rising unemployment rates in the nineties in Germany and France, only for Germany increasing mismatch is a potential explanation.
- Mismatch is, among others, one explanation for international differences in unemployment rates.
- Mismatch is not in general lower in countries with a more flexible labour market, but is decreasing in some of the countries which have chosen more flexibility on the labour market.

The above reported results have pointed out country specific differences in mismatch. Further studies should focus on national distinctions with respect to different importance of institutional aspects and macroeconomic variables. Hence, general conclusions on the basis of cross national studies (like, for example, panel estimates) do not provide enough information for a sophisticated comprehension of the causes of mismatch.

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## APPENDIX

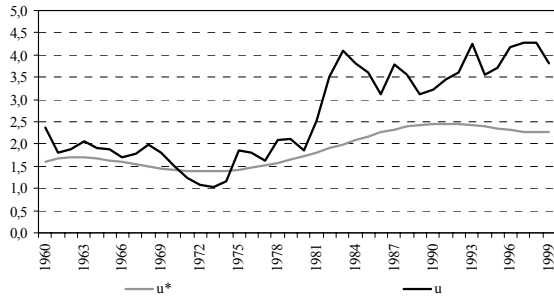


Figure 2a: BERU and actual unemployment rate for Austria

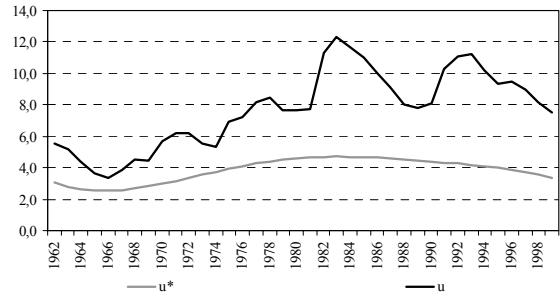


Figure 2b: BERU and actual unemployment rate for Canada

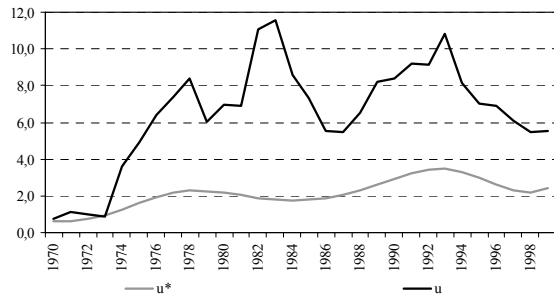


Figure 2c: BERU and actual unemployment rate for Denmark

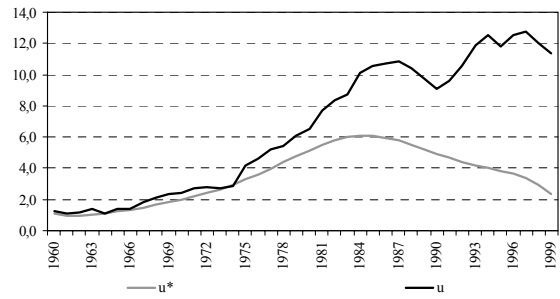


Figure 2d: BERU and actual unemployment rate for France

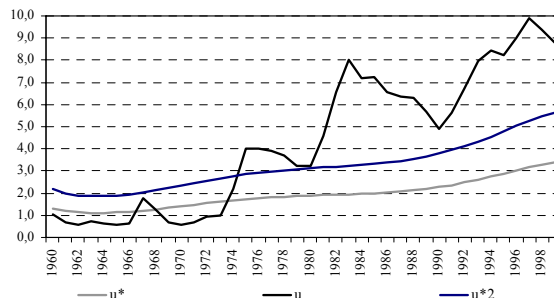


Figure 2e: BERU and actual unemployment rate for Germany

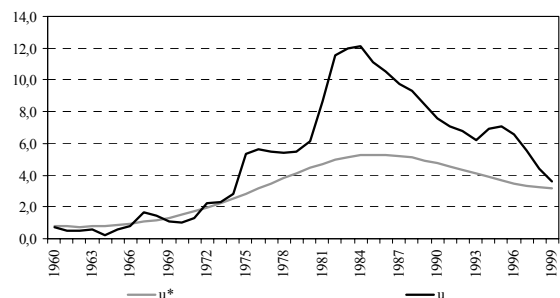


Figure 2f: BERU and actual unemployment rate for the Netherlands

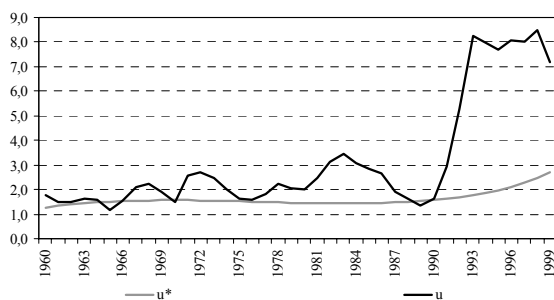


Figure 2g: BERU and actual unemployment rate for Sweden

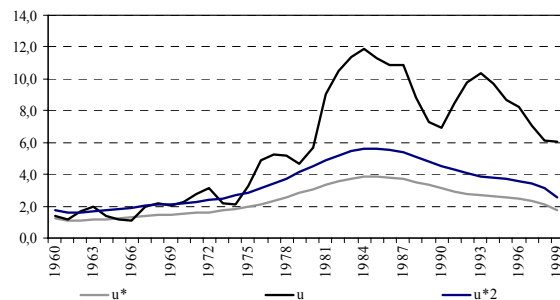


Figure 2h: BERU and actual unemployment rate for the UK

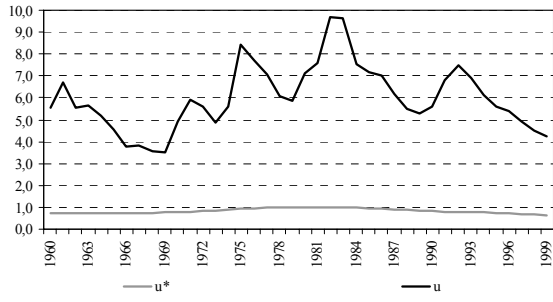


Figure 2i: BERU and actual unemployment rate for the USA