How the Distribution of Unemployment by Duration Affects the Unemployment Rate

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April 28, 2008

Abstract

This paper examines the effects of the distribution of unemployment by duration on the level of unemployment. It explores one central assumption that is observed empirically: when the share of long-term (short-term) unemployed increases, the unemployment rate increases (decreases). By embodying this assumption in a standard equilibrium unemployment model we characterize the joint behavior of unemployment and the distribution of unemployment by duration. In the theoretical part of the paper an extension of the standard equilibrium unemployment model is provided where the average job finding probability depends on the distribution of unemployment by duration. In the empirical section we estimate a panel data model for 16 OECD countries to test the implications of the theoretical model. The main results are: First, in a steady state equilibrium the flow rates are larger, the larger the share of short-term unemployed. Second, out of steady state the unemployment rate increases (decreases) with the share of long-term (short-term) unemployed. Third, the larger the duration dependent job finding probabilities the larger the share of short term unemployed. Fourth, panel estimates for 16 OECD countries provide robust and significant evidence that an increase in the share of short-term (long-term) unemployment decreases (increases) the unemployment rate. Therefore, the empirical evidence supports our hypotheses whereby (a) the reemployment probability decreases with an increasing spell of unemployment and (b) average exit rates have international differences. Hence, the different experiences with unemployment on both sides of the Atlantic can be explained by observed aggregated duration dependence and differences in the average exit rate.

Keywords: Distribution of Unemployment by Duration, Duration Dependence

JEL classification: J64, J63

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1 Introduction

This paper examines the effects of the distribution of unemployment by duration on the level of unemployment. It explores one central assumption that is observed empirically: when the share of long-term (short-term) unemployed increases, the unemployment rate increases (decreases). By embodying this assumption into a standard equilibrium unemployment model we characterize the joint behavior of unemployment and the distribution of unemployment by duration.

In the US, the shares of short-term and long-term unemployed have been roughly stable since the seventies. In addition, the ratio of long-term to short-term unemployed is small compared to other OECD countries. In contrast to this, the share of long-term unemployed has increased while the share of short-term unemployed has decreased in the same period for most of the European countries.[1] For example, the average share of short-term (long-term) unemployed between 1980 and 2003 is 71% (8%) in the USA and 8% (64%) in Italy.[2] The average rate of unemployment for this period is 6.4% for the USA and 15.7% for Italy.

Explanations for these developments relate both to the supply side and demand side. The supply side argument is often based on human capital theory. A stagnation or a loss of human capital occurs when an individual is unemployed.[3] The reemployment probability for those who are out of work for a long time decreases if firms find a sufficient number of job applicants with an appropriate level of skills among the short-term unemployed. A demand side driven explanation is given by Blanchard and Diamond (1994). They provide a model in which the exit rate from unemployment is a decreasing function of unemployment duration. The central assumption in this framework is that firms hire the applicant who has been unemployed for the least amount of time.

In this paper we provide an extension of the standard equilibrium unemployment model that allows for unemployment duration dependent job finding probabilities. That is, the average job finding probability depends not only on the market tightness but also on the distribution of unemployment by duration. This means that the more people are long-term unemployed, the lower the average job finding rate. For a given job destruction rate the unemployment rate increases with the share of long-term unemployed. In the empirical part of the paper we apply different panel estimators on data for 16 OECD countries to test the implications of the theoretical model.

[1] See Ljungqvist and Sargent (2008) for a discussion of these facts.

[2] The share of short-term unemployed comprises of people with a spell of unemployment of up to three months. A person is long-term unemployed if he or she is out of work for more than one year.

[3] Pissarides (1992), for example, uses a search model to show the unemployment effects, if workers lose skills when unemployed.

The approach allows us to analyze three central questions: First, is there international evidence for a stable negative relationship between the duration of unemployment and the reemployment probability? Second, does a collapse in the reemployment probabilities from unemployment at all durations of unemployment account for the increase in the share of long-term unemployed? Third, in contrast to the second question, has the exit rate from unemployment declined only for the long-term unemployed, while the other exit rates have remained constant?

The main results are: First, in a steady state equilibrium the flow rates are larger, the larger the share of short-term unemployed. In addition, the risk of becoming long-term unemployed is smaller, but the probability of remaining in long-term unemployment is larger. Second, out of steady state the unemployment rate increases (decreases) with the share of long-term (short-term) unemployed. Third, the larger the duration dependent job finding probabilities the larger the share of short term unemployed. In addition, the smaller the duration dependent job finding probabilities, the more the unemployment rate is driven by long-term unemployment. Fourth, panel estimates for 16 OECD countries provide robust and significant evidence that an increase in the share of short-term (long-term) unemployment decreases (increases) the unemployment rate. Therefore, the empirical evidence underlines our hypotheses whereby (a) the reemployment probability decreases with an increasing spell of unemployment and (b) average exit rates exhibit cross country differences. Hence, the different experiences with unemployment in North America, Australia, and Japan on the one hand, and Europe on the other hand, can be explained by observed aggregated duration dependence and differences in the average exit rate.

The paper is organized as follows. A discussion of duration dependence and (unobserved) heterogeneity is given in the next section. In section 3 we provide an extension of the standard equilibrium unemployment model that allows for unemployment duration dependent job finding probabilities. Section 4 describes the data and the econometric model and reports the estimation results. Considerations with respect to long-term unemployment policy are provided in section 5. Section 6 concludes.

2 Duration Dependence and (Unobserved) Heterogeneity

The aim of this paper is to analyze how the distribution of unemployment by duration affects the level of the unemployment rate. However, to discus policy aspects in section 5 it is useful to take a closer look at the causes of long-term unemployment. With regard to the causes of the international differences in long-term unemployment disunity exists. In many studies it has been argued that the experience with long-term unemployment in

Europe can be explained by an exit rate from unemployment that decreases with the spell of unemployment. This is what is called duration dependence.

In theoretical models the causes for duration dependence, and even its definitions, are varied. Lockwood (1991) provides a model for duration dependence that arises because of sorting. That is, duration dependence is present due to worker heterogeneity (known to the potential employer). Pissarides (1992) assumes in his model that the long-term unemployed lose some of their skills. He derives the implications of this for job creation. Hence, the results are driven by changes in job creation, not by duration dependence itself. In contrast to this, Coles and Masters (2000) argue: "How do the unemployed keep up with the latest technological advances without such hands-on experience? Being without a job, they may find their skills rapidly go out of date, or just go rusty. Employers may avoid hiring workers who have had an extended spell of unemployment." Blanchard and Diamond (1994) argue that employers have slight preferences to hire short-term unemployed. In this model, worker heterogeneity with respect to other personal characteristics is unknown to the potential employer. In Acemoglu (1995) long-term unemployed have to pass a screening stage. More precisely, firms use a training program that serves as a screening device. If a long-term unemployed person has lost some of his skills the firm will realize that as soon as employment begins. However, this produces temporary employment and, hence, reduces the share of long-term unemployed. And finally, extended periods of unemployment can have negative effects on attitudes towards work in the future (e.g. Sinfield (1981), Budd et al. (1988)).

The literature on different experiences with long-term unemployment can be subdivided into theoretical and empirical work. With respect to the theoretical papers we find different explanations for the causes of long-term unemployment. Pissarides (1992) shows that allowing for a loss of skills during unemployment increases persistence of unemployment shocks in the following periods, because vacancy creation depends on the skill distribution of the workforce. Blanchard and Diamond (1994) argue that the exit rate from unemployment is a decreasing function of unemployment duration. The central assumption in this framework is that firms hire the applicant who has been unemployment for the least amount of time. Ljungqvist and Sargent (1998) provide a model of general skills acquisition (when employed) and loss (when unemployed) to explain the difference between North American and European unemployment experiences. They argue that generous welfare payments in times of economic turbulence make the unemployed more reluctant to take up poorly paid jobs. This causes the divergence in long-term unemployment between North America and Europe. These results are entirely due to labor supply effects, because labor demand is exogenous. Haan et al. (2005) reassess the turbulence-unemployment relationship using a matching model with endogenous job destruction and conclude that higher turbulence leads to a reduction of unemployment. From this it follows that

changes in turbulence cannot explain the different experiences with unemployment in North America and Europe.

Coles and Masters (2000) have examined the effect of skill depreciation on the equilibrium unemployment rate and composition of unemployment and retraining using a search and matching model. They get similar results as Ljungqvist and Sargent (1998), but generated through labor demand. When unemployment benefits are sufficiently low, the share of long-term unemployed is zero. Using an efficiency wage model Eriksson (2006) shows that loss of skills during unemployment and ranking of the unemployed increase unemployment. However, long-term unemployment is affected only transitorily. An alternative explanation for the European experience with high unemployment (and high long-term unemployment) is given by Haan (2002). He argues that an increase in unemployment during the seventies played a key role because it led to an increase in the obligation to pay unemployment benefits. The implied increase in the tax rates decreased job creation and increased job destruction. Daveri and Tabellini (2000) argue in a similar way.

Empirical literature on duration dependence exists in considerable numbers.[4] Most of them are micro data studies that use in the majority of cases a mixed proportional hazard model to analyze if the exit rate from unemployment declines with duration of unemployment. The results are at best mixed. The main reason for this is that it is difficult to distinguish between heterogeneity driven duration dependence and true duration dependence: *Heterogeneity driven duration dependence*: Workers are heterogeneous and those who have experienced a longer unemployment spell are more likely to be of lower productivity. Employers sort them out and, hence, their exit probability falls. *True duration dependence:* True duration dependence in the sense that exit probabilities fall with the duration of the unemployment spell despite the fact that workers are heterogeneous. Along with longer unemployment spells workers may lose human capital.[5]

Heckman and Borjas (1980) differentiate four main types of structural dependence: (1) *Markov dependence:* First the probability that an employed worker will become unemployed differs from the probability that an unemployed worker will remain unemployed. (2) *Occurrence dependence*: The number of previous unemployment spells affects the probability that a worker will become or remain unemployed. (3) *Duration dependence*: The probability of remaining unemployed increases with the current unemployment spell. (4) *Lagged duration dependence*: The probability of remaining or becoming unemployed depends on the lengths of previous unemployment spells.

[4] Early work that find duration dependent exit probabilities from unemployment are Nickell (1979) and Lancaster (1979).

[5] See Acemoglu (1995) for a more detailed discussion of this view. For the latter view see, for example, Sinfield (1981), Layard et al. (1991), and Pissarides (1992).

Uncontrolled heterogeneity can have two sources: (1) The joint distribution of pure heterogeneity components is not determined by outcomes of the employment and unemployment processes. That is, pure heterogeneity components are exogenous to the process. (2) State dependent heterogeneity means that the unobserved loss components are direct outcomes of the process itself and so are not exogenous to the process. That is, such a component may affect future employment and unemployment and is affected by past employment and unemployment.

Improper treatment of heterogeneity can lead to seriously biased estimates of state dependence effects. Hence, without strong distributional assumptions about the nature of heterogeneity it is impossible to separate true duration dependence from spurious duration dependence, even if micro data are used.[6] The different attempts for the treatment of heterogeneity are likely to be one of the main causes for different results across micro studies.

More recent studies that deal with these aspects very carefully come to more common results. Abbring et al. (2001) find significant exit probability differences between males and females and nonwhites and whites. In addition, they find aggregated group-specific exit probabilities that decline with the duration of unemployment. Using data from the UK, Arulampalam et al. (2000) find strong evidence of state dependence consistent with the scarring theory of unemployment. Causes of state dependence (in unemployment occurrence) or scarring are productivity discrimination or the use of the employment history as a screening device.[7] Using data for Spain, Bover et al. (2002) conclude that the probability of finding a job decreases steadily with the duration of unemployment. Finally, Van den Berg and van Ours (1994) find negative duration dependence for the UK, no strong duration dependence for France, and a non-monotonic duration dependence for the Netherlands. Furthermore they find significant unobserved heterogeneity for France and the Netherlands, while for UK heterogeneity seems to be empirically unimportant.[8]

While micro data studies focus on the causes of an increasing share of long-term unemployed, macroeconomic studies analyze in some cases if duration dependence affects the unemployment rate. Haskel and Jackman (1988), Budd et al. (1987) and Budd et al. (1988) find evidence that duration dependence affects the level of unemployment in the UK and Germany but not in the Netherlands and the USA. Sider (1985) and Baker (1992) find

[6] See Heckman and Borjas (1980) for a detailed discussion.

[7] See Phelps (1972) and Lockwood (1991) for a more detailed discussion. See Rhum (1991) for a discussion and an application to US data.

[8] However, Ljungqvist and Sargent (2008) conclude on the basis of a simulation model "that the negative relationship between hazard rates and the length of unemployment spells is mainly due to heterogeneity among the unemployed rather than duration dependence."

at the aggregated level for the USA, that duration has played a more prominent role than incidence in steady state increases in the unemployment rate. Jackman and Layard (1991) find no evidence for pure heterogeneity and at best weak support for some heterogeneity. They explain the overall fall in UK exit rates from unemployment by the combined effect of (1) a fall in the ratio of vacancies to unemployment, and (2) a higher proportion of the unemployed being long-term unemployed. Using data for France, Abbring et al. (2002) conclude that unobserved heterogeneity (dynamic sorting), and not duration dependence (stigma effects), explains the observed negative duration dependence in the first six quarters of unemployment.[9] For higher durations negative individual duration dependence, and not dynamic sorting, is important.

Furthermore, evidence has been found that the ratio of exit rates at different durations is relatively constant over time.[10] Using data for 1995 Machin and Manning (1999) compare thirteen European countries and find only minor cross country differences in duration dependence (with the exception of Sweden).

The main drawback of macro or aggregated time-series is that they are not sufficiently informative, because they do not contain information on the composition of the heterogeneous inflow into unemployment. That is, personal characteristics are unobserved. However, in principle the results of Van den Berg and van Ours (1994) and Budd et al. (1987) and Budd et al. (1988) do not point at different directions. Furthermore, Van den Berg and Klaauw (2001) compare the duration distribution of micro and macro data for France and find only slightly but not significantly higher exit probabilities for macro data. That is, the duration dependence pattern is almost the same for both data. In addition, macro data have some advantages over micro data: (1) Macro data provide the exact aggregate unemployment duration distribution in the population (averaged over unobserved heterogeneity). (2) They cover a much longer time span than is usual in micro data. (3) They usually do not suffer from attrition. (4) In principle aggregated data cover the whole population which makes such data better suited for the analysis of the overall impact of aggregate events. (5) The macroeconomic consequences of differences in exit rates on the unemployment rate can be analyzed much better with macro data.[11]

In this paper the latter point is of interest. But what are the consequences for the estimates? In case of (unobserved) heterogeneity, individuals with the largest exit probability, on average, leave unemployment first. This

[9] One explanation for duration dependence is the stigma effects. It reduces the number of job opportunities of the long-term unemployed. See, for example, Vishwanath (1989) and Van den Berg (1990).

[10] See, for example, Jackman and Layard (1991) and Eriksson (1996).

[11] See Abbring et al. (2002) for a discussion of macro data in the context of duration dependence.

leads to a decline in the average quality of a cohort of unemployed from period to period (e.g. due to an increasing share of low skilled or discouraged worker). Hence, negative duration dependence in observed aggregated exit probabilities may occur even in the absence of true duration dependence. This is important for policy analysis. However, the estimates are biased only in the sense that we can not distinguish between (unobserved) heterogeneity and true duration dependence. They are not biased with respect to the impact of the observed aggregated duration dependence.

A simple example: Let us assume that $X = \psi + \epsilon$, whereby X is the observed aggregated duration dependence, ψ is the true duration dependence, and ϵ is the unobserved heterogeneity. The effect of ψ on the exit probability is biased, if ψ and ϵ are correlated. The effect of X on the exit probability is not biased, but we can not distinguish between the effects of ψ and ϵ. However, the latter objective is not the aim of this paper.

Put differently, if the share of long-term unemployed has an effect on the level of unemployment, it is of importance to estimate the magnitude of this effect. This point seems to be neglected somewhat in the literature. In addition, given that there are specific groups in the pool of long-term unemployed that experience very low exit probabilities (no true duration dependence), then it is appropriate to suppose that these groups can be identified simply by closer inspection of the unemployment statistics. That is, policy analysis is still possible, even if we estimate the observed aggregated duration dependence only. In the theoretical and empirical section we use only the term duration dependence. That is, in the empirical part duration dependence means observed aggregated duration dependence.

3 The Model

Following Machin and Manning (1999) two main hypotheses are developed to explain international differences in long-term unemployment. A third hypothesis that is of interest in this paper relates to an internationally stable relationship between the distribution of unemployment by duration and the unemployment rate. In this section we develop a model that allows to differentiate between these three hypotheses:

1. A collapse in the reemployment probabilities from unemployment at all durations of unemployment accounts for the increase in the share of long-term unemployed.

2. In contrast to the first hypothesis, the exit rate from unemployment declined only for the long-term unemployed, while the other exit rates have remained constant.

3. There is international evidence for a stable negative relationship be-

tween the duration of unemployment and the reemployment probability.[12]

In addition, the framework given below enables us to consider a fourth possible explanation. Jackman et al. (1996) consider the inflow rates into unemployment as a potential reason for the different experiences with unemployment. The idea is that higher job destruction rates produce higher unemployment for a given exit rate from unemployment. They do not find any important trend that could explain the rise in unemployment. In addition, we will see below that the job destruction rate is not able to explain a permanent change in the distribution of unemployment by duration. The effect is simply transitory.

The review in the previous section reveals that it seems to be a useful approach to extend the standard equilibrium unemployment model by unemployment duration dependent job finding probabilities.[13] In addition, this would offer the possibility to assess the above mentioned explanations.

Let us assume people can only be employed or unemployed and live forever. New cohorts do not enter the labor market. In the standard stock-flow model for steady state unemployment we have equal flows into and out of unemployment. The flow of people into unemployment in a given period is equal to the short-term unemployed in this period. Some of them find a new job within the same period, others don't. The same is true for those who became unemployed in previous periods and are still unemployed. Some of them find a new job within this period, the rest remains unemployed. From this it follows that the backflow into employment consists of people with different experiences of unemployment duration.

Given that firms are more reluctant to hire applicants with a longer unemployment duration, the backflow probability decreases with increasing unemployment periods. In addition, one could argue that the search intensity of the unemployed decreases with increasing individual unemployment duration.

In the standard approach for steady state unemployment stock-flow models the flow from unemployment to employment is equal to the flow in the opposite direction

$$pU = \lambda E. \tag{1}$$

U is the number of unemployed and E is the number of workers. On average an unemployed worker finds a job during a period with the probability p. The equilibrium in search and matching models usually depends

[12] This is a necessary but not sufficient condition for Hypotheses one and two if an international panel data set is used.

[13] See, for example, Pissarides (2000) for a good introduction to the standard equilibrium unemployment model.

on a measure of the tightness of the labor market defined as the ratio of vacancies to unemployed, $\theta = V/U$. The probability p depends on the labor market tightness θ because it determines how successful search is. Finally, the probability that a job will be destroyed by an idiosyncratic shock in a period is given by λ. Dividing equation (1) by $E+U$ and rearranging yields the unemployment rate:

$$u = \frac{\lambda}{\lambda + p(\theta)} \tag{2}$$

An increase in the vacancy rate increases the market tightness and, hence, the probability p. This is why equation (2) is sometimes referred to as the Beveridge curve. The Beveridge curve shift outwards if λ increases and vice versa.

It is easy to see that the probability $p(\theta)$ can be interpreted as a weighted average with weights given by the distribution of unemployment by duration. This follows directly from

$$pu = p(u_1 + u_2 + ... + u_n) = p\sum_i risk_i = p\sum_i s_i u = p\sum_i \frac{u_i}{u} u. \tag{3}$$

The term $risk_i$ is the probability of being unemployed with a specific duration of unemployment. Put alternatively, the risk of being unemployed is the sum of duration dependent risks ($u = \sum_i risk_i$). In addition, $risk_i$ is equal to the unemployment rate weighted by the duration dependent group size $s_i = U_i/U = u_i/u$. Equation (3) points out that the assumption of a constant $p(\theta)$ for a given θ is a special case of a more general approach in which different duration specific reemployment probabilities are considered. Put differently, if and only if $p(\theta)$ is the same for all unemployed, the distribution of the duration dependent shares has no impact on the average value of p. Only then duration dependence does not exist.

Let us now assume that the reemployment probability for a specific unemployed person depends on his spell of unemployment. For $i = 1, 2, ..., N$ (continuous) unemployment periods the duration specific reemployment probability $p_i(\theta)$ decreases with an increasing number of periods, if the probability to find a job decreases from period to period. Hence, duration dependence

$$p_1(\theta) > p_2(\theta) > ... > p_N(\theta) \tag{4}$$

simply means that the shorter the duration of unemployment, the higher the backflow probability. It is assumed that θ does not have an effect on the ratio of the p_i's. That is, all p_i's decrease proportionally if θ decreases. This

assumption is in line with empirical findings described at the beginning of this section. To each $p_i(\theta)$ corresponds a number of unemployed U_i with an unemployment experience of i periods, hence, U_i is the sum of the unemployed persons. Other reasons for heterogeneity, like skills, gender, or age remain unconsidered.

Following equation, (3), this yields:

$$\sum_i p_i(\theta) s_i u = p(\theta, f(s)) u \tag{5}$$

From this it follows that the larger the s_i for higher numbers of i, the lower p. Hence, the average exit rate does not only depend on the market tightness but also on the distribution of unemployment by duration, $f(s)$. That is, the quantity of unemployment is measured by θ and the quality by $f(s)$.

For the flow equilibrium (1), follows that

$$\sum p_i(\theta) s_i U = \lambda E \tag{6}$$

It is assumed that the distribution of the unemployed by duration has no impact on λE, because the idiosyncratic shock rate is independent for a given number of unemployed people. The steady state unemployment rate is given by

$$u = \frac{\lambda}{\lambda + \sum p_i(\theta) s_i} = \frac{\lambda}{\lambda + p(\theta, f(s))}. \tag{7}$$

While λ shifts the Beveridge curve outwards, p_i shifts the curve inwards. For s_i most effects are ambiguous. This is simply because if one of the shares changes, at least one of the others changes too. If the assumption in equation (4) holds,it is unambiguous that $\partial u/\partial s_1 < 0$ and $\partial u/\partial s_n > 0$. Hence, an increasing share of long-term unemployed increases the unemployment rate at given p_i and λ, and the opposite is true if the share of the single-period unemployed increases.

In the empirical part of the paper we distinguish between three different duration groups only, due to data availability. Hence, for a model with short-term (S), medium-term (M) and long-term (L) unemployed, steady state equilibrium unemployment is given by

$$u = \frac{\lambda}{\lambda + p_S(\theta) s_S + p_M(\theta) s_M + p_L(\theta) s_L}. \tag{8}$$

In this case only the effect of s_M is ambiguous. However, $\partial u/\partial s_M < 0$ if the change in s_M is to the disadvantage of s_L, and $\partial u/\partial s_M > 0$ if it is to

the disadvantage of s_S. Given the assumption in equation (4) we can order the effects on u:

$$\frac{\partial u}{\partial s_S}\Big|_{ds_M=0} < \frac{\partial u}{\partial s_S}\Big|_{ds_L=0} \; and \; \frac{\partial u}{\partial s_L}\Big|_{ds_M=0} > \frac{\partial u}{\partial s_L}\Big|_{ds_S=0}. \tag{9}$$

We now fractionize the flow into employment into inflow units to point out under which conditions the shares change. The evolution of the aggregated rate of unemployment is given by the difference between inflow and outflow. In a steady state, an equal number of persons flow into unemployment and back into employment. It is assumed that short-term unemployment is a one period unemployment experience.

In period one, λE people lose their job. In the same period a share δ find a new job and the share $(1-\delta)\lambda E$ remain in unemployment and leave the group of short term unemployed at the end of the period. From this it follows that the share of one period unemployed is a flow quantity. In the next period the share $(1-\delta)\lambda E$ is the flow into medium-term unemployment. Again, this quantity is divided into two groups, an outflow into employment according to the share β and a remaining part $(1-\beta)$. This does not mean that the fraction β of those who become medium-term unemployed find a new job, but the number of medium-term unemployed equal to $\beta(1-\delta)\lambda E$ get reemployed.

For simplicity we assume that there is only one additional third group, the long-term unemployed. The flow into the duration group of long-term unemployed,$(1-\beta)(1-\delta)\lambda E$, is equal to the number of people finding a new job, if this is the group with the last duration category. People cannot be more than long-term unemployed.[14]

$$\lambda E = \delta\lambda E + \beta(1-\delta)\lambda E + (1-\beta)(1-\delta)\lambda E \tag{10}$$

In steady state λE is fixed. The term $\delta\lambda E$ is equal to $p_S s_S$. In steady state δ cannot change, because this would change p, which is also fixed. From this it follows that neither p_S nor s_S can change. The same applies to the medium-term unemployed. The share β cannot change, since $\beta(1-\delta)\lambda E$ is equal to $p_M s_M$. Hence, $(1-\beta)(1-\delta)\lambda E$ remains unchanged, too.

The framework allows the following conclusions with respect to a steady state equilibrium, $\dot{u} = 0$:

1. Constant flows imply constant duration dependent probabilities and shares: $\dot{p}_i = 0$, $\dot{s}_i = 0$.

[14] Remember we assume that people can only be employed or unemployed and live forever. New cohorts do not enter the labor market.

2. For given values of the duration dependent probabilities, it follows from equation (8) that the larger the sum $s_M + s_L$ the lower the flow quantities and, hence, the probability that an employed becomes unemployed.

3. The larger δ and β the lower the probability of being long-term unemployed. However, the probability of remaining long-term unemployed increases.

Out of steady state, $\dot{u} \neq 0$, the following conclusions are possible:

1. From equation (8) it follows that the larger s_S (s_L), the smaller (larger) the unemployment rate. Hence, the unemployment rate is negatively related to s_S and positively correlated with s_L. The correlation of the unemployment rate with s_M depends on the difference between p_M and p. In addition, it follows that a fall in the reemployment probability at any duration will tend to raise s_L. In this case u is driven mainly by $p_L s_L$ and a new equilibrium will be reached at a slower rate.

2. The share s_S first increases with λ and then decreases, for given numbers of employed workers, E, and the duration dependent flow probabilities. In this case all other shares decrease and the unemployment rate increases. However, as long as E and the p_i's are constant the shares will move back to their initial ratio. Only the unemployment rate changes with λ.

3. The smaller the negative duration dependence the larger is s_S and the smaller s_L. However, a decrease in p_S and p_L for a given p_M increases s_S and s_L. Additionally, s_L increases if p_S decreases for given values of p_M and p_L.

4. Strong fluctuations in λ produce waves of newly unemployed. These waves pass through the shares one after another. For large differences in duration dependent flow probabilities or small values for all p_i's, the impacts of recessions on unemployment are much stronger, because this leads to a *tsunami* for the share of long-term unemployed. In addition, the *tsunami* is lagged behind the increase in the unemployment rate.

4 Empirical Analysis

In this section we investigate empirically the relation between unemployment and the distribution of unemployment by duration. In a first step we take a look at the correlation coefficients to reassess the conclusions derived above. The second part deals with estimates of a panel data model for 16 OECD countries.

4.1 Empirical Stylized Facts

A comparison of data for the unemployment rate and the share of long-term unemployment over time for almost all OECD countries reveals that if the unemployment rate has risen so has the share of long-term unemployment.[15] In order to provide a first cross country evidence for our data we calculate correlation coefficients for all countries considered in this paper. Table 1 provides the correlation coefficients for the unemployment rate and the duration groups short-term, medium-term, and long-term unemployment. The coefficients refer to 16 OECD countries and the period 1975 to 2000. For a detailed data description see section 4.2.

As predicted in the theoretical model above, the unemployment rate is negatively related to short-term unemployment and positively to the share of long-term unemployed. The correlation between the share of medium-term unemployed and the unemployment rate is almost zero. This means that $p_m \approx p$. Hence, a change in this share has only minor effects on the average job finding probability.

Table 1: Correlation Coefficients

	s_S	s_M	s_L
s_M	-0.4783		
s_L	-0.9143	0.0815	
u	-0.5114	0.0731	0.5481

s_S: share of short-term unemployed; s_M: share of medium-term unemployed; s_L: share of long-term unemployed; u: unemployment rate

The remaining correlation coefficients imply that (a) if the share of short-term unemployed increases, the remaining shares decrease and vice versa, and (b) a week linear bivariate relation exists only between the share of medium-term and long-term unemployed. The first observation is in line with previous observations that the share of long-term unemployed is lagged behind the actual unemployment rate. This can be explained by applying the model above. Let us assume, for example, a one period shock hits the economy. An increase in the idiosyncratic shock rate, λ, increases in the same period the share of short-term unemployed and the unemployment rate, but decreases the other shares. In the next period a part of this wave of newly unemployed move into the share of medium-term unemployed. At the same time the share of short-term unemployed decreases and the share of long-term unemployed increases (but is still smaller than before the shock!). The unemployment rate now starts to decrease. In the next period the remaining part of the unemployment wave enters the share of long-term

[15] See Machin and Manning (1999) and Webster (2005) for a detailed discussion.

unemployed. The unemployment rate decreases further, while the share of long-term unemployed increases.

4.2 Data

The standardized unemployment rate (u) is taken from the OECD online database. Unemployment by duration is subdivided into short-term unemployment (up to three months unemployed), medium-term unemployment (more than three months and up to one year unemployed), and long-term unemployed (more than one year unemployed). These data are taken from the OECD online database, too.

To get reliable estimates we consider a set of institutional and macroeconomic control variables. Institutional control variables are: The variables that measure labor market policy are benefit replacement rate (brr), benefit duration (bd), employment protection (ep), year to year changes in net union density (ud), and coordination of bargaining (co). *Benefit replacement rate* is a percentage of average earnings before tax and refers to the first year of unemployment, and *benefit duration* is measured by the replacement rate in the second to fifth year of unemployment, relative to that of the first year.[16] *Employment protection* increases with strictness of employment protection and has the range $\{0, 2\}$. *Net union density* is constructed as the ratio of total reported union members minus retired and unemployed members. *Coordination of bargaining* is an index with range $\{1, 3\}$ and increases in the degree of coordination in the bargaining process on the employers' as well as on the unions' side. Macroeconomic control variables are: Terms of Trade shocks (tts), labor demand shocks (lds), total factor productivity (tfp), real interest rate (r), and vacancy rate (v). The institutional as well as the pure macroeconomic control variables are taken from Nickell and Nunciata (2002).

With respect to the countries considered only those are accounted for who provide data for unemployment shares at lest for ten years: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, United Kingdom, and USA. The period is 1975 to 1995 due to data availability.

4.3 Econometric Model and Results

In this section we analyze econometrically whether the distribution of unemployment by duration has an effect on the level of the unemployment rate. In particular the identification of duration dependence that is stable over time and across countries is of interest here. In the theoretical section we have concluded that an increase in the share of short-term unemployed decreases the unemployment rate, while an increase in the share of

[16] See Nickell and Nunziata (2002) for a detailed description on how *bd* is calculated.

the long-term unemployed increases unemployment, if and only if duration dependence exists. For medium-term unemployed the prediction depends on the difference between p_M and p.

Due to data availability we distinguish between three different duration groups only. The share of short-term unemployed, s_S, comprises of people with a spell of unemployment of up to three month. The cut for the remaining unemployed is at one year unemployment. In the estimates only two of three shares can be included, since they sum up to one. We therefore estimate all three possible combinations. This allows us to interpret the share effects more specifically, since the estimated effects are always on account of the excluded share. We argue that significantly different estimates for the shares correspond to significantly different p_i's.

To ensure that we estimate the share effects, we control also for the effect of the vacancies on unemployment. That is we estimate the Beveridge curve. The vacancies might have some measurement errors, since they are calculated on the basis of national definitions. Hence, we have to be careful at least with respect to the slope of the Beveridge curve. In order to make the results more robust, we consider a comprehensive set of control variables (comparable to that of Nickell et al. (2005)) and countries, respectively.

The following equation will be estimated:

$$\begin{aligned}\log(u_{it}) &= \beta_0 + \beta_1 s_{jit} + \beta_2 s_{kit} \\ &\quad + \beta_3 brr_{it} + \beta_4 bd_{it} + \beta_5 ep_{it} + \beta_6 ud_{it} + \beta_7 co_{it} \\ &\quad + \beta_8 tts_{it} + \beta_9 lds_{it} + \beta_{10} tfp_{it} + \beta_{11} r_{it} + \beta_{12} \log(v_{it}) \\ &\quad + \alpha_i + \gamma_t + \epsilon_{it}\end{aligned}$$

s_j and s_k are two of the three duration groups (s_S, s_M, s_L) and α_i and γ_t are fixed cross-country and time effects, respectively. We consider two additional specifications to account in a different way for unobserved heterogeneity. First, instead of time effects we consider a time trend and country specific first order autoregressive terms. Second, we do the same but now with country specific time trends instead of the aggregated time trend. White robust covariances are used to control for cross-equation correlation and different error variances in each cross-section unit.

Table 2 displays the main results. For complete results we refer to the appendix. Regressions 1 to 3 are specified as standard fixed effects models. The negative effect of the short-term share is twice as large if it is on account of the share of long-term unemployed. For the positive effects of the long-term share the exact opposite is the case. For the share of medium-term unemployed we find a decreasing (increasing) effect on unemployment, if it is on account of the long-term share (short-term share). All estimated effects are significant at the 1% level.

Regressions 4 to 6 and 7 to 9 have different specifications with respect to unobserved heterogeneity. The estimated effects remain significant at the 1% level and the relative differences between them are quite stable, although the parameters decrease somewhat.

The results provide strong evidence that the distribution of unemployment by duration has a significant effect on the level of the unemployment rate. Hence, the hypothesis of internationally stable (observed aggregated) duration dependence is confirmed. Based on the Wald test we can conclude that the estimated coefficients are significantly different in all cases. All test results are significant at the 1% level. Therefore, we can conclude that the cross country differences in duration dependence are quite small.

With respect to the two remaining hypotheses we argue as follows: A deterioration of the exit rate for long-term unemployed would imply that the parameter p_L has fallen over time. In addition, we have to expect stronger country differences for this parameter than for the other exit rates. In both cases the significance level of the respective parameters should be weak. In contrast to this the hypothesis of a collapse in the reemployment probabilities from unemployment at all durations would be compatible with significant parameters, if the ratio of exit rates at different durations are relatively constant over time and across countries.

The results are in line only with the latter hypothesis. Hence, the high share of long-term unemployed is no evidence of a particular reemployment problem for the long-term unemployed. Again, it is not the aim of the paper to disentangle true duration dependence and (unobserved) heterogeneity, but the differences in duration specific average exit rates. Nevertheless, the results are in the same way consistent with employers sorting in consideration of (un)observed individual characteristics. In addition, Abbring et al. (2002) conclude that (true) duration dependence, and not dynamic sorting, is important for long-term unemployed. Hence, these results are also in line with the hypothesis of a collapse in the exit rates at all durations.

Caution is needed when interpreting the estimates in a way that European countries generally do not experience duration dependent exit rates from unemployment different from those in North America, Japan, New Zealand, or Australia. The estimates do not provide information about the average exit rate from unemployment.

Based on the conclusions at the end of the third section we should expect that countries with very low duration dependent exit rates reach a new equilibrium at a slower rate. However, the new higher equilibrium unemployment rate is reached very fast, if such an economy is hit by a shock on the way to that equilibrium. This could explain the German experience with a stairs-shaped development of unemployment in the last three decades. In addition, we can explain the East German experience with unemployment. After the German reunification the rapid increase in unemployment occurred not only because of higher destruction rates but also on account of a decline

Table 2: Main regression results

	1	2	3	4	5	6	7	8	9
s_S	-0.030‡	-0.015‡		-0.021‡	-0.011‡		-0.024‡	-0.012‡	
	(0.003)	(0.005)		(0.002)	(0.003)		(0.002)	(0.004)	
s_M	-0.015‡		0.015‡	-0.011‡		0.011‡	-0.012‡		0.012‡
	(0.004)		(0.005)	(0.004)		(0.003)	(0.004)		(0.004)
s_L		0.015‡	0.030‡		0.011‡	0.021‡		0.012‡	0.024‡
		(0.004)	(0.003)		(0.004)	(0.002)		(0.004)	(0.002)
R^2	0.949	0.949	0.949	0.978	0.978	0.978	0.982	0.982	0.982
FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
TE	✓	✓	✓						
AT				✓	✓	✓			
CT							✓	✓	✓
AR				✓	✓	✓	✓	✓	✓
W	84.72‡	84.72‡	84.72‡	224.10‡	224.10‡	224.10‡	168.82‡	168.82‡	168.82‡
N	258	258	258	242	242	242	242	242	242

Notes: dependent variable: log of unemployment rate; s_S: share of short-term unemployed; s_M: share of medium-term unemployed; s_L: share of long-term unemployed; FE: fixed effects; TE: time effects; AT: aggregated time trend; CT: country time trend; AR: first order autoregressive term; W: Wald test (Chi-square) for the null hypothesis $s_j = s_k$; N: observations; ‡: significant at the 1% level; standard error in parenthesis.

in the exit rates at all durations. This has triggered the *tsunami* effect described above.[17]

To reveal the estimated impact of a change in the distribution of unemployment by duration we compare the rate of unemployment with a hypothetical unemployment rate with a "frozen" duration distribution. Needless to say that the latter is somewhat unrealistic. However, it helps to illustrate the impact of the share distribution on the unemployment rate. Figure 1 includes the actual rate of unemployment (ur), the estimated rate of unemployment (est), and the estimated rate of unemployment with a constant share of long-term unemployed (no) for all countries except New Zealand and Portugal.[18] The "frozen" share of long-term unemployed is always the

[17] The consideration of (observed aggregated) duration dependence in the equilibrium unemployment framework helps to soften Shimer's (2005) criticism, whereby the theoretical model can explain the business cycles to a moderate extent only.

[18] For these two countries we only have nine observation, 1987 to 1995.

country specific value of the first year in the estimates. The estimated unemployment rates are calculated based on regression 9.

FIGURE 1 ABOUT HERE

The estimated unemployment rates approximate the actual unemployment rates quite well. The hypothetical unemployment rate with a constant share of long-term unemployed has to be compared primarily with the estimated values. Only those economies with a stable and small average share of long-term unemployed experience an almost stationary unemployment rate. The share of long-term unemployed varies in Canada between 4% and 17.8%, in Japan between 12.5% and 22.4% and in the US between 4.2% and 13.3% over the observational period. In addition, the unemployment rate with constant shares is not much different from the other ones for these countries, with the exception of Canada since 1992.

In contrast to this, the difference between the rate with the frozen long-term share and the remaining two rates is seizable for France and Spain. For France and Spain the average shares are 36% and 48%, respectively. Although we cannot simply argue that, for example, the unemployment rate has doubled in Spain solely because of shifts in the distribution of unemployment by duration, the figures suggest that duration dependence and a fall in all duration dependent exit rates have a substantial impact on the unemployment rate.

The Nordic Countries are good examples to illustrate what happens to the share of long-term unemployed if the economy is hit by a large shock. Before the economic slowdown Sweden, Norway, and Finland have been exceptions to the European experience with long-term unemployment. The estimates reveal that even these countries could run into serious problems with respect to higher unemployment rates, even though the unemployment rate has not risen much in Norway.

The figures for Denmark (since 1986), Germany (1991 to 1993), the Netherlands (since 1987), and the UK (1989 to 1993) provide information about how the share of long-term unemployed can slow down a decline in the unemployment rate. This is in line with the theoretical conclusions, whereby the unemployment rate declines faster and reaches a lower level, if the share of long-term unemployed is small or decreases simultaneously. While the unemployment rate continues to increase in Germany over the second half of the nineties, Denmark, the Netherlands, and the UK experience a substantial decline in unemployment. For example, the share of long-term unemployed decreases from 44% (1983) to 20% (2000) in Denmark, from 59% (1985) to 27% (2002) in the Netherlands, and from 50% (1985) to 23% (2002) in the UK. The unemployment rates decrease in the same period from 11.4% to 4.6% in Denmark, from 10.9 to 3.1% in the Netherlands, and from 11.3 to 5.1% in the UK. However, these examples also show that the

reduction of long-term unemployment takes time. The good message is that European countries could experience a markedly lower unemployment rate in the future. This leaves the question as to what increases the exit rates from unemployment?

5 Policy to Reduce Long-Term Unemployment

Advice on policies towards long-term unemployment are ambiguous. A part of the literature deals with effects on the average exit probability from unemployment. A number of studies find that an increase in unemployment compensation reduces the exit rate from unemployment significantly.[19] Using data from the UK, Arulampalam and Steward (1995) come to the same conclusion. In addition, they point out that in times of high unemployment the effects of benefits decline. Instead demand constraints (lack of job offers) are found to have strong negative effects on the exit rate. Lalive et al. (2008) find that Swiss active labor market programmes do not affect the duration of unemployment.

Using data for Spain, Bover et al. (2002) conclude that more flexibility on the labor market and a reduction in unemployment benefits and benefit duration increase the exit rates out of unemployment. However, they find larger effects in an expansion than in a recession. Acemoglu (1995) argues in a similar way on the basis of a theoretical model. Labor market policies reduce the incentives of long-term unemployed to maintain their skills. Burgess and Turon (2005) conclude that economies with costly job search exhibit higher unemployment rates and lower worker flow rates. From this it could follow that employment protection has positive effects on long-term unemployment. However, this is not a conclusion advanced by the authors.

With respect to policy advice, it seems to be important to account for the results of Arulampalam and Steward (1995) and Bover et al. (2002). In times of high unemployment and bad macroeconomic performance it seems to be unhelpful to reduce benefits. Moreover, their results could be an indication of a stock of people who are affected by the level of benefits with respect to their search activity. This stock is independent of the business cycle and labor demand growth.[20] For the remaining unemployed with higher search intensity a reduction in benefits could result in faster job acceptance (first-best job) and, hence, lower average job match duration. This, in turn, could reduce the matching quality and job creation.[21] The same conclusions apply if duration dependence is the result of sorting by the unemployed

[19] See, for example, Card and Levine (2000), Lalive (2006), Lalive and Zweimüller (2004), Lalive et al. (2006), Røed and Zhang (2003), and van Ours and Vodopivec (2006).

[20] This groups is to some extent comparable to the *rest unemployed* in Jovanovic (1987) and Alvarez and Shimer (2008).

[21] See Belzil (2001) for a discussion of that point and an empirical investigation for Canada.

themselves. That is, those who become unemployed have different search intensities and, hence, they select themselves into the groups of short-term or long-term unemployed.

Another part of the literature argues that policies to reduce long-term unemployment need to be based on the precise mechanism underlying the observed duration dependence. The two main explanations are heterogeneity driven duration dependence and true duration dependence. Van den Berg and van Ours (1994) conclude that policy should be directed towards preventing workers becoming long-term unemployed if duration dependence is important. If personal characteristics are important, policy may be oriented towards training activities. Following Arulampalam et al. (2000) policies reducing short-run unemployment incidence will have longer-run effects by reducing equilibrium rate of unemployment only if there is true state dependence. These policies will have no effect if the dependence in unemployment incidence does not exist. Coles and Masters (2000) suggest that subsidizing retraining to reduce long-term unemployment is inappropriate. Instead, they conclude that the government should subsidize vacancy creation. In addition, Bean (1997) and Pissarides (1992) point out that the lower average quality of job applicants, due to a large share of long-term unemployed, leads firms to open viewer vacancies during a demand contraction, thus exacerbating the problem.

The only unambiguous finding from this literature appears to be that vacancy creation is a driving force. In equilibrium search models the probabilities of finding a job and filling a vacancy are closely connected. Garibaldi and Mauro (1999) have shown that job creation is larger in the US, Canada, and Australia than in European countries. They conclude that labor market institutions may be an important explanation for international differences. However, we have controlled for labor market institutions in our estimates. Hetze and Ochsen (2006) point out that oil price shocks and the interest rate affect the European countries more than North America.

As pointed out in the theoretical section a different experience with job destruction is not a cause for an increase in the share of long-term unemployment. Of course, the unemployment rate will change, but the shares are affected only transitorily.

Finally, early retirement schemes could be a reason for the rise in long-term unemployment. Primarily, this policy instrument is used in a lot of European countries to reduce long-term unemployment. However, early retirement schemes also signal to firms that the average value of a job match with an older worker could be lower than that of a match with a younger one. Hetze and Ochsen (2006) find strong evidence in favor of this hypothesis. On the other hand firms get rid of unproductive workers at first and those older workers, who remain in jobs, are of high quality. Hence, firms are willing to employ these older but highly productive workers, which means that job creation is enhanced while this policy is in place. Stopping early

retirement programs implies that this productivity gain disappears.

6 Conclusions

In this paper we analyze the effects of the distribution of unemployment by duration on the level of unemployment. We explore one central assumption that is observed empirically: when the share of long-term (short-term) unemployed increases, the unemployment rate increases (decreases). In the theoretical part of the paper an extension of the standard equilibrium unemployment model that allows for unemployment duration dependent job finding probabilities is provided. In the empirical part of the paper we apply different panel estimators on data for 16 OECD countries to test the implications of the theoretical model. The approach allows us to analyze three central questions: First, is there international evidence for a stable negative relation between the duration of unemployment and the reemployment probability? Second, can the increase in the share of long-term unemployed be accounted for by a collapse in the reemployment probabilities from unemployment at all durations? Third, in contrast to the second question, has the exit rate from unemployment fallen only for the long-term unemployed, while the other exit rates have remained constant?

Main results are: First, in a steady state equilibrium the flow rates are larger, the larger the share of short-term unemployed. In addition, the risk of becoming long-term unemployed is smaller, but the probability of remaining in long-term unemployment is larger. Second, out of steady state the unemployment rate increases (decreases) with the share of long-term (short-term) unemployed. Third, the larger the duration dependent job finding probabilities the larger the share of short term unemployed. In addition, the smaller the duration dependent job finding probabilities, the more the unemployment rate is driven by long-term unemployment. Fourth, panel estimates for 16 OECD countries provide robust and significant evidence that an increase in the share of short-term (long-term) unemployment decreases (increases) the unemployment rate. Therefore, the empirical evidence supports the hypotheses one and three whereby (a) the reemployment probability decreases with an increasing spell of unemployment and (b) average exit rates exhibit cross country variation. Hence, the different experiences with unemployment in North America, Australia, and Japan on the one hand, and Europe on the other hand, can be explained by observed aggregated duration dependence and differences in the average exit rate. This means that it is not only the exit rate from unemployment for long-term unemployed that is worse in Europe than in the US.

The approach in this paper can be extended by distinguishing the labor force according to gender, skills, or age. Especially the latter seems to be important since the next 20 years demographic change will alter drastically

the structure of employment within the industrialized countries.

7 Appendix

8 References

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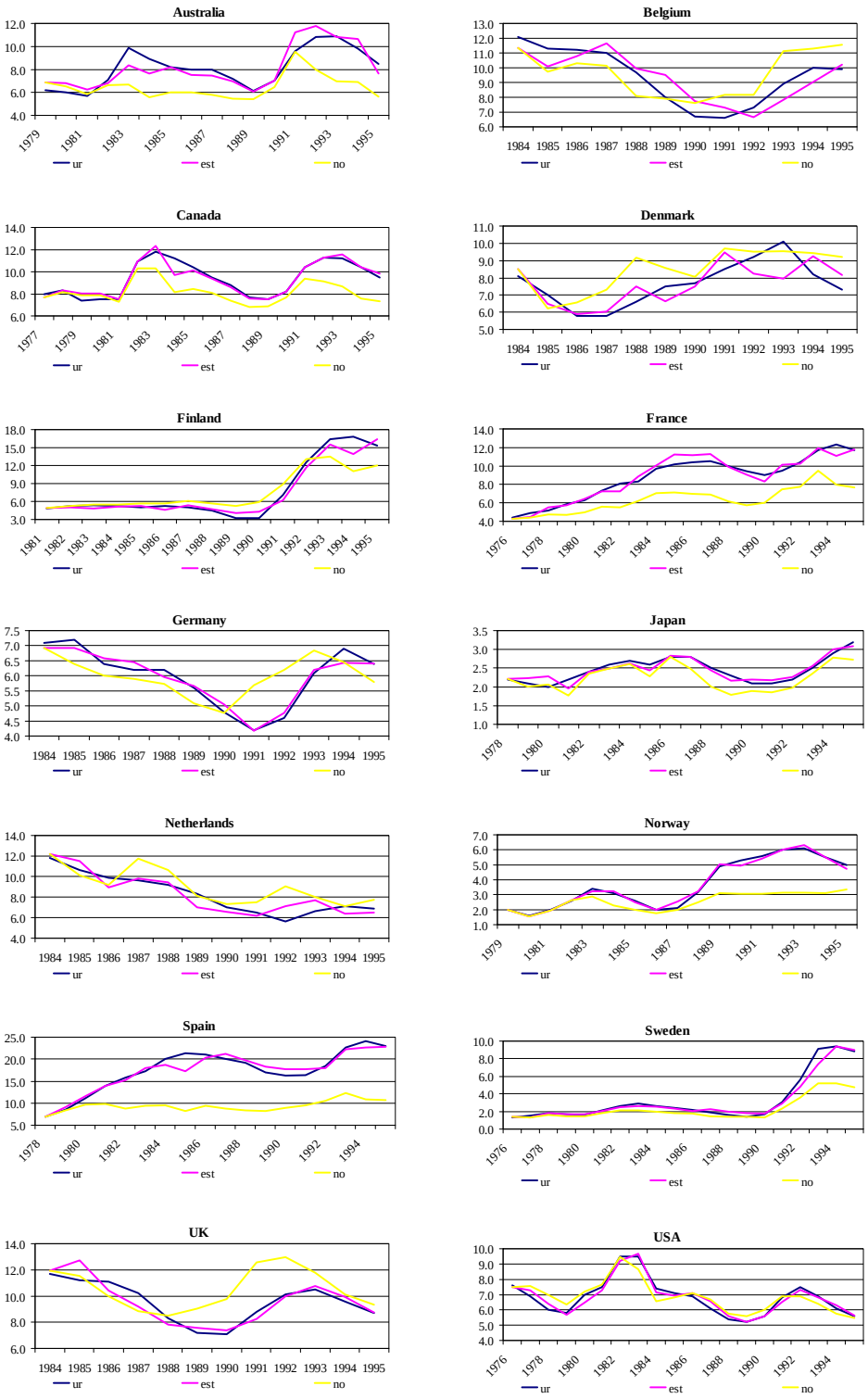

Figure 1: Unemployment rates, estimated unemployment rates, and hypothetical unemployment rates

Table 3: Complete regression results

	1	2	3	4	5	6	7	8	9
s_S	-0.030‡	-0.015‡		-0.021‡	-0.011‡		-0.024‡	-0.012‡	
	(0.003)	(0.005)		(0.002)	(0.003)		(0.002)	(0.004)	
s_M	-0.015‡		0.015‡	-0.011‡		0.011‡	-0.012‡		0.012‡
	(0.004)		(0.005)	(0.004)		(0.003)	(0.004)		(0.004)
s_L		0.015‡	0.030‡		0.011‡	0.021‡		0.012‡	0.024‡
		(0.004)	(0.003)		(0.004)	(0.002)		(0.004)	(0.002)
brr	1.005†	1.005†	1.005†	-0.341	-0.341	-0.341	-1.060‡	-1.060‡	-1.060‡
	(0.423)	(0.423)	(0.423)	(0.256)	(0.256)	(0.256)	(0.276)	(0.276)	(0.276)
bd	1.225‡	1.225‡	1.225‡	0.625‡	0.625‡	0.625‡	0.239	0.239	0.239
	(0.237)	(0.237)	(0.237)	(0.229)	(0.229)	(0.229)	(0.400)	(0.400)	(0.400)
ep	-0.793‡	-0.793‡	-0.793‡	0.027	0.027	0.027	-1.460†	-1.460†	-1.460†
	(0.186)	(0.186)	(0.186)	(0.137)	(0.137)	(0.137)	(0.604)	(0.604)	(0.604)
ud	0.897	0.897	0.897	0.050	0.050	0.050	-0.029	-0.029	-0.029
	(1.093)	(1.093)	(1.093)	(0.524)	(0.524)	(0.524)	(0.694)	(0.694)	(0.694)
co	-0.171♯	-0.171♯	-0.171♯	-1.143‡	-1.143‡	-1.143‡	-1.536‡	-1.536‡	-1.536‡
	(0.098)	(0.098)	(0.098)	(0.282)	(0.282)	(0.282)	(0.305)	(0.305)	(0.305)
tts	0.633	0.633	0.633	0.126	0.126	0.126	0.148	0.148	0.148
	(1.017)	(1.017)	(1.017)	(0.449)	(0.449)	(0.449)	(0.488)	(0.488)	(0.488)
lds	-1.559	-1.559	-1.559	-1.484‡	-1.484‡	-1.484‡	-1.625‡	-1.625‡	-1.625‡
	(1.314)	(1.314)	(1.314)	(0.491)	(0.491)	(0.491)	(0.645)	(0.645)	(0.645)
tfp	-3.757‡	-3.757‡	-3.757‡	-2.795‡	-2.795‡	-2.795‡	-3.682‡	-3.682‡	-3.682‡
	(0.500)	(0.500)	(0.500)	(0.682)	(0.682)	(0.682)	(0.653)	(0.653)	(0.653)
r	0.853	0.853	0.853	0.486	0.486	0.486	0.041	0.041	0.041
	(0.537)	(0.537)	(0.537)	(0.445)	(0.445)	(0.445)	(0.414)	(0.414)	(0.414)
$\log(v)$	-0.163‡	-0.163‡	-0.163‡	-0.252‡	-0.252‡	-0.252‡	-0.231‡	-0.231‡	-0.231‡
	(0.034)	(0.034)	(0.034)	(0.031)	(0.031)	(0.031)	(0.037)	(0.037)	(0.037)

Notes: dependent variable: log of unemployment rate; s_S: share of short-term unemployed; s_M: share of medium-term unemployed; s_L: share of long-term unemployed; brr: benefit replacement rate; bd: benefit duration; ud: first difference of net union density; co: coordination of bargaining ; tts: Terms of Trade shocks; lds: labor demand shocks; tfp: total factor productivity; r: real interest rate; v: vacancy rate; ‡: significant at the 1% level; †: significant at the 5% level; ♯: significant at the 10% level; standard error in parenthesis.

Table 4: Complete regression results (continued)

	1	2	3	4	5	6	7	8	9
R^2	0.949	0.949	0.949	0.978	0.978	0.978	0.982	0.982	0.982
FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
TE	✓	✓	✓						
AT				✓	✓	✓			
CT							✓	✓	✓
AR				✓	✓	✓	✓	✓	✓
W	84.72‡	84.72‡	84.72‡	224.10‡	224.10‡	224.10‡	168.82‡	168.82‡	168.82‡
LLC	-7.899‡	-7.899‡	-7.899‡	-12.06‡	-12.06‡	-12.06‡	-12.87‡	-12.87‡	-12.87‡
ADF	107.1‡	107.1‡	107.1‡	189.6‡	189.6‡	189.6‡	190.2‡	190.2‡	190.2‡
N	258	258	258	242	242	242	242	242	242

Notes: FE: fixed effects; TE: time effects; AT: aggregated time trend; CT: country time trend; AR: first order autoregressive term; W: Wald test (Chi-square) for the null hypothesis $s_j = s_k$; LLC: Levin, Lin & Chu t* (null hypothesis: common unit root process); ADF: ADF - Fisher Chi-square (null hypothesis: individual unit root process) N: number of observations; ‡: significant at the 1% level; standard error in parenthesis.