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WAGE FORMATION, REGIONAL MIGRATION AND LOCAL LABOUR MARKET TIGHTNESS

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Wage formation, regional migration and local labour market tightness[*]

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Abstract

Economic theory predicts that local labour market tightness affects local wage setting as well as individuals' migration decisions. But how should we measure local labour market tightness? In this paper we show that the common practice of using the local rate of unemployment as the tightness indicator may be misplaced. Instead, we propose a *human capital adjusted outflow rate from unemployment* that can be computed on the basis of micro register data. This outflow rate performs better than traditional measures of regional labour market conditions in panel data analyses of regional wages and interregional migration.

JEL classification: J31, J61

Keywords: Regional wages; interregional migration; labour market tightness

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1. Introduction

Local labour market conditions affect human behaviour in a number of ways. In two different strands of the economics literature, they are attributed particularly prominent roles; i.e. in the economics of *wage formation* and in the economics of *migration*. But whereas the relevant economic theories typically predict causal relationships between labour market *transition probabilities* and economic behaviour, empirical research invariably aims at identifying linkages between the *local rate of unemployment* and economic behaviour. In some cases (Blanchflower and Oswald 1990, 1994), these relationships are even elevated into empirical laws. There is now a huge literature about wage curves that explain regional wages as a function of regional unemployment[1], and there is also a rapidly expanding literature that examines the relation between interregional migration and regional unemployment.[2] Empirical wage curve studies are motivated by theories of wage determination, e.g. efficiency wage- and bargaining theories, which predict that wages depend on the probability and consequences of becoming unemployed. Empirical studies of population movements are usually motivated by the human capital approach to migration (Sjaastad 1962) which predicts that location decisions of job seekers depend on expected lifetime earnings and therefore on how likely it is to become unemployed and how likely it is for the unemployed to find new jobs.

Whereas the underlying theories emphasize transition rates between employment and unemployment, empirical studies of both wages and interregional migration routinely use the unemployment rate to characterize labour market conditions. However, the unemployment rate is an imperfect proxy both for the probability that an employed person will loose his/her job, and the probability that an unemployed person will obtain a new job. Our research suggests that changes in the stock of unemployment do not always correlate well over time with a randomly selected person's employment prospects. In fact, the results in Gaure and

[1] Recent contributions include Edin et al. (1994), Manning (1994), Wagner (1994), Bratsberg and Turunen (1996), Winter-Ebmer (1996), Partridge and Rickman (1997), Wulfsberg (1997), Janssens and Konings (1998), Pannenberg and Schwarze (1998), Turunen (1998), Dyrstad and Johansen (2000), Kennedy and Borland (2000), Raaum and Wulfsberg (2000) and Bell, Nickell and Quintini (2002).

[2] Recent studies of interregional migration flows include Pissarides and McMaster (1990), several contributions in Padoa Schioppa (1991), Blanchard and Katz (1992), Jackman and Savouri (1992), Eichengreen (1993), Gabriel et al (1993), Decressin and Fatás (1995), Westerlund (1997), Daveri and Faini (1999), Fredriksson (1999), Cannari et al (2000), Carlsen (2000) and Brunello et al (2001). Recent micro data studies of migration decisions or households' willingness to move are Pissarides and Wadsworth (1989), Hughes and McCormick (1994), Antonin and Bover (1997), Faini et al (1997), Axelsson and Westerlund (1998), Ahn et al (1999) and Ritsilä and Ovaskainen (2001).

Røed (2003) indicate that the aggregate rate of unemployment behaves *pro-cyclically* around the times of business cycle turning points. There are two reasons for this. First, because it takes time to level out the flows into- and out of unemployment, the stock of unemployed will continue to increase for some time after the turning point of a recession and continue to decrease for some time after the peak of an expansion. Second, due to selection effects there are systematic compositional changes in the unemployment pool over the business cycle.

In this paper, we use a large micro data set to compute estimates of transition rates from unemployment to employment for 90 Norwegian regions. The data set contains information about individual unemployment spells during 1990-1999 on a monthly basis. The number of observations is more than 10 million.

Changes in the rate of outflow from unemployment reflect both changes in labour demand and changes in the composition of the unemployment pool. We use the data set to estimate regional time series of a human capital adjusted outflow rate that is purged from selection effects due to either observed or unobserved differences between unemployed persons. Variation in the human capital adjusted outflow rate only reflects variation in labour demand, that is, variation in the employment prospects faced by any given person.[3]

The human capital adjusted outflow rate is included as explanatory variable in panel data analyses of manufacturing wages at the regional level and population movements between regions. The adjusted outflow rate has positive and statistically significant effects on hourly wages as well as on net in-migration to regions, also when controlling for traditional measures of labour market pressure, such as the regional unemployment rate. With few exceptions, the other labour market variables become statistically insignificant when included together with the adjusted outflow rate. Our results can be interpreted as supportive evidence of the theories which motivate empirical studies of regional wage curves and interregional migration, but suggests that empirical implementation of the theories should be given more attention regarding indicators of regional labour market conditions.

[3] Changes in labour demand may also induce changes in choosiness (or reservation wages) among the unemployed. This may dampen the effect of labour demand on the outflow rate. But, under very general and reasonable assumptions, labour demand and the outflow rate always move in the same direction (Gaure and Røed, 2003).

Government agencies and other policymakers may prefer to use raw rather than adjusted outflow rates for policy purposes since the procedure used to compute adjusted outflow rates is data and computer intensive. We have computed outflow rates with no controls for selection and re-estimated the wage and migration equations using the raw outflow rates. The raw outflow rates do a good job in explaining regional wages and interregional migration, but adjusted outflow rates perform somewhat better.

The paper is organized as follows. In the next section, we present microeconomic arguments for an alternative labour market tightness indicator. Section 3 presents the micro data set and explains how the regional time series of the adjusted outflow rate are computed. Section 4 presents panel data analyses of regional wages and interregional migration. Whereas other Scandinavian studies of regional labour markets have used one of the two local administrative levels as regional unit, this study considers genuine local labour markets constructed from data about commuting flows. Section 5 concludes.

2. Theoretical background

To the extent that models of wage formation or interregional migration are carefully embedded in microeconomic utility maximising behaviour, there is no direct role for regional or national rates of unemployment. What matters are the underlying flows, and the way these flows affect the utility levels associated with employment and unemployment, respectively. To illustrate, let U_t represent the discounted value (utility) of being presently unemployed and let V_t be the utility of being employed. The relationships between the utility derived from these two states can then be described as follows

$$U_t = b_t + \frac{1}{1+r}\left[p_t V_{t+1}^e + (1-p_t)U_{t+1}^e \right], \tag{1}$$

$$V_t = w_t + \frac{1}{1+r}\left[(1-q_t)V_{t+1}^e + q_t U_{t+1}^e \right], \tag{2}$$

where b_t is the unemployment benefit, w_t is the wage, p_t is the probability of transiting from unemployment to employment, q_t is the probability of transiting from employment to unemployment, and r is the discount rate. The subscript t refers to the (discrete) time period, and the superscript e is indicative of an expectation. Now, assume that a steady state prevails, such that all variables are constant and equal to their expectation. We then have from (1) and (2) that the (time-invariant) utility of being unemployed is equal to

$$U = \frac{1+r}{r(r+q+p)}\left((q+r)b + pw\right). \tag{3}$$

Equation (3) tells us that the utility of unemployment is determined by five factors: i) How much the person concerned receives in compensation (b), ii) how much he/she is going to earn when a job eventually is obtained (w), iii) how long time that is expected to take (*1/p*), iv) for how long time he/she is then expected to keep that job (*1/q*), and finally, v) which weight is attached to current versus future utility (r). Outside steady state, the value of unemployment is also affected by expectations about future developments of these variables. The business cycle (aggregate labour demand) affects the utility of unemployment because it affects the two transition rates into- and out of unemployment. There is no particular role for the rate of unemployment. However, since we are in a steady state, we also have that the flows into- and out of unemployment are of equal size, implying that

$$u = \frac{q}{q+p}, \tag{4}$$

where u is the rate of unemployment. Hence, there is apparently a simple relationship between the two transition rates of interest and the rate of unemployment. The steady state relationship in (4) is sometimes used as the microeconomic rationale for the appearance of the rate of unemployment in aggregate wage curves (see for example the textbook by Layard et al, 1991, p. 145). However, it is important to bear in mind that the relationship is indeed of steady-state nature, and it seems ill advised to condition on steady state in analyses aimed at identifying the role of out-of-steady-state phenomena, such as business cycles.

Given the large empirical literature that identifies an apparently stable relation between regional unemployment and regional wages, and the considerable number of studies that find a significant effect of regional unemployment on population movements between regions, one may question whether the lack of sound microeconomic foundation is of practical importance. We believe that it may be very important, and the reason is that the changes in the rate of unemployment not at all correlate well over time with a randomly selected individual's employment prospects. In particular, there are indications that the rate of unemployment behaves in a *pro-cyclical* fashion around the times of business cycle turning points (Gaure and Røed, 2003). There are two reasons for this. The first is simply that it takes time to level out the flows into- and out of unemployment. Consider for example a situation where labour demand eventually starts to pick up after a long recession. The rate of unemployment will then *continue to increase* as long as the inflow to the unemployment pool is larger than the outflow, even when both the inflow decreases and the outflow increases, and hence employment prospects improve for everyone (given their labour market status). The second reason is that the composition of the unemployment pool changes over the business cycle. At a business cycle trough, there is typically a large fraction of long-term unemployed with poor individual employment prospects. In addition, those that enter unemployment at this stage of the cycle may also be a negatively selected group. As a consequence, the outflow from unemployment may pick up rather slowly.

3. Computing adjusted outflow rates

In this paper, we seek to develop a regional indicator of labour market tightness that *only* reflects the changes in aggregate labour demand, i.e. the changes in job prospects *as perceived by any given person*. For that purpose, we have collected register data of individual unemployment spells in Norway from 1990-1999 on a monthly basis. The total number of observations is more than 10 million. However, given our focus on the development of wages in the manufacturing sector, we also study the sub-population of unemployed with a previous job in this sector. The data is described in Table 1.

- Table 1 about here -

We use these data to estimate the pure calendar time variation in the transitions from unemployment to employment, under the assumption that the calendar time variation affects the transition rate in a proportional way. However, since the data are discrete, we must formulate the model in terms of monthly transition probabilities. To be specific, let the probability p of transiting from unemployment to employment for a person i, living in region j, during calendar month t be expressed as follows

$$\begin{gathered} p(x_{it}, t, j, d, v_i) = 1 - \exp(-\sigma(t, j)\lambda(d)h(x_{it})v_i), \\ i = 1, ..., N, \;\; j = 1, ..., 90, \;\; t = 1990.1, ..., 1999.12, \;\; d = 1, ...48, \end{gathered} \tag{5}$$

where x_{it} is a vector of individual characteristics (age, education, gender etc.), d is spell duration, and v_i is a person-specific unobserved covariate. Equation (5) is the discrete version of a so-called Mixed Proportional Hazard rate model. The parameters of interest in the present setting are those embedded in the term $\sigma(t, j)$, i.e. the regional business cycle effects. In order to avoid arbitrary parametric restrictions, *we only use (exponentiated) dummy variables*. We estimate separate business cycle effects for each region and for each calendar year, implying that $\sigma(t, j)$ contains 900 parameters to be estimated. We estimate spell duration effects with the aid of 48 spell duration dummy variables. The vector of personal characteristics x_{it} contains 34 age dummies, 8 education dummies, and dummies indicating gender, marital status, nationality and access to part-time work. Unobserved heterogeneity is handled non-parametrically by assuming that the unobserved variables v_i is discretely distributed (Lindsay 1983), with the number of mass-points chosen by adding points until an Information Criterion is satisfied or until it is no longer computationally feasible to add more points. Let B_i be the number of spells experienced by individual i during the whole estimation period. Let $y_{ib}=1$ if spell number b of individual i ends in a transition (non-censored), and zero otherwise, let d_{ib} be the duration of that spell. Let W be the number of mass points in the distribution of unobservables and let π_w be the probability that the unobserved covariate obtains the value v_w. The likelihood function in terms of observations of (d_{ib}, y_{ib}, t, x_{it}) is then given as

$$L = \prod_{i=1}^{N} \sum_{w=1}^{W} \pi_w \prod_{b=1}^{B_i} \left(\left(p(x_{it}, t, j, d_{ib}, v_w) \right)^{y_{ij}} \prod_{s=y_{ib}}^{d_{ib}-1} \left(1 - p(x_{it-s}, j, t-s, d_{ib}-s, v_w) \right) \right), \quad \sum \pi_w = 1. \quad (6)$$

As a result of this procedure, we obtain separate business cycle indicators $\hat{\sigma}_{js}$ for each region j and each year s that are purged for any selection effects due to either observed or unobserved differences between the unemployed. In addition, of course, we obtain estimates of the structural duration dependence and of the effects of individual characteristics, but it is beyond the scope of this paper to present these results (they are available upon request). The model is estimated for all unemployed, and for unemployed with an attachment to the manufacturing sector. For the latter model, we used the Hannan-Quinn information criterion to select the preferred model, and ended up with five mass-points in the mixing distribution. However, the exact number of mass-points turned out to have virtually no effect on the business cycle indicator, insofar as at least two points were allowed. For this reason, we limited the number of mass-points to two in the larger model comprising all unemployment spells. With more than 10 million observations, huge computational resources are required to estimate the model with a larger number of mass-points.

Figure 1 illustrates the difference between our estimated business cycle indicator and the rate of unemployment. The business cycle indicator is normalised such that it gives the predicted average monthly exit probability for an unemployed unmarried Norwegian man (aged 35, 12 years of education, one month spell duration). According to the yearly averages of the estimated indicator, the labour market reached a trough in 1992, the recovery took a break in 1994, and it peaked in 1998. According to the rate of unemployment, these developments all occurred one year later. This is basically in line with the results in Røed (2001) and Gaure and Røed (2003), based on monthly national business cycle indicators.

- Figure 1 about here-

4. Panel data analyses of wages and migration

4.1 Introduction

In this section, we include the human capital adjusted outflow rate as explanatory variable in panel data analyses of regional wages and interregional migration. Compared to other Scandinavian studies of regional labour markets, one innovation of this study is that we use genuine local labour markets as regional unit. Other studies have used one of the two local administrative levels, the counties or the municipalities, as regional unit. However, local labour markets generally comprise more than one municipality, and most counties comprise several local labour markets.

Recently, Statistics Norway has divided the country into 90 travel-to-work areas, denoted regions, on the basis of information about commuting flows across municipal borders. Most data sources provide information about labour market variables at the municipal level. Fortunately, every amalgamation of municipalities during the nineties has involved municipalities from the same region. Therefore, we are able to compute consistent time series of variables at the regional level if consistent time series of labour market variables at the municipal level are available.

Annual and comparable data on wages at the municipal level are available for manufacturing only. Our dependent variable in the panel data analysis of regional wages is the nominal hourly manufacturing wage rate. The wage and migration analyses are based on the 89 (out of 90) regions for which a complete set of variables are available. Consistent time series of manufacturing wages are available until 1998. Since the wage equation includes lagged dependent variable, and we use lags of regional labour market variables as instruments, the estimation period is 1992-1998.

Annual data on population movements to and from each municipality are collected by the social security offices. Since every municipality is uniquely assigned to one and only one region, we are able to compute net flows for each region. Our dependent variable in the panel data analysis of regional population movements is net in-migration scaled by beginning-of-year population.

Table 2 presents the two dependent variables and the explanatory variables. Outflow1 is the human capital adjusted outflow rate for the total sample of unemployed persons, whereas outflow2 is based on the subsample of unemployed with a previous job in the manufacturing sector. The two outflow variables are strongly correlated, and as we will see, they produce quite similar results in the analysis of manufacturing wages.

- Table 2 about here -

We consider two alternative unemployment variables: open unemployment includes persons registered as unemployed, whereas total unemployment also includes participants of labour market programs.[4] The vacancy rate is a flow measure of vacancies; a stock measure produces virtually identical results. The data sources for all variables are Statistics Norway and the national Labour Market Agency.

The regional labour market variables are highly correlated: The two outflow rates are negatively correlated with the unemployment rates and positively correlated with the vacancy rate, the vacancy rate is negatively correlated with the unemployment rates, and there is very strong correlation between open and total unemployment.

4.2 Regional wages

We first report results for regional wages. The wage equation to be estimated takes the form

[4] Regional time series of total unemployment are available from 1993.

$$\log\left(Wage\right)_{it} = \alpha_1 \log\left(Wage\right)_{it-1} + \alpha_2 \log\left(Value\ added\right)_{it} + \log\left(\mathbf{LABOUR}\right)_{\mathbf{it}} \boldsymbol{\alpha}_{\mathbf{3}}$$
$$+\alpha_t + \alpha_i + \varepsilon_{it}, \tag{7}$$

where subscript i and t refer to region and year, respectively. $Wage_{it}$ is hourly manufacturing wage costs. $Value\ added_{it}$ is manufacturing value added at factor prices per hour worked. $\mathbf{LABOUR}_{it}$ is a vector of regional labour market variables listed in Table 2, α_t is a set of time dummies included to control for aggregate effects common to all regions, α_i represents unobservable time invariant regional specific effects, and ε_{it} is a random error term assumed to be identically and independently distributed.

Given the short time period, it is difficult to discriminate between alternative dynamic specifications. However, preliminary analyses suggest that the regional wage dynamics can be adequately represented by a simple partial adjustment formulation where the explanatory variables are included without lags.

Since the wage equation includes lagged dependent variable, the within-groups estimators are biased. Furthermore, regional labour market variables and value added per hour worked should be regarded as potentially endogenous because employment decisions of firms depend on wages. To obtain consistent estimates, we apply the GMM system estimator suggested by Arellano and Bover (1995) and Blundell and Bond (1998). The GMM system estimator uses both equations in first-differences in which regional specific effects are eliminated, and equations in levels. Endogenous variables lagged two years or more are valid instruments in the differenced equations if there is no serial correlation in the random error term. The levels equations require instruments which are orthogonal to the regional effects. As shown in Blundell and Bond (1998), lags of first-differences may be uncorrelated with the regional effects even if the levels are correlated with the effects. We use all explanatory variables lagged two and three years as instruments in the differenced equations and one lag of their first-differences as instruments in the levels equations.

Table 3 presents wage equations with alternative combinations of regional labour market variables. In all equations, the diagnostic test statistics indicate that the instruments are valid: the Arellano and Bond (1991) test of serial correlation suggests that the error terms are white noise, and the orthogonality restrictions are accepted by the Sargan test. However, it is well known that the Sargan test may have low power in finite samples, cf. Bowsher (2002). To have some indication of the power of the test, we estimated the wage equations with endogenous variables lagged one year as additional (but invalid) instruments in the transformed equations. The test now overwhelmingly rejects the null hypothesis of instrumental validity.[5]

- Table 3 about here -

The point of departure is a wage equation corresponding to the standard regional wage curve. Equation (3.1) therefore includes the rate of open unemployment. The estimated short-run unemployment effect is negative and statistically significant (p-value equal to 0.06). The long-run unemployment elasticity of wages is –0.063, which is comparable to the estimate in the preferred equation reported for Norway in Blanchflower and Oswald (1994) but well below the estimates of Dyrstad and Johansen (2000) and Raaum and Wulfsberg (2000).

Equation (3.2) includes the estimated outflow rate based on all unemployed, whereas (3.3) includes the outflow rate for manufacturing workers. In both cases, the estimated effects are positive and highly significant. The short-run effects are very similar, and the derived long-run elasticities are approximately 0.17. The long-run effect implies that increasing the outflow rate from one standard deviation below the mean value to one standard deviation above will increase manufacturing wages by 8.7%. The consequence of reducing the rate of open unemployment by two standard deviations around the mean is a wage increase of 5%. The conclusion so far is that the outflow rate performs better than open unemployment both in terms of statistical and economic significance.

Equation (3.4) to (3.6) contains the outflow rate (based on unemployed manufacturing workers) along with alternative measures of regional labour market tightness.[6] Both open unemployment and total unemployment enter with the wrong sign, whereas the estimated effect of the vacancy rate is positive as expected, but statistically insignificant from zero. The

[5] The same check was performed in the analysis of migration reported below - with the same conclusion. It should be noted that although this result provides some indication of the power of the Sargan test in *our context*, the results cannot be generalised.

[6] Although the results in equation (3.2) and (3.3) are very similar, outflow2 performs better than outflow1 when other regional labour market variables are included in the wage equation.

estimated effect of the outflow rate is rather robust, but becomes somewhat weaker and statistically insignificant (at conventional levels) when the vacancy rate is included. As a robustness check we re-estimated equation (3.3) with 19 county dummies included in the levels equations.[7] Equation (3.7) shows that all estimates are virtually unchanged: the effect of the outflow rate increases slightly and remains statistically significant while the estimated effect of open unemployment remains positive and insignificant.

To test for parameter stability over time, we re-estimated the wage equations including a break dummy interacted with the explanatory variables. The sample break is 1995/96. Using equation (3.3) the pre-break estimate of the outflow rate is 0.057 whereas the post-break estimate is 0.067. The difference is statistically insignificant as the t-value is only 0.25. Similar results were obtained based on the other equations reported in Table 3.[8]

We finally note a positive and significant effect of value added on wages. The long-run insider weight approximates 0.25 which is fairly consistent with the results in Johansen (1996) using panel data for Norwegian industries at the aggregate level, but well above the results in Dyrstad and Johansen (2000) using data for manufacturing wages and unemployment at the municipality level.

4.3 Interregional migration

We now examine whether the adjusted outflow rate can explain variations in population movements between regions. The migration equation to be estimated is

$$Inmigration_{it} = \beta_1 \log\left(Wage\right)_{it} + \log\left(\mathbf{LABOUR}\right)_{\mathbf{it}} \boldsymbol{\beta_2} + \beta_t + \beta_i + u_{it}, \tag{8}$$

where $\mathbf{LABOUR_{it}}$ is the vector of regional labour market variables used above. Since we estimate the equation with data on migration flows for the whole population, we use the estimated outflow rate based on all unemployed (outflow1). All explanatory variables are scaled by their respective aggregate means, β_t and β_i represent time and region specific

[7] These dummies are included to control for regional differences in the wage level, and are removed from the equations in first-differences.
[8] Detailed results are available from the authors on request.

effects, respectively, and u_{it} is an error term assumed to be iid. Preliminary analyses suggest that we can neglect lags both in the left-hand side variable and in the explanatory variables.

All explanatory variables may be affected by population flows and should be considered potentially endogenous. We therefore apply the system GMM estimator described in Section 4.2. The set of instruments used in the first-differenced equations includes the second and third lags of the endogenous variables, whereas the first lag of their differences is used in the levels equations.

Table 4 presents results for the migration equation with alternative combinations of regional labour market variables. From the table, we note that all diagnostic tests are well below their respective critical values.

- Table 4 about here -

We start with a traditional migration equation with open unemployment and compare the result with a 'competing' equation with the human capital adjusted outflow rate. The estimated effect of open unemployment is negative, which is consistent with the findings of most panel data studies of interregional migration,[9] whereas the effect of the outflow rate is positive. Both effects are highly significant when only one of these labour market variables is included; cf. equations (4.1) and (4.2). The estimated effects on migration flows are substantial. The coefficient reported in equation (4.2) implies that increasing the outflow rate from one standard deviation below mean to one standard deviation above mean raises net in-migration by 0.97, which is 1.5 times the standard deviation of net in-migration. A corresponding decrease in open unemployment raises net in-migration by 0.95.

When the outflow rate and the rate of open unemployment are combined in equation (4.3), their partial effects are reduced, but the estimates of both variables remain significant. Using these results we find that increasing the outflow rate by two standard deviations raises net in-migration by 0.53, which is slightly below the standard deviation of net in-migration. The effect of decreasing open unemployment by two standard deviations is almost exactly equal.

[9] See Carlsen (2000) for Norwegian evidence and Westerlund (1997) and Fredriksson (1999) for Swedish evidence concerning labour market effects on interregional migration.

Total unemployment is included in equation (4.4) as an alternative to open unemployment, whereas equation (4.5) includes the vacancy rate. The coefficients of these variables are small in absolute value and clearly insignificant, and the vacancy rate enters with the wrong sign. We also re-estimated equation (4.3) including 19 county dummies in the levels equations, see note 7 above. Interestingly, the estimated effect of the outflow rate reported in equation (4.6) is highly significant and well above the corresponding estimate without county dummies. On the other hand, the coefficient of open unemployment is now positive and insignificant. These results indicate that the estimated unemployment effects reported in equation (4.1) and (4.3) are mainly driven by cross section variation.

The outflow effect on migration flows is fairly stable over time. Based on equation (4.2) we find a pre-break estimate of 1.711 whereas the post-break estimate is 2.124. Again, the difference is statistically insignificant (t-value = 0.96).

All migration equations include the manufacturing hourly wage rate. Most estimated wage effects are positive, but statistically insignificant. The exceptions are equation (4.5), where the coefficient is significantly above zero, and equation (4.6), where the coefficient is negatively signed.

We finally report results using information on regional net in-migration for different population groups according to age, gender and education level. The results in Table 5 show that the outflow rate has a positive and statistically significant effect on net in-migration for all groups whereas the estimated unemployment effect is always insignificant from zero.

- Table 5 about here -

4.4 Results using raw outflow rates

So far we have reported results using human capital adjusted outflow rates that are purged from selection effects. A final question is how important it is to control for selection effects. The question is of practical relevance because the procedure that we use to compute adjusted outflow rates is both data intensive and computer intensive whereas raw outflow rates will be more easily accessible.

We have computed outflow rates with no controls for selection and re-estimated the wage and migration equations reported above using the raw outflow rates. Selected results are reported in Table 6 where the raw outflow rate used in the wage equations is based on data for unemployed manufacturing workers whereas the outflow rate used in the migration equations is based on all unemployed.

- Table 6 about here -

The raw outflow rate performs well in both models when outflow is included as the only labour market tightness indicator, and the estimated effects are close to the estimates obtained with the human capital adjusted outflow rates. The effects of the raw outflow rates are somewhat smaller and less significant compared to the results based on adjusted rates when the models are expanded with open unemployment. This is especially the case for the migration equation (6.5) that should be compared with (4.3). We therefore conclude that the raw outflow rates do a good job in explaining regional wages and interregional migration, but controlling for selection effects represents a gain at the margin.

5. Conclusion

Empirical studies of regional wages and interregional migration are usually motivated by theories predicting that wages and migration flows depend on the transition rates between employment and unemployment. The regional unemployment rate is routinely included as a proxy for these transition rates. However, due to: i) lags between the flows into- and out of unemployment and the unemployment stock and ii) compositional changes over the business cycle in the unemployment pool, changes in the stock of unemployed persons do not reflect pure time variation in the employment prospects of any given person.

In this paper, we have used a large Norwegian micro data set with information about individual unemployment spells during the nineties to compute regional estimates of a human capital adjusted outflow rate that is purged from selection effects due to observed or unobserved differences between unemployed persons. The adjusted outflow rate has a positive and statistically significant impact on both regional wages and net in-migration to regions. With few exceptions, the adjusted outflow rate outperforms alternative regional labour market indicators, and renders these variables superfluous in models of both regional wage formation and interregional migration. Our results can be interpreted as supportive evidence of theories of wage formation and interregional migration that emphasise transition rates between employment and unemployment, but suggest that the empirical implementation of the theories deserve more attention.

Policymakers may prefer to use raw rather than adjusted outflow rates for policy purposes as the former do not require detailed information about each unemployed person and therefore can be computed faster and at a much lower cost. Our results suggest that raw outflow rates perform quite well in wage and migration equations although not as well as human capital adjusted outflow rates.

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Table 1 Descriptive statistics: Variables used to estimate outflow rates

	All unemployed	Manufacturing
Time period covered	1990.1-1999.12	1990.1-1999.12
Age group	25-59	25-59
Number of observations (total months of unemployment)	10,125,364	2,573,237
Number of unemployment spells	1,039,812	270,992
Number of individuals	589,591	163,937
Number of local regions	90	90
Average unemployment months per individual	17.17	15.70
Average months per spell	9.74	9.50
Average transition rate	0.07	0.08
Fraction women	0.53	0.20

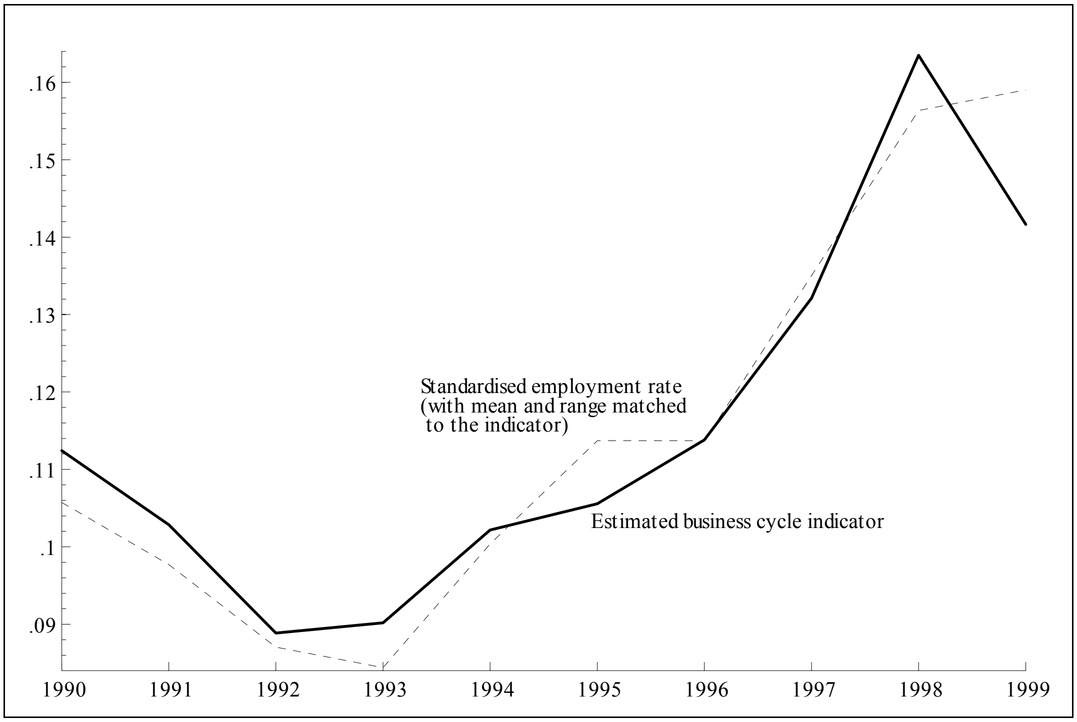

Figure 1. Average estimated business cycle indicators for each year and the standardised employment rate (1-standardised unemployment rate).

Table 2 Definitions and descriptive statistics: Variables used in panel data analyses

Variable	Definitions	Mean	St.dev
Log wages (lw)	The natural logaritm of hourly manufacturing wages	4.893	0.127
Net in-migration rate (m)	Net in-migration to region i divided by beginning-of-year population (in percent)	-0.100	0.650
Outflow rate (outflow1)	Estimated outflow rate from unemployment, all unemployed. See text for details.	0.136	0.034
Outflow rate, manufacturing (outflow2)	Estimated outflow rate from unemployment, unemployed with previous job in manufacturing. See text	0.136	0.035
Open unemployment (uopen)	Registered unemployed scaled by labour force	0.050	0.019
Total unemployment (utot)	Sum of registered unemployed and labour market slots scaled by labour force	0.072	0.031
Vacancy rate (vac)	Annual inflow of vacancies scaled by labour force in county	0.170	0.050
Log value added (lva)	The natural logaritm of value added per hour worked in manufacturing	5.367	0.265

Partial correlations

	lw	m	outflow1	outflow2	uopen	utot	vac
m	0.154						
outflow1	0.420	0.100					
outflow2	0.368	0.101	0.872				
uopen	-0.438	-0.222	-0.787	-0.693			
utot	-0.511	-0.176	-0.775	-0.681	0.967		
vac	0.401	-0.186	0.583	0.441	-0.388	-0.402	
lva	0.615	0.164	0.185	0.182	-0.206	-0.257	0.080

Table 3 Estimated wage equations – left-hand side variable is log (wage)

	(3.1)	(3.2)	(3.3)	(3.4)	(3.5)	(3.6)	(3.7)
log (wage (-1))	0.603	0.612	0.635	0.638	0.644	0.657	0.601
	(10.6)	(10.3)	(11.5)	(11.2)	(11.5)	(13.1)	(9.68)
log (value added)	0.104	0.097	0.092	0.092	0.096	0.102	0.086
	(3.53)	(3.29)	(3.00)	(2.97)	(3.32)	(3.37)	(2.73)
log (uopen)	-0.025	-	-	0.004	-	-	0.006
	(1.60)			(0.19)			(0.24)
log (outflow1)	-	0.066	-	-	-	-	-
		(2.22)					
log (outflow2)	-	-	0.061	0.064	0.050	0.031	0.070
			(2.44)	(2.05)	(1.64)	(1.53)	(2.16)
log (utot)	-	-	-	-	0.011	-	-
					(0.53)		
log (vacancy rate)	-	-	-	-	-	0.013	-
						(0.67)	
Sargan (p-value)	0.267	0.343	0.214	0.210	0.283	0.557	0.636
AR(1)	-4.867	-4.831	-4.914	-4.893	-5.020	-4.907	-4.940
AR(2)	-1.621	-1.386	-1.607	-1.628	-1.601	-1.547	-1.621
Sample period	1992-98	1992-98	1992-98	1992-98	1993-98	1992-98	1992-98
County dummies	No	No	No	No	No	No	Yes

Notes: Estimates with one-step robust t-statistics in parentheses. Estimation method is GMM-SYS, see Blundell and Bond (1998). All equations include time dummies. Sargan is the Sargan (1958) test for instrumental validity, AR(i) is the Arellano and Bond (1991) test for serial correlation of order i based on the transformed residuals. Number of regions is 89.

Table 4 Estimated migration equations – left-hand side variable is net in-migration rate

	(4.1)	(4.2)	(4.3)	(4.4)	(4.5)	(4.6)
log (wage)	1.070	1.168	0.918	1.799	2.241	-0.580
	(0.87)	(0.87)	(0.72)	(1.17)	(1.94)	(0.46)
log (uopen)	-1.188	-	-0.686	-	-	0.344
	(4.78)		(2.10)			(0.99)
log (outflow1)	-	1.892	1.039	1.855	2.597	2.162
		(4.94)	(2.30)	(3.28)	(5.40)	(4.67)
log (utot)	-	-	-	-0.016	-	-
				(0.05)		
log (vacancy rate)	-	-	-	-	-0.164	-
					(0.42)	
Sargan (p-value)	0.309	0.318	0.258	0.162	0.322	0.319
AR(1)	-4.981	-5.407	-5.248	-4.649	-5.643	-5.537
AR(2)	0.729	0.132	0.280	-0.558	-0.344	-0.104
Sample period	1992-98	1992-98	1992-98	1993-98	1992-98	1992-98
County dummies	No	No	No	No	No	Yes

Notes: Dependent variable is net in-migration to region i in year t, as a percentage of beginning-of-year population. Estimates with one-step robust t-statistics in parentheses. Estimation method is GMM-SYS, see Blundell and Bond (1998). All equations include time dummies. Sargan is the Sargan (1958) test for instrumental validity, AR(i) is the Arellano and Bond (1991) test for serial correlation of order i based on the transformed residuals. Number of regions is 89.

Table 5 Migration regressions for different population groups

	Age 16-66	Age 16-39	Age > 40	Male	Female	College Degree	Not College Degree
Mean (st. dev) of dependent variable	-0.300 (0.740)	-0.653 (1.225)	0.074 (0.302)	-0.126 (0.681)	-0.073 (0.663)	-1.775 (1.600)	-0.048 (0.749)
log (wage)	-0.580 (0.46)	0.740 (0.34)	-0.396 (0.89)	0.345 (0.29)	0.404 (0.29)	6.155 (2.45)	-0.308 (0.19)
log (uopen)	0.344 (0.99)	0.518 (0.76)	0.196 (1.00)	0.426 (0.97)	0.003 (0.01)	0.222 (0.21)	0.190 (0.36)
log (outflow1)	2.162 (4.67)	3.901 (4.79)	0.748 (3.13)	2.308 (3.85)	1.402 (2.34)	3.074 (2.50)	2.281 (3.34)
Sargan (p-value)	0.277	0.153	0.393	0.318	0.307	0.242	0.641
AR(1)	-5.439	-5.000	-5.618	-4.379	-5.362	-4.635	-5.323
AR(2)	-0.200	0.260	0.986	-0.778	-0.226	1.362	-1.402
Time period	1992-98	1992-98	1992-98	1993-98	1993-98	1993-98	1993-98
County dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Dependent variable is net in-migration to region i in year t, as a percentage of beginning-of-year population. Estimates with one-step robust t-statistics in parentheses. Estimation method is GMM-SYS, see Blundell and Bond (1998). All equations include time dummies. Sargan is the Sargan (1958) test for instrumental validity, AR(i) is the Arellano and Bond (1991) test for serial correlation of order i based on the transformed residuals. Number of regions is 89.

Table 6 Results using raw outflow rates

	Wage equations			Migration equations		
	(6.1)	(6.2)	(6.3)	(6.4)	(6.5)	(6.6)
log (wage)	-	-	-	1.355	0.997	-0.758
				(1.01)	(0.795)	(0.59)
log(wage(-1))	0.633	0.629	0.590	-	-	-
	(11.80)	(11.30)	(9.51)			
log (value added)	0.089	0.090	0.082	-	-	-
	(2.88)	(2.91)	(2.54)			
log(raw outflow)	0.054	0.048	0.053	1.687	0.549	2.516
	(2.44)	(1.72)	(1.72)	(4.15)	(1.09)	(4.65)
log (uopen)	-	-0.007	-0.000	-	-0.931	0.614
		(0.33)	(0.01)		(2.72)	(1.51)
Sargan (p-value)	0.178	0.248	0.523	0.318	0.191	0.293
AR(1)	-4.904	-4.829	-4.895	-5.283	-5.118	-5.472
AR(2)	-1.705	-1.711	-1.762	0.461	0.521	0.077
County dummies	No	No	Yes	No	No	Yes

Notes: Estimates with one-step robust t-statistics in parentheses. Estimation method is GMM-SYS, see Blundell and Bond (1998). All equations include time dummies. Sargan is the Sargan (1958) test for instrumental validity, AR(i) is the Arellano and Bond (1991) test for serial correlation of order i based on the transformed residuals. Sample period is 1992-98, number of regions is 89.