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The impact of ageing on regional employment:
Linking spatial econometrics and population projections for a scenario analysis of future labor market outcomes in the Nordic regions

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Abstract

Ageing is a key challenge for many countries. The purpose of this paper is to simulate how ageing affects future regional labour market outcomes. We develop a simulation procedure based on data for 71 Nordic regions in Finland, Norway, Sweden and Denmark. The procedure combines spatial econometrics and population projections for scenario analyses of future employment patterns up to 2021. Compared to a "benchmark scenario" based on projections of the working age population, we find that predicted regional labour market outcomes tell a much richer story when estimation results and population projections are combined. To this end, our results can be helpful for economic policymaking, which is constantly in need of accurate regional labor market forecasts.

Keywords: regional employment, ageing, spatial econometrics, scenario analysis

JEL Classification Codes: R11, R23, J11, J21, J26

1. Introduction

The need to alleviate regional labour market imbalances remains a continuing concern in the long-run for many countries. This is particularly so for Nordic regions characterised by moderate size, sparse population and rapid ageing. For policy makers, the crucial question arises whether labour market resources in these regions can be sustained in the long run or whether the ageing process represents a real threat to the vitality of such regions. The standard approach in the economic literature to answer this question is to proxy the effects of ageing on

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the labour market by utilising available population projections. However, the present paper goes one step further by taking into account both regional heterogeneity in population projections and heterogeneity in the labour market behaviour of different age groups across regions and their neighbourhoods for a scenario analysis of regional labor employment patterns. We implement the proposed scenario approach for 71 Nordic regions in order to identify future regional employment shortcomings up to 2021. The results indicate that the predicted average regional decline in employment is up to two-third higher when spatial heterogeneity of labour market behaviour is included in the predictions.

The remainder of the paper is organized as follows: Section 2 gives a brief motivation for the linkage between regional labor market behaviour and population ageing. Building on this conceptual background, Section 3 presents the estimation results on regional heterogeneity in labour market behaviour for regional labor markets in Nordic regions associated with elaborate welfare systems. The estimation results are then used in Section 4 in combination with population projections up to 2021 to assess future employment patterns in these regions. We compare the results of our scenario analysis with a “benchmark” case solely based on population predictions. Section 5 provides some concluding remarks.

2. Linking regional labour market behaviour and population ageing

The likely impacts of population ageing on the functioning of economic systems are manifold. Throughout this paper, we focus on a scenario approach for the regional employment rate as a key variable for policy making. Employment is an important source of the local tax base and thus crucial for public service provision (see Tiebout, 1956). In the absence of earnings from regional employment as a tax base to ensure the local public provision of goods, some regions may be disadvantaged see e.g. Nechyba (1996) and Josselin *et al*. (2009). This is particularly important for the Nordic countries,[1] where taxation on personal income ranges from 23.2 percent (Norway) of total taxes to 50.7 percent (Denmark), as compared to an OECD average of 24.1 percent.[2] Developing methods to analyse future regional employment patterns is therefore an important task as the ageing process progresses.

The effects of ageing on regional labour market outcomes have predominantly been illustrated by combining traditional population projections of the working age cohort with different assumptions on labour market behaviour in terms of labour market participation; see, for instance, Boersch-Supan (2001). However, such a static approach only offers partial insights into the future regional labour market outcomes. On the one hand, official population projections consider the future population in different age groups taking into account regional differences in fertility and mortality rates as well as migration propensities within and between countries. On the other hand, however, the projections do not account for regional heterogeneity and neighbourhood effects in modelling labour market behaviour. This is a crucial limitation as labour market adjustments may materialise through various channels (see, e.g., Decressin and Fatás, 1995). Changes in labour market behaviour caused by ageing are also highlighted in simulation exercises based on theoretical models; see Burniaux *et al*. (2004) and Dixon (2003).

Therefore, the scenario approach offered here combines estimated differences in regional labour market behaviour with population projections to attain a prediction of the regional employment outcomes from ageing. To do so, we start with the specification of a region *i*’s employment rate (*Erate*) defined as the share of employed persons in the region´s working

[1] Nordic countries have during the 1990’s reformed their tax system into a dual tax system separating taxation on labour income and capital income. This has also been adapted other OECD countries, see Birch Sørensen (2010).
[2] See http://www.oecd.org/ctp/tax-policy/revenue-statistics-tax-structures.htm

age population. To assess the mutual drivers in regional labor market behaviour, we can decompose the *Erate* into the following terms:

$$Erate_{i,t} = \frac{E_{i,t}}{WP_{i,t}} = \frac{E_{i,t}}{L_{i,t}} \times \frac{L_{i,t}}{POP_{i,t}} \times \frac{POP_{i,t}}{WP_{i,t}}, \tag{1}$$

where i and t are cross-sectional (regional) and time indices, respectively, E is the number of employed in a region, WP is the working age population, L is the labour force and POP is the total population. Equation (1) states that the employment rate is a product of the employment per labour force (E/L), activity rate (L/POP) and total age ratio (POP/WP). Based on the time derivative of equation (1) and using the *Divisia index*, a change in the employment rate can be approximated by the sum of changes in employment per labour force, activity rate and total age ratio. Furthermore, given that employment per labour force (E/L) can also be expressed in terms of the unemployment rate (U/L),[3] the change in the employment rate can be approximated by:

$$\Delta\frac{E_{i,t}}{WP_{i,t}} = -\Delta\frac{U_{i,t}}{L_{i,t}} + \Delta\frac{L_{i,t}}{POP_{i,t}} + \Delta\frac{POP_{i,t}}{WP_{i,t}}, \tag{2}$$

where Δ refers to the time derivative. The first term in equation (2) reflect that an increase in the employment per labour force relates to a corresponding decrease in the unemployment rate. The second term in equation (2) reflects that an increase in the activity rate in turn should increase the employment rate as long as most of the persons entering the labour market find employment. Finally, the third term reflects that as the number of persons outside the working ages rises, this should also impact the employment rate since school age children and retired people are not in employment. The third term can therefore change if either the population under or over the working ages grows differently from the working age population. Thus, the third term can, in approximate terms, can also be written as:

$$\Delta\frac{POP_{i,t}}{WP_{i,t}} = \left(\Delta\frac{WP_{i,t}}{WP_{i,t}} + \Delta\frac{YOUNG_{i,t}}{WP_{i,t}} + \Delta\frac{OLD_{i,t}}{WP_{i,t}}\right), \tag{3a}$$

where $YOUNG$ is the number of young persons in the population of age less than or equal to 15 years, OLD is the number of elderly people in the population of age 65 years or more, $YOUNG/WP$ is the young age ratio and OLD/WP is the old age ratio. Hence, equation (2) can be expressed as:

$$\Delta\frac{E_{i,t}}{WP_{i,t}} = -\Delta\frac{U_{i,t}}{L_{i,t}} + \Delta\frac{L_{i,t}}{POP_{i,t}} + \left(\Delta\frac{YOUNG_{i,t}}{WP_{i,t}} + \Delta\frac{OLD_{i,t}}{WP_{i,t}}\right) \tag{3b}$$

Equation (3b) allows identifying the relevant variables for empirical analyses of ageing effects on changes in the regional employment rate taking into account different labour market conditions and labour demand structures. For empirical estimation purposes, however, we need to transform this deterministic model setup into a stochastic model specification to obtain reliable behavioural labor market parameters as input for the scenario analysis. Moreover, we aim at adopting a flexible modelling approach, which starts from an unrestricted multiple-equation framework comprising the above identified variables and allows for the estimation of direct effects running from the age structure to regional employment rates as well as further indirect effects running through the regional labor market conditions.

[3] With $(E/L) = 1 - (U/L)$.

3. Estimating the direct and indirect effects of ageing on regional employment

Using harmonized data for 71 Nordic regions in Finland, Norway, Sweden and Denmark over the period 1991 to 2005, we thus setup a three-equation system to capture the direct and indirect effects of ageing on changes in the employment rate as:[4]

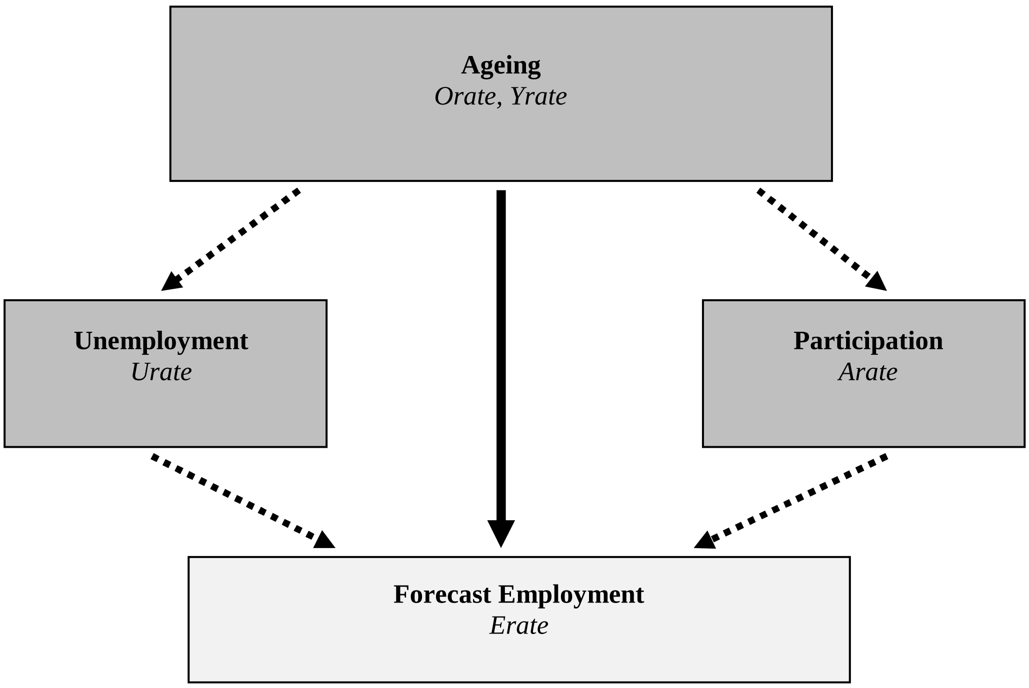
$$\Delta Erate_{i,t} = \iota + \alpha_{Erate} \times L.\Delta Erate_{i,t} + \beta_{1,Erate} \times L.\Delta Yrate_{i,t} + \beta_{2,Erate} \times L.\Delta Orate_{i,t} + \beta_{3,Erate} \times L.\Delta Urate_{i,t} + \beta_{4,Erate} \times L.\Delta Arate_{i,t} + \varepsilon^{E}_{i,t} \tag{4a}$$

$$\Delta Urate_{i,t} = \iota + \alpha_{Urate} \times L.\Delta Erate_{i,t} + \beta_{1,Urate} \times L.\Delta Yrate_{i,t} + \beta_{2,Urate} \times L.\Delta Orate_{i,t} + \beta_{3,Urate} \times L.\Delta Urate_{i,t} + \beta_{4,Urate} \times L.\Delta Arate_{i,t} + \varepsilon^{U}_{i,t} \tag{4b}$$

$$\Delta Arate_{i,t} = \iota + \alpha_{Arate} \times L.\Delta Erate_{i,t} + \beta_{1,Arate} \times L.\Delta Yrate_{i,t} + \beta_{2,Arate} \times L.\Delta Orate_{i,t} \; \beta_{3,Arate} \times + L.\Delta Urate_{i,t} + \beta_{4,Arate} \times L.\Delta Arate_{i,t} + \varepsilon^{A}_{i,t} \tag{4c}$$

where *Yrate* is the young age ratio (*YOUNG/WP*), *Orate* is the old age ratio (*OLD/WP*), *Urate* is the unemployment rate (*U/L*) and *Arate* is the activity rate (*L/POP*). *Yrate* and *Orate* are considered as exogenous with respect to the regional labor market system and are not modelled through explicit equations. The occurrence of *L.* indicates the use of a time lag operator; ι is a vector of ones, $\beta_{i,eq.}$ are variable coefficients and $\varepsilon^{E}, \varepsilon^{U}, \varepsilon^{A}$ are the equations' error terms. Direct employment effects of ageing stems from the inclusion of *Orate* and *Yrate* in (4a), while the system's other two equations capture the indirect effects of ageing on the employment rate running through the unemployment and activity rate channel. A schematic overview of the different impact channels of ageing on regional employment are given in Figure 1.

Figure 1. Direct and indirect effects of ageing on the employment rate



[4] Detailed source descriptions and summary statistics for the variables are given in Table A.1 of the appendix. In order to harmonise the data, a few imputations have been undertaken based on underlying indicators.

We estimate the 3-equation system using the seemingly unrelated regression estimator (SURE) for the pooled dataset.[5] Since the dependent variables and covariates are defined in first differences, there are no regional fixed effects included. A set of time trends has been included in the estimation of equations (4a)-(4c). Moreover, when using regional data the issue of spatial dependencies emerges. Dynamic models with spatial dependence have previously been considered for other countries and for the EU as a whole, see e.g. Elhorst (2005) or Blien *et al.* (2006). Recent overviews of space-time dynamic panel data modelling and forecasting approaches are given in Elhorst (2012) and Baltagi et al. (2014) among others. As a pre-test in order to check the magnitude of spatial dependence for the variables in focus, we compute a space-time augmented version of the standard Moran's *I* index (STMI) as recently proposed by Lopez et al. (2011). Table 1 shows that all variables with the exception of $\Delta Arate_{i,t}$ show a statistically significant degree of spatial correlation across Scandinavian regions.

Table 1. Test statistics of the STMI index for variables in labor market system

Variables	**STMI**	***P*-Value**
$\Delta Erate$	0.082***	(0.00)
$\Delta Urate$	0.075***	(0.00)
$\Delta Arate$	0.019	(0.21)
$\Delta Yrate$	0.066***	(0.00)
$\Delta Orate$	0.499***	(0.00)

Note: ***, **, * denotes statistical significance at the 1, 5 and 10% level, respectively.

We then address spatial dependency in a threefold manner: First, we capture neighborhood effects through a Spatial Durbin Model (SDM) framework by means of including spatial lags of the regressand and regressors for each equation in (4a) to (4c).[6] We use first-order contiguities to define spatial neighbors in the spatial weighting matrix **W**.[7] Spatial lags are then computed as **W***y for each variable y (as a stacked vector of observations according to $y=[y_{1,1},\ldots, y_{1,T}, \ldots, y_{N,1},\ldots y_{N,T}]$). Since we only include a time-lagged spatial lag of the dependent variable, the specification is also referred as space-time recursive model (see Anselin et al., 2007). The choice of this model puts certain restrictions on the functional form and implies that all explicitly modelled spatial effects are assumed to have a deferred effect on y. Although this modelling approach is a simplification compared to a full space-time dynamic approach, which also accounts for instantaneous spatial effects, this helps us to limit the degree of simultaneity in the equation system. Elhorst (2012) points out that the formulation of ex-ante restrictions may have the advantage of avoiding severe identification problems related to complex space-time dynamic panel model specifications. Thus, for the

[5] Note that SURE models can be estimated equation-by-equation using standard OLS if either error terms are uncorrelated or each equation contains exactly the same covariates on the right-hand-side (Kruskal's theorem) without loss of efficiency. See Greene (2003), chapter 14 for a reference on such special cases of the SURE model.

[6] Details on the Spatial Durbin Model framework are given in LeSage and Pace (2009).

[7] We use a standard 67x67 first-order queen contiguity matrix. Two regions are contiguous if they are neighbours not separated by the sea, in which case they are assigned an entry of 1 in the contiguity matrix. This requirement therefore removes Iceland, Bornholm in Denmark, Gotland in Sweden and Åland in Finland from the sample.

SDM approach each equation of the above 3-equation system will be extended as (below the exemplary case of equation (4a) is shown in its spatially extended form):

$$\begin{aligned}\Delta Erate_{i,t} &= \iota + \alpha_{Erate} \times L.\Delta Erate_{i,t} + \beta_{1,Erate} \times L.\Delta Yrate_{i,t} + \beta_{2,Erate} \times L.\Delta Orate_{i,t} \\ &+ \beta_{3,Erate} \times L.\Delta Urate_{i,t} + \beta_{4,Erate} \times L.\Delta Arate_{i,t} + \rho_{Erate} \times \sum_{j=1} w_{i,j} \times L.\Delta Erate_{j,t} \\ &+ \gamma_{1,Erate} \times \sum_{j=1} w_{i,j} \times L.\Delta Yrate_{j,t} + \gamma_{2,Erate} \times \sum_{j=1} w_{i,j} \times L.\Delta Orate_{j,t} \\ &+ \gamma_{3,Erate} \times \sum_{j=1} w_{i,j} \times L.\Delta Urate_{j,t} + \gamma_{4,Erate} \times \sum_{j=1} w_{i,j} \times L.\Delta Arate_{j,t} + \varepsilon^{E}_{i,t},\end{aligned} \tag{5a}$$

where $w_{i,j}$ is a typical element of the spatial weighting matrix **W** linking two regions *i* and *j* by means of their geographical location.

We control for a second type of spatial dependence by including country-specific time trends implying that the spatial dependence emerges from common trends for all regions in a single country. Finally, country-specific time dummies capture a more general form of deterministic spatial dependence. This implies cross-sectional dependence that can be interpreted as arriving from national shocks; see Jensen and Schmidt (2011). It is noticeable that contemporary values for covariates do not appear in any of the specifications, alleviating the problem of simultaneity and thus also the need for instrumental variable estimation, see e.g. Beenstock and Felsenstein (2007). Since the inclusion of further variables to control for spatial dependence reduces the degrees of freedoms for estimation, the lag operator for all variables is restricted to the order 1.

Turning to the estimation results, Table 2 reports the SURE regression output for the system of equations (4a) to (4c) including spatial lags and country-specific time dummies. In general, the results show that it is important to consider spatial dependencies in different forms.[8] A key result from Table 2 is that the effect of ageing on the employment rate is channelled through both direct and indirect effects. Thereby, the positive variable coefficient for *ΔOrate* in the equation for the employment rate indicates that an increasing share of elderly people in the total regional population also increases the employment rate. However, at the same time *ΔOrate* has a negative impact on the change in the activity rate, which filters through to the employment rate through the statistically significant positive variable coefficient for *ΔArate* in the equation for *ΔErate*. Whether one effect dominates the other will be further investigated in our scenario analysis. Given the supportive empirical results, we will apply the estimates from Table 2 including both types of spatial dependence for the scenario analysis to forecast future employment patterns.

The parameter estimates from (4a) to (4c) are therefore used to calculate long-run elasticities (θ) comprising the total effect of all included lags for a regressor. Since we include a contemporaneous spatial lag term of the dependent variable as well as a time lag, the total long-run impact of regressor *x* w.r.t regressand *y* can be calculated as:

$$\theta_{x,y} = z'\left[(1-\alpha)\times\mathbf{I} - \rho\mathbf{W}\right]^{-1} \times \left(\mathbf{I}\times\beta + \mathbf{W}\times\gamma\right) z \times (1/N)\,, \tag{6}$$

where α is the coefficient for the autoregressive lag specification of the regressand (*L.y*), while ρ measures the degree of spatial dependence stemming from the time-lagged spatial lag of *y*. Moreover, β is the associated coefficient measuring the conditional correlation between

[8] Cross-sectional dependence captured by the country-specific time dummies seems to be particularly important in the equations for *ΔErate* and *ΔArate*. Detailed regression outputs can be obtained from the authors upon request.

regressor ($L.x$) and y, while γ accounts for the impact of the time-lagged spatial lag term of regressor x on y. Finally, z is an $Nx1$ vector of ones (see also LeSage and Pace, 2009).

Table 2. SURE estimates for labor market system including spatial dependence

Dep. Var.	***ΔErate***	***ΔUrate***	***ΔArate***
L.ΔErate	-0.051*	0.239	0.023
	(0.028)	(0.324)	(0.026)
L.ΔUrate	0.016***	-0.028	-0.009***
	(0.003)	(0.036)	(0.003)
L.ΔArate	0.884***	-2.535***	0.039
	(0.037)	(0.423)	(0.0345)
L.ΔYrate	0.007	-0.176	0.027***
	(0.011)	(0.121)	(0.009)
L.ΔOrate	0.054***	0.089	-0.116***
	(0.019)	(0.227)	(0.018)
W* *L.ΔErate*	-0.009	0.506	0.004
	(0.042)	(0.479)	(0.038)
W* *L.ΔUrate*	-0.110**	0.231***	0.007
	(0.005)	(0.053)	(0.004)
W* *L.ΔArate*	0.0001	-0.729	0.067
	(0.053)	(0.601)	(0.049)
W* *L.ΔYrate*	-0.014	0.002	0.025
	(0.017)	(0.201)	(0.016)
W* *L.ΔOrate*	-0.048	0.402	0.057*
	(0.034)	(0.3389)	(0.032)
I: *F*-test country specific time dummies (*p-value*)	22.65***	3.40*	21.71***
	(0.00)	(0.07)	(0.00)
II: *F*-test *Δx*+ **W***Δx=0* (*p-value*)	84.69***	3.76**	2.19
	(0.00)	(0.05)	(0.14)
III: *F*-test *ΔYrate= ΔOrate* (*p-value*)	3.41*	0.82	35.45***
	(0.06)*	(0.37)	(0.00)
IV: *F*-test **W***ΔYrate*= **W***ΔOrate* (*p-value*)	0.64	0.69	0.69
	(0.42)	(0.41)	(0.41)
V: *F*-test **W***Δx*+ **W***Δy=0* (*p-value*)	1.16	4.85**	5.10**
	(0.28)	(0.03)	(0.02)
No. of lags per regressor	1	1	1

Source: Data from official statistical offices of Finland, Norway, Sweden and Finland.

Note: ***, **, * denotes statistical significance at the 1, 5 and 10% level, respectively. Unless explicitly stated, values in parenthesis are standard errors. Variables are in first differences to avoid problems of non-stationarity.

Five tests are offered: An *F*-test for the joint significance of country-specific time dummies (I), a test for joint significance of all parameter estimates (II), a test of the significance of decomposition of *ΔYrate* and *ΔORate* (III), a test for the significance of decomposition the spatial lags of *ΔYrate* and *ΔORate* (IV) and a test for the joint significance of all neighbourhood variables (V).

4. Scenario analysis of future regional employment patterns

Based on the long-run elasticities from equation (6) in conjunction with regional population projections offered by national statistical offices, equation (7) reflects our basic approach for the scenario analysis. Combining these elasticities with projected changes in regional age compositions, it is possible to forecast the change in the employment rate for a given region. The forecasted change in the employment rate is:

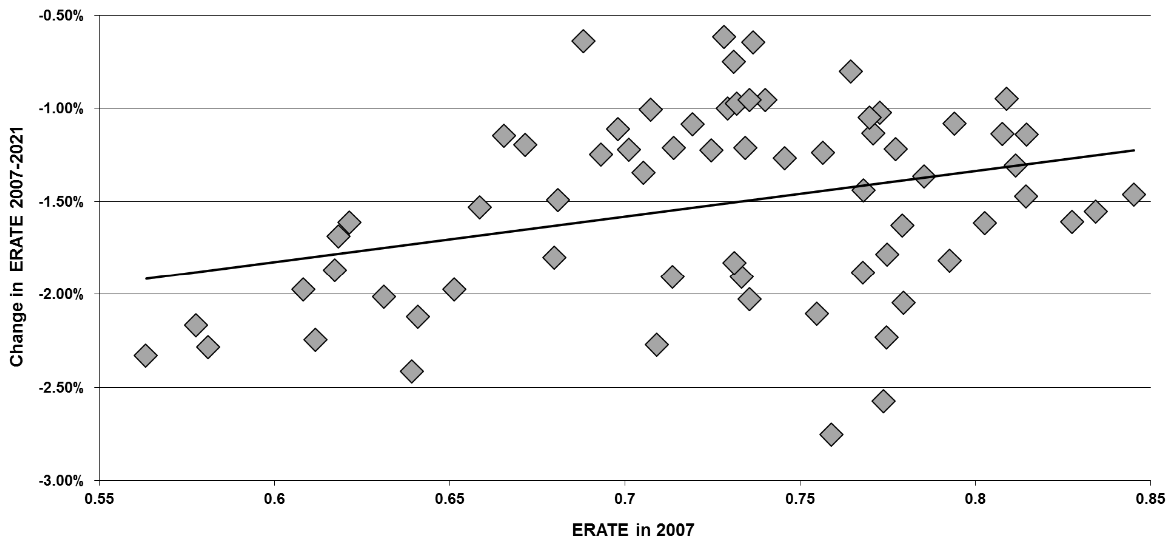
$$\Delta Erate_{i,t+n} = \sum_{m} \theta_{x_m,Erate} * \Delta POPSH^{m}_{i,t+n} \quad t=2007,\ n=1,\ldots\ldots,14 \tag{7}$$

where $\theta_{x_m,Erate}$ is the elasticity defined in equation (6) for the effect of the *m*-th regressor on the *Erate* and $\Delta POPSH^{m}_{i,t+n}$ is the associated change in the share of the population in age group *m* projected *n* periods into the future for region *i*, specifically *ΔYrate* and *ΔOrate*. While equation (7), however, indicates that only direct impacts (including neighborhood effects) of ageing on the employment rate are considered, the indirect effects are predicted through similar equations including long-run elasticities for the (spatially extended) equations (4b) and (4c) as illustrated above in Figure 1 (dashed lines). For example, the indirect employment effect emerging through the unemployment rate is determined by multiplying the two long-run elasticities for $\Delta POPSH^{m}_{i,t+n}$ on *ΔUrate* ($\theta_{x_m,Urate}$) and for *ΔUrate* on *ΔErate* ($\theta_{Urate,Erate}$) and calculate the quantitative impact of a change in the share of the population in age group *m* projected *n* periods into the future for region *i*.

A first step in the scenario analysis is then to compare the change in the employment rate in the Nordic regions from 2007 to 2021 to the level of the employment rate in 2007. This would indicate whether ageing processes would result in marked shifts in the employment rates of the different regions. As Figure 2 shows, a vaguely positive relationship emerges between the initial level of the employment rates in the Nordic regions and the scenario for future change (indicated by a correlation coefficient of 0.32, see trend line in Figure 2). Even so, there is a sizeable variation. This highlights the degree of regional heterogeneity in the response of labour market behaviour to ageing processes. It thus becomes important to determine whether these regional heterogeneities are the result of a straightforwardly uniform response to ageing through the direct effects of ageing on the employment rate or if more complex indirect labour market dynamics are required to render the full effect of ageing on labour market outcomes. Figure 3 offers an analysis of the relative magnitude of direct and indirect effects for the Nordic regions.

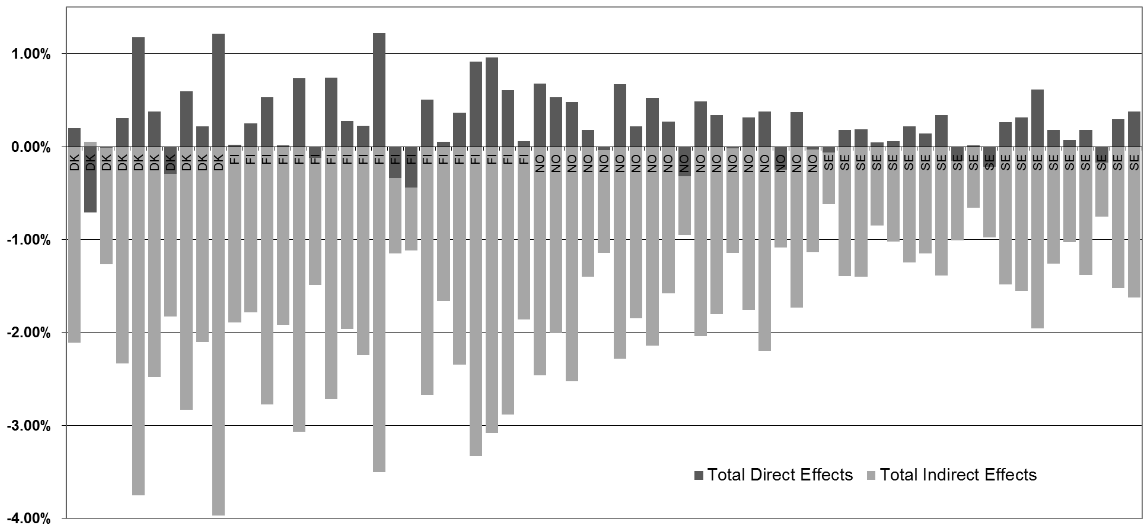
Figure 3 reveals that the regional heterogeneity in the predicted change of employment rates depends both on direct and indirect effects. While ageing has a moderately positive direct overall effect on the change in the employment rate, including the indirect effects changes the result significantly. This can be illustrated if we calculate the cross-regional average of the direct effect being 0.26 percentage points, while it is -1.78 percentage points for the indirect effect. Hence, ageing may be less of a problem if focussing on the potential for both the young and old to become employed, but adding aspects of unemployment and being inactive in the labour market changes this outcome substantially. Furthermore, marked differences remain in terms of the direct and indirect effects across the Nordic regions, which can also be seen by plotting geographical maps for the direct and indirect employment effects in Figure A.1 in the appendix.

Figure 2. Predicted changes in employment rate 2007-2021 and employment rate 2007



Source: Harmonised Nordic regional data and own calculations; based on estimates from Table 2.

Figure 3. Direct and indirect employment effects of ageing in 2007-2021 (in %)



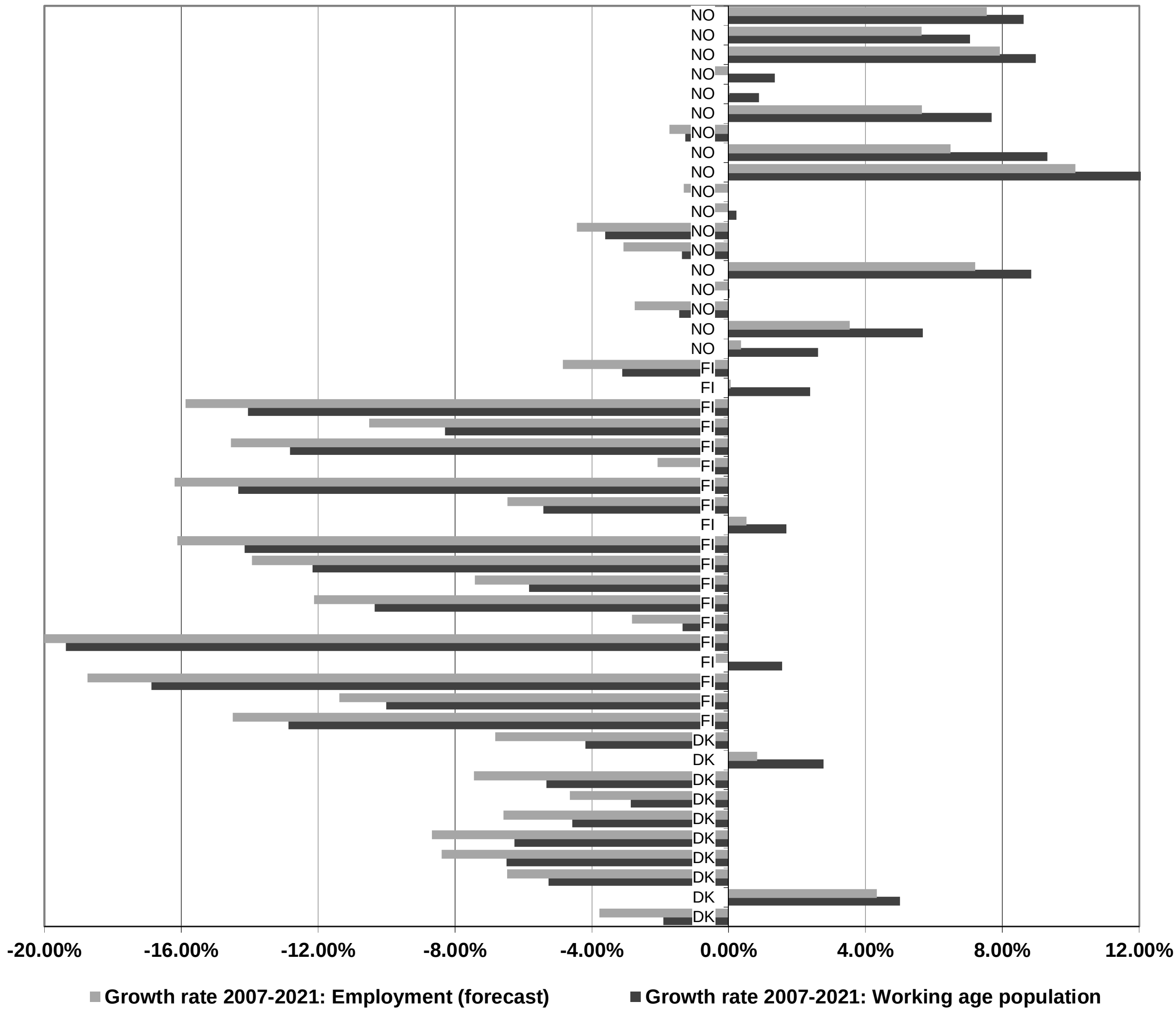
Source: Harmonised Nordic regional data and own calculations; based on estimates from Table 2.

Finally, Figure 4 compares the projected growth rate in the regional working age population from 2007 to 2021 based on population projections with the forecasted growth rate in regional employment for the same period in the Nordic regional labour markets.[9] Forecasted regional employment in 2021 is calculated by multiplying the region specific employment rate from equation (7) with the projected working age population for the same region, upon which a growth rate from 2007 to 2021 is calculated. The difference between the growth rate in working age population and employment in Figure 4 therefore indicates the

[9] A problem over the reliable projections available for some age groups requires the exclusion of Sweden in Figure 4.

importance of considering behavioural responses in regional labour market from ageing through the channels shown in Figure 1. The forecasted change in regional employment outcomes offers a rather different set of results compared to the assessment of projected change in the working age population. Taking a simple cross-regional average of growth rates indicates that focussing on forecasted employment rather than simply projecting working age population would render a significantly “worse” future average employment level. Figure 5 shows the difference in projections geographically, indicating that especially Danish and south-eastern Finish regions show a stronger difference in the projections. Furthermore, in some Finnish and Norwegian regions an increase in the working age population is changed to a moderate decrease in regional employment, e.g. Itä-Uusimaa, Nord-Trøndelag and Troms. Thus, not only the magnitude of the future labor market pattern but also the general direction of change may be affected by the use of different simulation procedures.

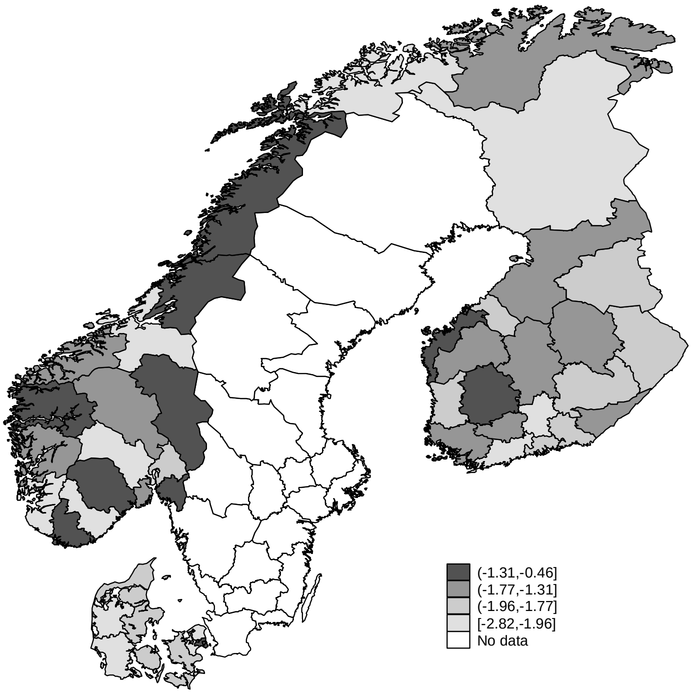
Figure 4. Comparison of projections for Nordic regions up to 2021 (in %)



Source: Harmonised Nordic regional data and own calculations; based on estimates from Table 2.

Note: Due to the lack of reliable regional population projections for the Swedish regions they have been left out of the figure. Furthermore, as a result of the 2007 regional reform process the number of regional entities in Denmark, for which population projections are available, was reduced to 5.

Figure 5. Graphical distribution of difference in projections from Figure 4 (in %)



Note: Class breaks correspond to quantiles of the distribution of variables, for details see Figure 4.

5. Conclusion

The ability to assess future trends in regional labour market outcomes becomes increasingly important as ageing progresses in European regions. Based on data for 71 Nordic regions, this paper offers a estimation-based scenario analysis to predict the future impacts of ageing on regional labour markets. The evidence provided here leads to the conclusion that it is important to consider regional variation in labour market responses to ageing when predicting regional labour market outcomes. Regional heterogeneity in labour market behaviour may significantly alter the consequences of ageing for any particular region. Ageing may thus impact the future of regions rather differently compared to a “benchmark” case based on projected working age population.

From a regional development perspective such insights are clearly important as they highlight some of the regional problems and imbalances connected to ageing processes. In addition, related to future challenges in local public finances, the procedure proposed here allows for an improvement in the potential to analyse the ability to finance local public goods through taxes on earnings from regional employment. In the Nordic unitary states, where local authorities in the form of municipalities often are responsible for providing local public goods and financing them through taxes on local earnings, see e.g. Mønnesland (2001), this is of importance. From a firm perspective, the proposed procedure furthermore shows where bottlenecks in terms of recruitment may result more outspokenly from ageing.

Of course, some caveats apply: the approach taken here does not explicitly consider the importance of mobility. Mobility is included through the official population projections and through spatial dependencies in the form of neighbourhood effects. In this light it may be desirable to promote a more explicit modelling of mobility effects on labour market behaviour, as mobile labour market resources may have different patterns of behaviour on the labour market. Albeit desirable, a problem in gaining sufficient data for the different countries, the present approach has abstained from such. The current approach has focussed on ageing but future work may extend the approach by considering other groups gaining employment in different regional labour markets and how this affects labour market behaviour.

Finally, along with the fast advancing state-of-the-art in the field of spatial econometrics (see Elhorst, 2010), alternative estimators should be tested with regard to their predictive power in data settings commonly found in the context of applied regional research (moderate number of regions in sample as well as a short to moderate number of time observation). Here, Mitze (2011) has recently taken a first step to provide further evidence on the small sample properties of dynamic system panel estimators in such data settings. Although the results generally favour the use of “simple” (meaning limited information) estimators over full information alternatives, further research is surely needed to provide additional evidence for the use of dynamic systems including spatial dependence (see, e.g., Baltagi and Deng, 2012, for a simultaneous system of spatial autoregressive equations). Such evidence, together with the application of the above proposed scenario analysis, may be helpful for economic policy making, which is constantly in need of accurate regional labor market forecasts and policy simulations.

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Appendix: Data description

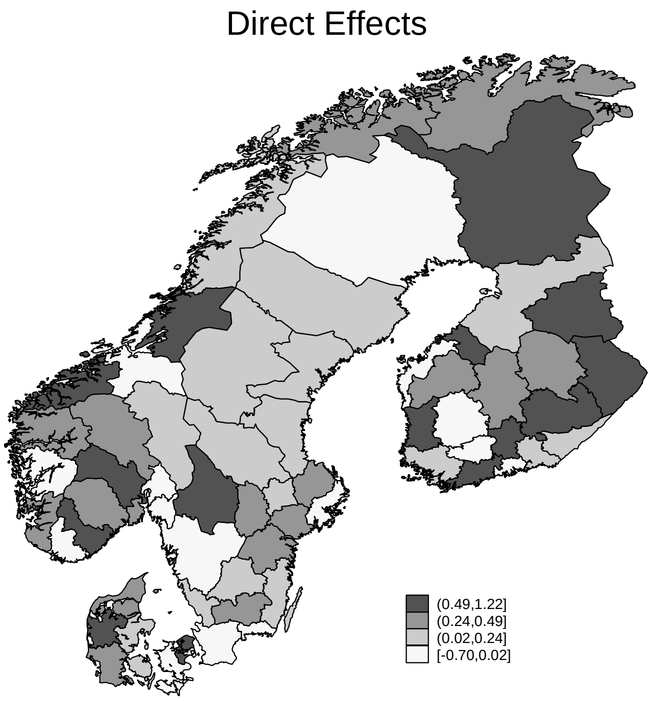
The data has been ascertained from the international organization Nordregio, which collects data the statistical bureaus of the Nordic countries (Statistisk Centralbyrån in Sweden, Statistisk Sentralbyrå in Norway, Tilastokeskus in Finland, Danmarks Statistik in Denmark and Hagstofa Íslands in Iceland) and harmonizes the data to make it comparable. Further, some adjustments have been undertaken by the authors, where missing data were a problem in the Nordregio data. These imputations are all based on additional data from the respective statistical bureaus of the Nordic countries. The different variables used in the analysis are summarized in Table A1 below:

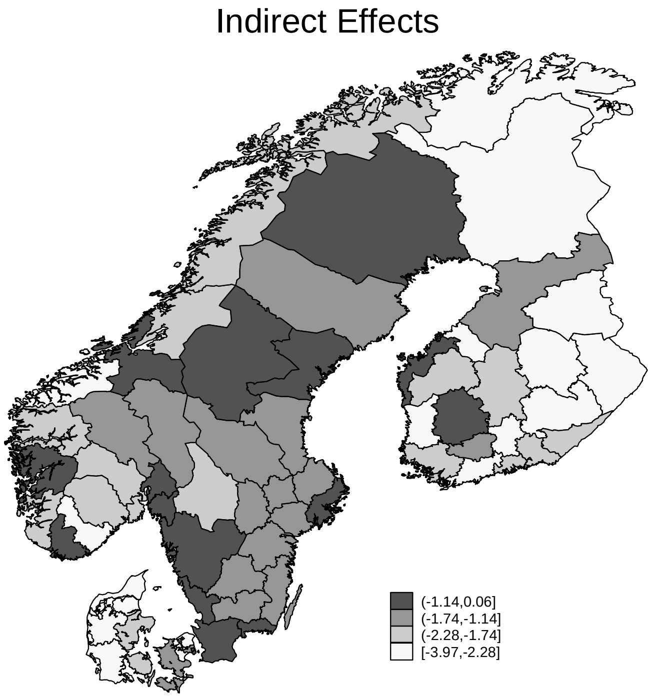
Table A1. Summary statistics of variables in 3-equation labor market system

Variable	Mnemonic	Obs.	Regions	Years	Mean	Std. dev.	Min	Max
Employment rate (in %)	*Erate*	1065	71	15	69.6	7.5	47.9	83.7
Activity rate (in %)	*Arate*	1065	71	15	49.2	3.0	43.6	60.6
Unemployment rate (in %)	*Urate*	1065	71	15	8.5	6.0	1.6	28.9
Share of young people in population (in %)	*Yrate*	1065	71	15	29.2	3.4	13.4	47.5
Share of old people in population (in %)	*Orate*	1065	71	15	25.5	3.9	15.0	35.5
Employment rate (annual growth rate)	*ΔErate*	994	71	14	-0.002	0.027	-0.171	0.050
Activity rate (annual growth rate)	*ΔArate*	994	71	14	-0.001	0.013	-0.045	0.043
Unemployment rate (annual growth rate)	*ΔUrate*	994	71	14	0.008	0.212	-0.466	1.447
Share of young people in pop. (annual growth rate)	*ΔYrate*	994	71	14	-0.004	0.028	-0.551	0.060
Share of old people in pop. (annual growth rate)	*ΔOrate*	994	71	14	0.002	0.014	-0.135	0.041

Note: "*Δ*" denotes the first difference operator for variables based on logarithmic transformations. For a detailed description of variable definitions, see main text.

Figure A.1. Geographical distribution of direct and indirect employment effects (in %)





Note: Class breaks correspond to quantiles of the distribution of variables, for details see Figure 3.