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Estimating and forecasting the labour market imbalance by education for the county of South Jutland¹

by

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Abstract.

During the past half decade attention to bottleneck problems on the Danish labour market with special concerning to labour by education. This paper extend the concerning to the regional labour market by education.

The paper presents a dynamic forecast model at county level giving special attention to the level of education , skills etc.

Peoples supply of labour by education, age and sex are determined by the present distribution of the peoples on education , age and sex. On the demand side, forecast are made by use of the regional model EMIL, and matched with forecasts made from the supply side. Demand for labour by education and the distribution of labour by education among industries are determined endogenously with overall demand by industry given exogenously.

Employment and hence Unemployment given labour supply is modelled using a simple behavioural equation based on a relation between the strength in supplies struggles for a job in a given educational group in two different labour demand factors, and the relative change in labour supply.

The model is applied on data for a rural region in Denmark, i.e. the county of South Jutland, and the forecasts are made for the period up to 2015.

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1. Introduction.

During the first half of this decade there has been a great attention to identify bottlenecks in the regional labour markets. For an obvious reason, it is interesting to identify potential future mismatch in the labour market by education. The model is a first draft adjustment of the flexmodel developed in the Danish Institute of Border Region Studies and AKF to deal with the regional level. The model was developed to a closed overall labour market. The optimal choice depending only on industry to search employment and with educational group to use in the production. At the regional level the decision include relocation both on the demand side and the supply side. This model is a forecast depending on the initial condition for commuting, education choice, labour market participation rate, including retirement from the labour market and the regions share of total industry and all industries in Denmark.

The paper present a dynamic forecast model for the regional labour market: demand for labour by education and the distribution of labour by education among industries are determined endogenously with overall demand by industry given exogenously. The model is derived for a simple behavioural equation based on a strong relationship between the strength in the struggle for jobs of an educational group represent by two distinct labour demand factors and the change in relative supply. The relationship has been proved to be significant on the real data and gives a good forecast of education by education.

The paper is organized as follows: the labour supply is derived in section 2, an short introduction to the regional labour demand is introduced section 3, the adjustment of the flexmodel to regional level is introduced in section 4. The result of the model is reported in section 5.

2. Labour supply.

The principle determination of future labour supply is the distribution of the underlying populations on age and sex. An restricted assumption for this model, is on the inter-regional labour mobility. This model assuming that inter-regional labour mobility by education is independent of relative regional labour demand by education.

The total labour supply can be decomposed into two component; the supply from internal

residents and from the external residents. It's presumed that relative realised demand from external residents is constant, ie. the model is derived from a simple behavioural equation based on a strong relationship between the "strength" in the struggle for jobs of an educational group from the region and the shift in relative supply from the region and net-commuting from other regions keep it's constant share.

The future supply of labour by education is given by information of initial condition at the last data year. The forecast of the labour supply derived in 3 parts: First the future distribution of the population on age and sex is derived from Danmarks Statistik including future inter-county relocations. The inter-county relocations follow from past relocation and then is independent of economic condition etc. The second part is the distribution of education for the entire population. Data cover the total population, every people is contained one of the two groups: finished education or ongoing education, thereafter all people is divided by the combination of sex, age, county, education group, industry and unemployed or out of labour force. First at all a great part of the arrived formal education will not depreciate one year later. It is only the dynamics in and out of the stock of qualified persons there is interesting- relocation, mortality and completion of education. The method for derive the completion of education is to find the density of education from a cross section from the last data year, this density is then becoming the future time series for new generation in the educations system with one condition, that the densities is not decreasing with age.

$$QPOP_{a, k, t} = \text{MAX}(QPOP_{\tau, k, t-1}) \quad \tau = 15, \dots, a, a \leq 35 \quad (1)$$

where $\tilde{q}_{POP a, k, t}$ is the share/density of the k th educational group with age a at time t of an total population with age a at time t in the county. This method is used until every educational group reach global maximum density of this educational group in the cross section data set, thereafter a generation approach is used. The only educational group there differentiate from this pattern is the unskilled, the flow in to an educational group will arrive primarily from the unskilled or might possibly from an other educational group. For already acquire education it is assumed that every generation keeps the distribution of education year by year, this method will be called the generations approach .

$$qPOP_{a, k, t} = qPOP_{a-1, k, t-1} \quad (2)$$

The last part is to derive the participation rate. The participation rate is determined by age, sex, education and time. For the population under 35 year the participation rate is derived from age profiles:

$$qpat_{a,k,t} = qpat_{a,k,t-1} \quad (3)$$

For the population above 35 but under 60 year it is assumed that the participation rate for an given educational group with age a and sex k will one year later have the same participation rate:

$$qpat_{a,k,t} = qpat_{a-1,k,t-1} \quad (4)$$

The retirement is modelled with the same relative retirement from last data depending on educational group, sex and age.

$$qpat_{a,k,t} = qpat_{a-1,k,t-1} \cdot qpat_{a,k,T} / qpat_{a-1,k,T-1} \quad (5)$$

where T is the last year with data. If the denominator in the last element of eq. is null and the nominator is different from null the retirement is derived form total retirement. This approach is static in the way it reproduce the past into the future especially how skilled labour force enter the labour marked, with consideration to distribution on education and participation rate. The approach gives other things equal an good forecast on the growth in education level, determined by the replacement of the preceding generation by the rising generation in the labour marked.

3. Labour demand.

The future labour supply is dertermined by interaction between the models ADAM and EMIL, the former from Danmarks statistik and the last from Amternes og Kommunernes forskningsinstitut. A benchmark series of national numbers on labour employment by industry is decomposed into county levels by EMIL. EMIL distinguish between two employments definitions: first employment by residence or employment by workplace. The method use employment by residence, e.i. the labour force resident in the county will

struggle for there constant part of Danish employment conditional on industrial change and is then independent of shift in relative labour supply by education on the inter-county level.

4. Employment by education.

The purpose of the model is to derive an forecast for unemployment by education. This approach is an simple implementing of Groes et al.(1994) forecast model for an closed economy. The unemployment is by definition the residual form labour force and employment. For this purpose, the flexmodel is used to derive the employment by education given demand for labour, supply of labour by education, and information of the initial employment for labour by education in each industry in the county.

Table 1. structure of the model

Industry \ Education	Industry 1	Industry j	Industry 21	Employment	Unemployment	Labour force		
Education 1	$\tilde{a}_{1,1}$	...	$\tilde{a}_{1,j}$	...	$\tilde{a}_{1,21}$	$\tilde{D}_{1..}$	$\tilde{U}_{1..}$	$\tilde{S}_{1..}$
	.		.		.			
	.		.		.			
	.		.		.			
Education i	$\tilde{a}_{i,1}$	...	$\tilde{a}_{i,j}$	...	$\tilde{a}_{i,21}$	$\tilde{D}_{i..}$	$\tilde{U}_{i..}$	$\tilde{S}_{i..}$
	.		.		.			
	.		.		.			
	.		.		.			
Education 89	$\tilde{a}_{89,1}$	...	$\tilde{a}_{89,j}$	...	$\tilde{a}_{89,21}$	$\tilde{D}_{89..}$	$\tilde{U}_{89..}$	$\tilde{S}_{89,21}$
Sum	$\tilde{D}_{..1}$	$\tilde{D}_{..j}$	$\tilde{D}_{..21}$	\tilde{D}	\tilde{U}	\tilde{S}		

Let us denote the employers' accumulated employment of, or demand for labour divided according to education as \tilde{D}_i , where subscript i denotes the i th educational group, and *tilde* denotes employment by residence in South Jutland. There is no distinguishing between demand and realized demand (employment), only requirement is realised demand do not exceed supply, $\tilde{D}_i \leq \tilde{S}_i$, where \tilde{S}_i is the supply of labour with education i . Let $\tilde{a}_{ij}(t)$ be the

demand for labour of education i from South Jutland in the j th industry from the whole county in period t , e_i . employment by residence. $\tilde{S}_i(t)$ is the supply of labour with the i th education from South Jutland. $\tilde{D}_j(t)$ the demand for labour in the j th industry intended for residents of south jutland, and $\tilde{U}_i(t) = \tilde{S}_i(t) - \tilde{D}_i(t)$, unemployment for the i th education. Although it might take negative values, we will call the mismatch term \tilde{U}_i unemployment. The difference of employment at two following periods is decomposed in three parts:

$$\Delta \tilde{D}_i^g(t+1) = a + b_1 [\Delta \tilde{S}_i^g(t+1) - \Delta \tilde{S}_i^g(t)] + b_2 \Delta \tilde{D}_i^g(t+1) + b_3 \Delta D_i^j(t+1) + \varepsilon_i(t+1) \quad (6)$$

- The first part is $\Delta \tilde{S}_i^g(t+1) - \Delta \tilde{S}_i^g(t)$ where $\Delta \tilde{S}_i^g(t+1) = \tilde{S}_i(t) \cdot \Delta \tilde{S}(t+1) / \tilde{S}(t)$ the interpretation of this part, is the additional supply press from the i th educational group relative to total labour supply will induce changes. Educational groups with positive supply press will increase the employment share, and education groups with negative supply press will decrease their employment share.
- The second part $\Delta \tilde{D}_i^g(t+1) = \tilde{D}_i^g(t) \cdot \Delta \tilde{D}(t+1) / \tilde{D}(t)$, this factor is the change in employment for the i th educational group depending on change in total employment.
- The third part $\Delta \tilde{D}_i^f(t+1) = \sum_j c_{ij}(t) \Delta \tilde{d}_j$ where $c_{ij}(t)$ is the i th educational group share of total employment in industry j in period t . This part is interpreted as the change in employment in consequence of the change by industry.

This relation is estimated using OLS on the South Jutland labour market on 90 educational groups and 21 industries where $b_2 = b_3 + 1$.

Table 2 *Estimation results*

	a	b ₁	b ₂	b ₃	Adj R-sq	restric- tion
1980-81	-0,59	0,82 ***	0,62 **	0,18	0,97	
1981-82	0,59	0,87 ***	1,83 ***	-0,28 ***	0,98	***
1982-83	0,89	0,88 ***	2,44 ***	-0,25 **	0,98	**
1983-84	1,91	0,97 ***	0,35 ***	0,17 ***	0,99	***
1984-85	0,51	0,98 ***	1,08 ***	-0,06	0,99	
1985-86	-3,58	1,02 ***	1,47 ***	-0,11 **	0,98	***
1986-87	-0,22	0,94 ***	1,13 ***	-0,02	0,99	
1987-88	0,30	0,81 ***	-0,30	0,85 ***	0,97	***
1988-89	-1,84	0,82 ***	-1,46	0,56 **	0,95	
1989-90	1,55	0,85 ***	0,75 ***	0,23	0,99	
1990-91	-0,01	0,87 ***	0,79	-0,01	0,99	
1991-92	-0,17	1,06 ***	9,61	0,13	0,98	
1992-93	2,45	0,89 ***	0,94 ***	0,20 *	0,98	
1993-94	-4,53	1,06 ***	2,29 ***	0,58 ***	0,96	**
1994-95	-3,44	0,65 ***	1,25 ***	-0,01	0,94	**

Ann: * significant on 10 % level

** significant on 5 % level

*** significant on 2 % level

As can be seen from Table 2, the model fits well and gives strong evidence of non-fixed educational coefficients over time, but it should also be noted that the three estimates of b do not always coincide, which might indicate some misspecification of the model.

The forecast model hence follows Groes et. al. (1994) in the specification of the future distribution of education on industry. In order to allow the educational coefficients to change over time, e.i. let the distribution of education on industry to be depending on other variables then $\tilde{D}_i^f(t)$ which then will become an extreme case of the model, there

need to be specified following.

First, the coefficients have to fulfil the following conditions:

$$\text{for all } i, \quad \sum_j c_{ij}^*(t+1) \tilde{D}_j(t+1) = \tilde{D}_i(t+1) \quad \text{and} \quad (7)$$

$$\text{for all } j, \quad \sum_i c_{ij}^*(t+1) = 1 \quad (8)$$

where c_{ij}^* is a set of coefficients that fulfil the system [7] and [8].

The basic assumption will be that an educational group, witch increases (decreases) its employment, in excess of what fixed coefficients would have yielded, will receive (lose) the additional employment in the industries in proportion to the importance of the groups within the industries. Hence, following Skou (1987), we specify initial coefficients $c_{ij}^0(t+1)$

as:

$$c_{ij}^0(t+1) = c_{ij}(t) \frac{\tilde{D}_i(t+1)}{\tilde{D}_i^f(t+1)} \quad (9)$$

this equation does only fulfil [8] by change. Therefor we have to adjust the coefficient by following iterative system:

$$c_{ij}^{\tau+1}(t+1) = \frac{c_{ij}^{\tau}(t+1)}{\sum_j c_{ij}^{\tau}(t+1)} \quad (10)$$

$$c_{ij}^{\tau+2}(t+1) = \frac{c_{ij}^{\tau+1}(t+1) \tilde{D}_j(t+1)}{\sum_j c_{ij}^{\tau+1}(t+1) \tilde{D}_j(t+1)} \quad (11)$$

This system [10]-[11] is computed recursively for $\tau = 0, 2, 4, \dots$ until the discrepancy of [8] and [9] is insignificant. Let τ' be the last iteration, and define the final coefficients as:

$$c_{ij}^*(t+1) = c_{ij}^{\tau'}(t+1) + (\tilde{D}_i(t+1) - \sum_j c_{ij}^{\tau'}(T+1) \tilde{D}_j(T+1)) / \tilde{D}_i(t+1) \quad (12)$$

these coefficients fulfil [8] and [9]. Hence, with the coefficients of [12] we can compute $\tilde{d}_{ij}(t+1)$ and we are able to update table 1. for period t+1, Thus with [6] and the system of [8]-[12] can obtain the full information for the dynamic model for period T, T+1 T+2,....

The full model has been evaluated using historic data for the whole Danish labour market with good results by Groes *et al* (1987). Hence it needs to be evaluated on regional data.

5. Prospects of Educational Mismatch. The South Jutland Labour Market: 1996-2015.

In spring 1998 the model presented in the previous sections was used to forecast the South Jutland labour market. The forecast involved the entire labour market divided into 90 educational groups and 21 industries. We used annual panel data containing every single individual of the labour force, with information about education and employment status, i.e. employed or unemployed and if employed, in which industry. Students and people on vocational training is aggregated to one educational group with identical behaviour.

The inputs to forecast were $\tilde{d}_{ij}(1996)$, $\tilde{S}_i(t)$ and $\tilde{D}_j(t)$ for all i,j and $t = 1997, \dots, 2015$.

The labour supply by education was forecasted by the model in section 3. The demand by industry and the overall unemployment $\tilde{U}_i(t)$, was forecasted by the aggregated model ADAM on the national level and by EMIL on the regional level.

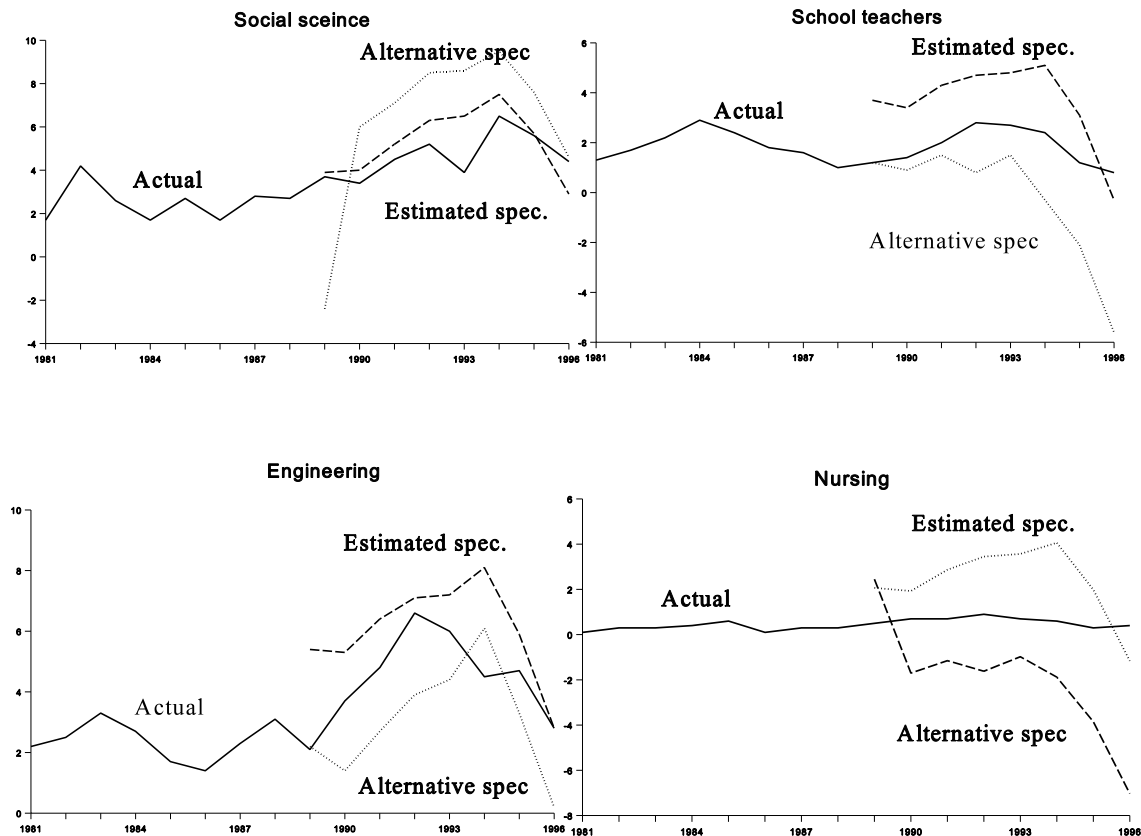
The forecast for the period 1998-2015 is shown in table 3 and figure 2

The primal result from the model is, despite aggregated labour supply exceeding aggregated labour demand, there are distinct mismatch problems present. The unskilled and Office & adm. Labour represent over unemployment while Teachers, Health and medicine, Nursing, Engineers represent under employment and is a cause of bottleneck problems.

6. Prospects of Educational Mismatch. The south Jutland Labour Market: 1989-1996.

The model can be evaluated by using historic data for labour supply by education and labour demand by industry. To see how well the forecast fits, we can report on some actual unemployment figures in figure 1, the group of people educated as school teachers, the field of social science, the field of engineering and science and nursing at the medium-cycle education courses. Apparently, in all cases, the model managed to predict the time trend. Furthermore, it should be noted that for engineering and social science the model is able to follow the business cycle. In which the unemployment shifted from upwards to downwards during the period. There is used an alternative specification of the model

Abbildung 1 Forecast and actual unemployment for selected educational groups



according to the coefficients $b_2 = b_3 = 0,5$. This specification was chosen because it was better to dampen the business cycle for some educational groups primary in the public service sector.

6. Discussion.

There is presented a model for forecasting unemployment by education which explicitly assumes flexible educational coefficients within industries but low flexible educational coefficients within regions. Despite its simplicity, the model fits data well and the result from the experiment with the model's prediction is feasible for planning tools. However, the model is rudimentary; first, the mechanism for distributing the group's residual change of employment in industries is a problem and a topic for further study. Secondly, wages do not appear in the model, and at last the inter-regional relocations do only depend on past condition and do not change in case of shift the relative regional labour demand by educations.

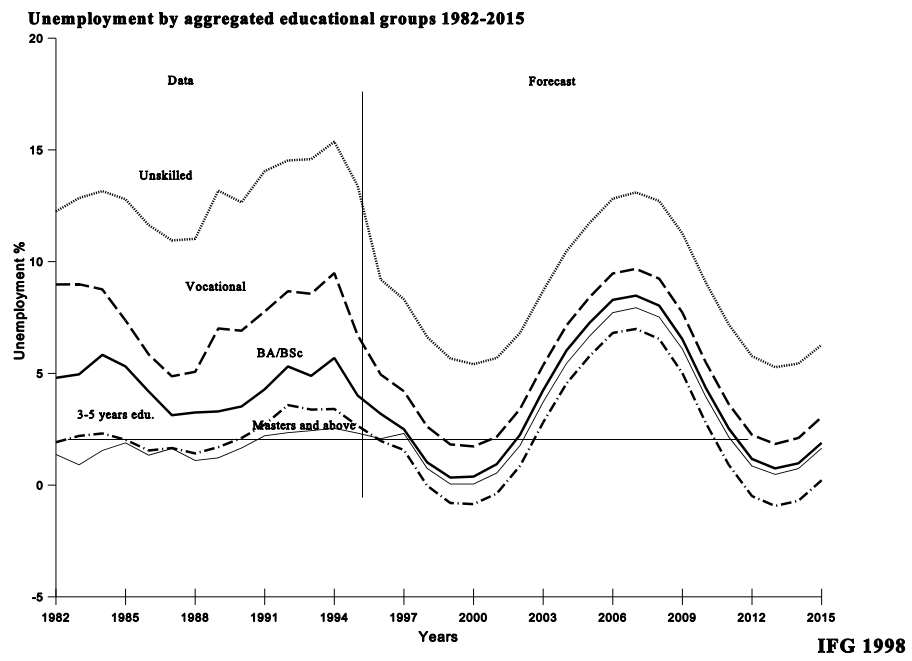
To summarize, there has been put forward a model that, despite its simplicity, is a useful

planning tool as its stands, but also a fruitful framework for further work in this area.

Table 5.2 Unemployment by education 1996 - 2015, selected years.

	1996	2000	2007	2013	2015
			Unemployment %		
<i>Unskilled total</i>	9.2	5.4	13.1	5.3	6.3
Men	6.7	2.7	10.5	2.4	3.5
Women	11.9	8.4	16.2	9.0	10.0
<i>Vocational total</i>	5.0	1.7	9.7	1.8	3.1
Office & adm, men	4.7	1.5	9.4	1.7	3.0
Office & adm, women,	7.6	4.6	11.9	4.5	5.6
Metal industry	3.3	0.0	8.5	-0.1	1.2
Construction	3.3	-0.5	7.5	-1.6	-0.6
Printing	7.3	3.6	12.5	5.1	6.5
Service	8.7	5.2	12.4	5.1	6.1
Food	5.2	2.1	9.7	2.8	4.2
home care	2.8	-0.5	7.0	-0.5	0.5
Other vocational	2.4	-0.5	8.7	1.7	3.1
<i>Short-cycle higher education</i>	3.2	0.4	8.5	0.7	1.9
Ped.,Hum	2.9	0.6	8.4	1.0	2.0
Technical	3.4	0.3	9.1	0.8	2.2
Nursing	4.0	0.9	8.4	1.1	2.0
Other Ba/BSc	3.3	-0.3	7.1	-0.5	0.5
<i>Medium-cycle higher education</i>	2.0	-0.8	7.0	-0.9	0.2
Teachers, etc.	1.8	-0.9	6.3	-1.6	-0.6
Social science	3.5	1.2	9.5	2.1	3.4
Technical	3.0	0.4	8.9	0.0	1.4
Nursing	0.5	-2.9	5.0	-2.3	-1.2
<i>Long-cycle higher education</i>	2.1	0.1	7.9	0.5	1.7
Hum.	1.3	1.5	8.7	1.0	1.9
Social science	3.1	2.0	9.9	2.7	3.9
Engineering and science	3.5	1.1	9.1	1.0	2.3
Medicine	0.7	-2.9	4.6	-3.6	-3.0
Other long ed.	1.9	-1.8	6.9	0.4	2.0
<i>All stud.</i>	1.3	-3.8	4.2	-3.4	-2.1
<i>All educations</i>	5.7	2.1	9.8	1.8	3.0

Abbildung 2.



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