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## Freezing of the agricultural structure and the local Economies

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**Paper for  
The 39<sup>th</sup> European Congress of the Regional Science Association  
in Dublin, Ireland, 23-27 August 1999**

**Freezing of the Agricultural Structure and the Local Economies**

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## **Introduction**

The purpose of this paper is to present the results of an analysis of the regional consequences of freezing the farm structure in agriculture for a period of 13 years. The analysis has been carried out for the Committee Regarding the Structural Development of Agriculture set up by the Danish Ministry of Foods, Agriculture and Fisheries (1998). The analysis presented is preliminary and therefore the paper also focusses on the weaknesses and the possibilities for improving the analysis in future studies. A more detailed documentation of the analysis (in Danish) is found in Jensen (1998).

The Structural Committee's report analyses the development of productivity within agriculture during the last 30 years and draws up different future possible developments under alternative assumptions of society's demand on agriculture.

Among other things, the historical analysis deals with the structure of agriculture and its importance to productivity. Because of considerable increasing returns to scale in agriculture the structural development towards fewer and bigger farms has to a high degree contributed to the rather high productivity growth during the last 30 years.

This development is expected to continue in the future. The 65,000 existing farms in 1995 are expected to be reduced to 41,000 in 2008 if no further limitations of the structural development are made.

In the Structural Committee's report an alternative to this expected baseline scenario is set up including four scenarios containing different degrees of restrictions of the structural development:

1. Freezing of the farm structure at the present level
2. Limitation of the total pig production
3. Limitation of the number of animal units per farm
4. Limitation of direct subsidies per farm.

All these alternative scenarios will to a varying degree affect agriculture economically because they lower productivity and by that the competitiveness of the agricultural sector. The biggest reduction in income and employment will occur when using scenario no. 1, and it is the regional consequences of this scenario seen in relation to the baseline scenario that are described in this paper. It has also been dealt with in the Structural Committee's report (pp. 197-198).

## **Summary**

If the structure in the Danish agricultural sector is fixed on its present level, so that the farms are no more allowed to grow in size, it is estimated that it will not give cause for big regional discrepancies in employment and income. However, some of the rural municipalities in Jutland will be affected a little harder on employment than urban municipalities and municipalities with a large share of manufacturing. The reason why it is not unambiguously the rural municipalities that are affected the most is that, apart from a drop in activity and employment in agriculture and food processing, there is a shift in aggregate demand towards more exports (in particular from the manufacturing sector) and less domestic demand. This is due to the lowering of the wage rate and thereby improved competitiveness. Therefore, the activity in private services and construction is reduced and these branches are often located in the cities B as opposed to the manufacturing sector. In Denmark many factories are located in rural areas. This result is supported by the fact that agriculture accounts for a small part of the total economic activity in most municipalities.

The regional estimates are based on results for employment and income in various branches at national level from the Danish Institute of Agricultural and Fisheries Economics (SJFI). On the basis of these results it is estimated that agricultural employment after 13 years will be reduced by 5,000 persons, or 6%, compared to a development with increasing average farm size and a reduction in the number of farms. The production and real GDP at factor costs in agriculture are reduced by 20%. The farmers will to some extent transfer the increased unit costs to the output prices and this means a reduction in the competitiveness that brings along a reduction in agricultural exports of 30%. Also, the food processing industry suffers since it accounts for a large share of agricultural exports.

In most other branches production and employment are reduced B in particular in private services and construction. This is due to a general fall in domestic activity driven by lower private consumption. In turn this is due to the falling income in agriculture, sub-suppliers and food processing. In manufacturing a small gain is expected as a result of lower wage rates and thus improved competitiveness. The lower wage rates are a result of the increased unemployment.

The regional consequences are calculated using quite simple methods and they are assumed to overestimate the negative effects in the cities. Therefore it is concluded that future regional analyses concerning agriculture should be carried out with a better utilization of the agricultural and macroeconomic model in the Danish Institute of Agricultural and Fisheries Economics (SJFI) and with an improved version of the AKF model for the Danish municipalities.

## **Assumptions**

On the basis of the results concerning the agricultural sector's productivity and exports from SJFI's general equilibrium model, AAGE, (Ministry of Food, Agriculture and Fisheries, 1997) the consequences for the rest of the economy B e.g. production, income and employment within all sectors, inclusive of the food processing industry B have been calculated using Statistics

Denmark's macro model, ADAM (Statistics Denmark, 1996). On the basis of this the consequences regarding employment and income within the Danish municipalities have been calculated by breaking down the results by means of AKF's municipal model, LINE.

SJFI has provided AKF with three results for the agricultural sector calculated by means of AAGE for scenario 1 in the Structural Committee's report. In a fixed structure at the present level the agricultural sector's total factor productivity will decline by 0.6% per year and the labour productivity will decline by 1.3% per year compared with a continuous structural development. These results are based on Hansen (1990) who analyses the structural contribution to the productivity growth historically.<sup>1</sup> Finally, according to AAGE, after 13 years with a fixed structure agricultural exports decline by 29.8% compared to a continuous structural development.

The three results from SJFI are incorporated in ADAM assuming that the other production factor B which has a lower productivity growth B is capital. The assumption is thus that the productivity of neither land nor raw materials is affected. Using the agricultural sector's share of costs<sup>2</sup> in 1992 a decrease in capital productivity (buildings and machinery) of 1.45% together with a decrease in labour productivity lead to the mentioned decrease in total factor productivity of 0.6%. In ADAM production is demand driven. This means that initially the input of labour and capital in agriculture increases, but the production level and input of land and raw materials are maintained. Then the production declines because of the lower agricultural exports due to increased costs and reduced competitiveness, and thus the demand for capital and labour is reduced.

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<sup>1</sup> It has not been possible to use information about differences among the different agricultural branches B this could have shown direct regional differences due to an uneven distribution of agricultural branches throughout the country.

<sup>2</sup> According to SJFI the share of costs is 10% for land, 25% for machinery and buildings, 18% for labour and 47% for raw materials.

As primary agriculture in 1992 accounted for 79% of the production value in ADAM's agricultural sector, these assumptions have been multiplied by 0.79 before incorporating them into ADAM's agricultural sector which encompasses forestry and fishery. This does not apply to food exports because these exports are assumed directly or indirectly to come from primary agriculture.<sup>3</sup>

The analyses made using ADAM have been carried out taking the baseline scenario as the point of departure. To agriculture this scenario is almost the same as the baseline scenario of the welfare analyses carried out in 1996/97 in cooperation with SJFI<sup>4</sup> B i.e. a continuous development towards fewer and bigger farms. The selection of the baseline scenario only influences the size of the effects a little and is not dealt with here.

Finally, it is assumed that the increased costs in agriculture of 0.6% per annum have full price reflection on the output prices of agriculture. They thus grow by 0.6 percentage point more per annum than in the baseline scenario.

The assumption of the fixed structure in agriculture is not combined with assumptions of more ecological production or the like. We assume that the same goods are produced irrespective of the structural development.

The scenario is incorporated in ADAM by adjusting the productivity of labour and capital within agriculture, the output price of agriculture (which is exogenous in ADAM) and the agricultural exports. Apart from this the exogenous variables in ADAM have not been changed. We have simulated over the period 1997 till 2010 and the results are presented in the following as changes in relation to the baseline scenario in 2010.

When transferring the results on employment, industrial earnings etc. to AKF's municipal model, LINE, the consequences for employment and income in the municipalities are calculated in the light of the existing industrial structure. LINE calculates the disposable income of the local citizens on the basis of earned income, transfers (i.a. dependent on unemployment and thus the rate of employment) and direct taxes. Transfer of earned income among municipalities due to commuting is also taken into account. LINE is described in Madsen et al. (1997).

## **Results at National Level**

Table 1 outlines the effects after 13 years on employment in trade and industry, the GDP at factor

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<sup>3</sup> Here, we have left out food exports deriving from fisheries and the fishing industry.

<sup>4</sup> This corresponds to the assumptions of the baseline scenario in the Structural Committee's report. See Poul Uffe Dam et al. (1997) about welfare analyses.

costs and the earnings after capital expenditure etc. The results are presented as differences in relation to the baseline scenario/development with a continuous structural development towards fewer and bigger farms.

**Table 1. National Effects Year 2010. ADAM**

		Absolute change	Percentage change
Agriculture (ADAM)	Employment, 1000 people	-4.7	-6.3
	Real production, billion 1980 DKK	-12.0	-18.3
	Earnings, billion DKK	-1.3	-6.8
	GDP at factor costs, billion 1980 DKK	-6.8	-18.8
Food industry	Employment, 1000 people	-11.2	-18.7
	Real production, billion 1980 DKK	-18.4	-19.5
	Earnings, billion DKK	-6.0	-24.6
	GDP at factor costs, billion 1980 DKK	-4.1	-19.7
Food exports, billion 1980 DKK		-19.4	-29.8
All sectors	Employment, 1000 people	-61.9	-2.3
	Real GDP, billion 1980 DKK	-23.7	-3.3
	Real private consumption, billion 1980 DKK		
	Real exports, billion 1980 DKK	-14.2	-3.5
	Real imports, billion 1980 DKK	-15.2	-3.8
	Real investments, billion 1980 DKK	-14.9	-4.4
	Wage rate, DKK/hour	-9.3	-7.4
	Consumer prices, index 1980 = 1	-15.3	-6.4
		-0.1	-2.1
Employment distributed on sector, 1000 people	Agriculture	-4.7	-6.3
	Industry	-9.0	-1.9
	Private services	-35.2	-3.3
	Building and construction	-13.0	-7.3

During the scenario with no structural development the competitiveness of the agricultural sector deteriorates. This leads to more expensive raw materials and higher output prices for the food industry, and a decline in food exports and agricultural production as well as in production and employment within the food industry. Add to this that the food industry and the Danish consumers to a certain degree tend to substitute Danish agricultural products with foreign ones. The initial increase in employment within agriculture due to the low labour productivity is by far compensated for by lower activity and employment within agriculture. After 13 years employment in the agricultural sector as defined in ADAM decreases by 5,000 people or 6% and production decreases by 18%. That the decrease in employment is relatively smaller than the decrease in production is due to lower labour productivity. As a result of lower food exports the activity of the food industry also decreases by almost 20%. This leads to a reduction of people employed at about 11,000.

Even though the real GDP at factor costs within agriculture decreases by almost 20% the nominal GDP only decreases by about 5% and the nominal earnings within agriculture by



about 7% as the increased unit costs lead to increased output prices of about 7%. Within the food industry the earnings decrease by about 25%.

The decreasing earnings within agriculture and related industries lead to lower activity in general. Private consumption decreases in real terms by 32%, and industrial investments (except for agriculture) decrease by about 7%. Thus, the real GDP decreases by about 3% and total employment by more than 2% or 60,000 people. Apart from agriculture and food industry it is especially the domestic market sectors construction and private services that are affected.

Due to increased unemployment the wage level decreases by about 6% and the consumer prices by about 2%. The decreasing wage level contributes to an improved competitiveness, and even though ADAM proceeds slowly a small increase of more than 2% can be seen in industrial exports as well as in employment of about 2,000 people after 13 years. In the long term ADAM has a 100% crowding-out effect<sup>5</sup> on employment, but the effect does not attribute very much to the employment effect after 13 years.

The effect on the balance of payments is negative because of the decline in exports, but after 13 years the decline is only about 5 billion DKK in current prices. This is due to the fact that the decline in exports almost corresponds to a decline in imports, which is a consequence of lower investments and lower private consumption. In ADAM the balance of payments has no effect on fiscal policy.

## **Municipal Results**

LINE has calculated the effects after 13 years on employment by place of work as well as employment, earnings and disposable income by place of residence. The municipal effects are presented on the maps in figure 1-4. Table 2 shows the average effect for different municipal groups.

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<sup>5</sup> A crowding-out effect on employment means that an increase in employment in one sector in the course of time will crowd out employment in the other sectors because long-term employment is determined by the supply of labour.

**Table 2. Consequences for Employment and Income by Municipalities**  
**Change in per cent**

Municipal group	Employment by place of work	Employment by place of residence	Earnings by place of residence	Disposable income
Metropolitan area <sup>1</sup>	-2.20	-2.18	-7.02	-5.98
5 biggest Danish cities <sup>2</sup>	-2.65	-2.43	-7.17	-5.83
Danish islands exclusive of the Metropolitan area and the city of Odense	-2.67	-2.70	-7.30	-5.87
Jutland exclusive of the cities of Århus, Aalborg, Esbjerg and Randers	-2.94	-2.94	-7.28	-5.79
Danmark in all	-2.58	-2.58	-7.17	-5.88

<sup>1</sup> The municipalities of Copenhagen and Frederiksberg, and the counties of Copenhagen, Frederiksborg and Roskilde.

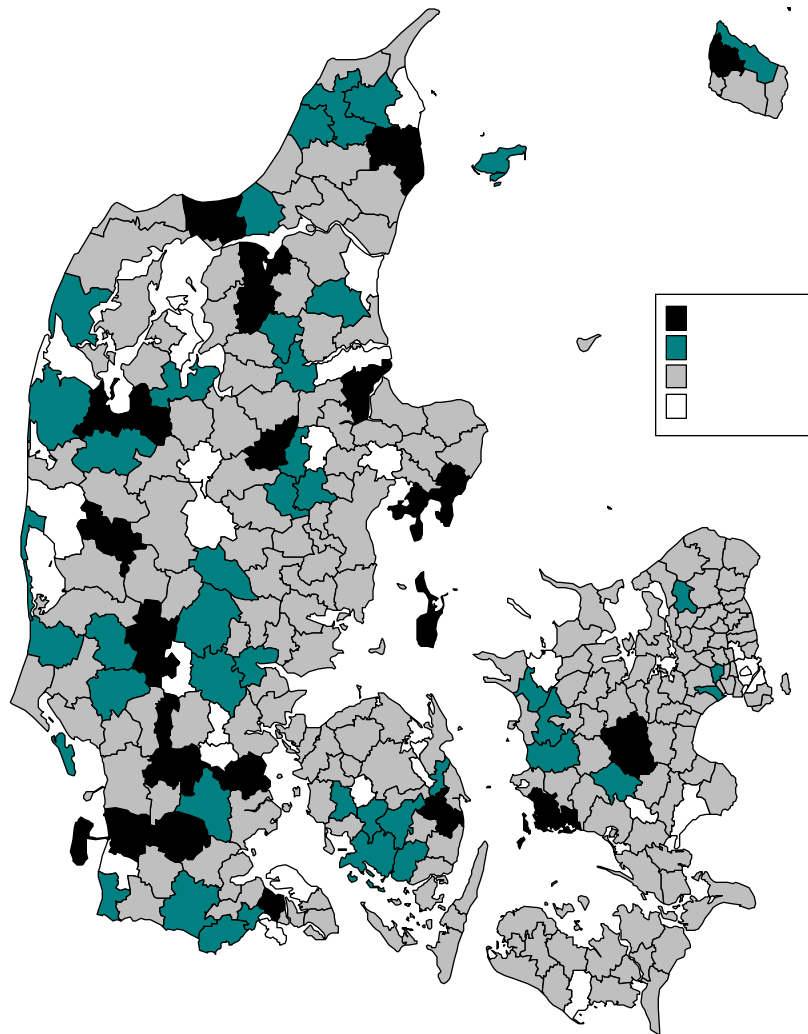
<sup>2</sup> Århus, Odense, Aalborg, Esbjerg, Odense and Randers.

In general, the employment level in the municipalities by place of work declines by between 1-4%, see figure 1. The decline is biggest in the Jutlandic<sup>6</sup> municipalities where agriculture makes up a relatively big part of the total employment. This especially applies to the North and West of Jutland. However, there is a clear tendency towards a very small decline in employment in Jutlandic municipalities where big industrial enterprises are situated (e.g. Lego in Billund). The decline in employment in Copenhagen is a little below the national average (1.9% in the Municipality of Copenhagen) because of the concentration of public services. Otherwise, the big cities are just as affected as a lot of rural municipalities, i.e. a decline of 2-3%. There is an indication that especially municipalities with big slaughterhouses like, e.g. Ringsted are affected very much.

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<sup>6</sup> Jutland is the big peninsula in the west of Denmark which B to the south B borders on Germany.

*Figure 1: Change in Employment Assessed by Place of Work*

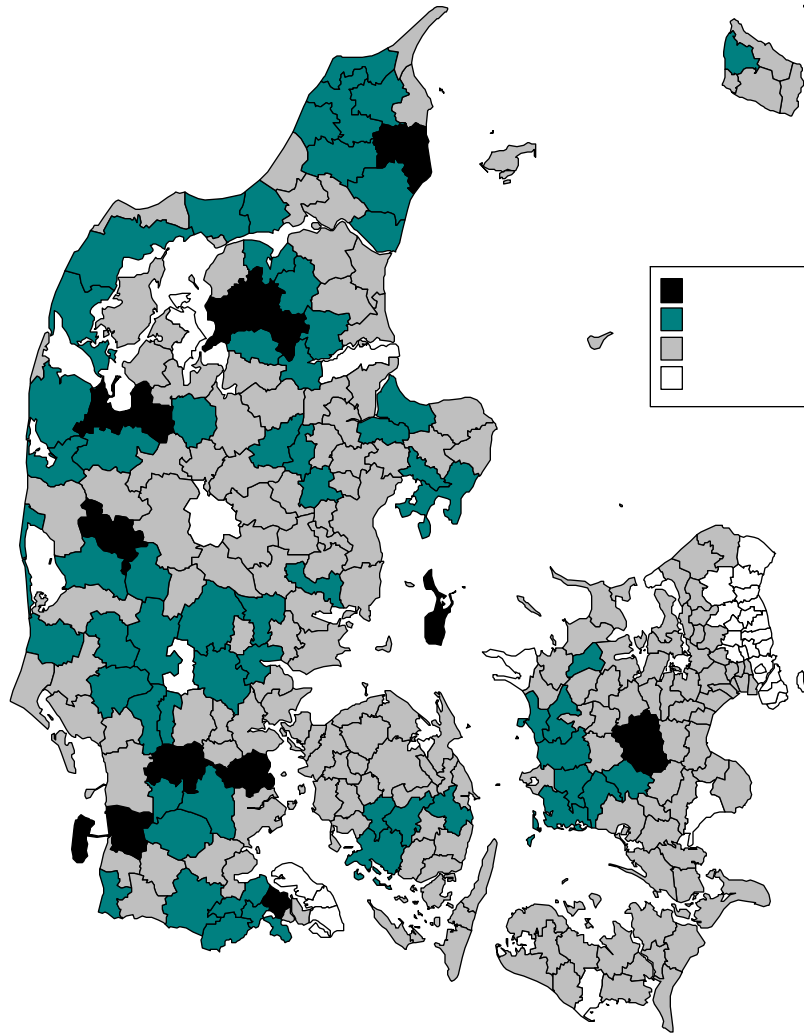


Taking into account that a number of people live in one municipality and work in another (i.e. transfer of employment through commuting) we get employment by place of work. We assume that in each municipality and within each sector the place of residence of people who have been dismissed is like the average of those employed. The effect on employment by place of residence follows in broad outline the same lines as employment by place of work, but the differences are evened out where commuting is big, see figure 2. This especially applies to the metropolitan area. Here the relatively favourable development is spread, especially to the municipalities north of Copenhagen where a lot of people working in central Copenhagen live.

For employment the scenario looks worst in the western part of Denmark, but the dispersion is also the biggest here because some big industrial enterprises are situated here. The regional differences are very modest though and are generally limited to a few

per cent.

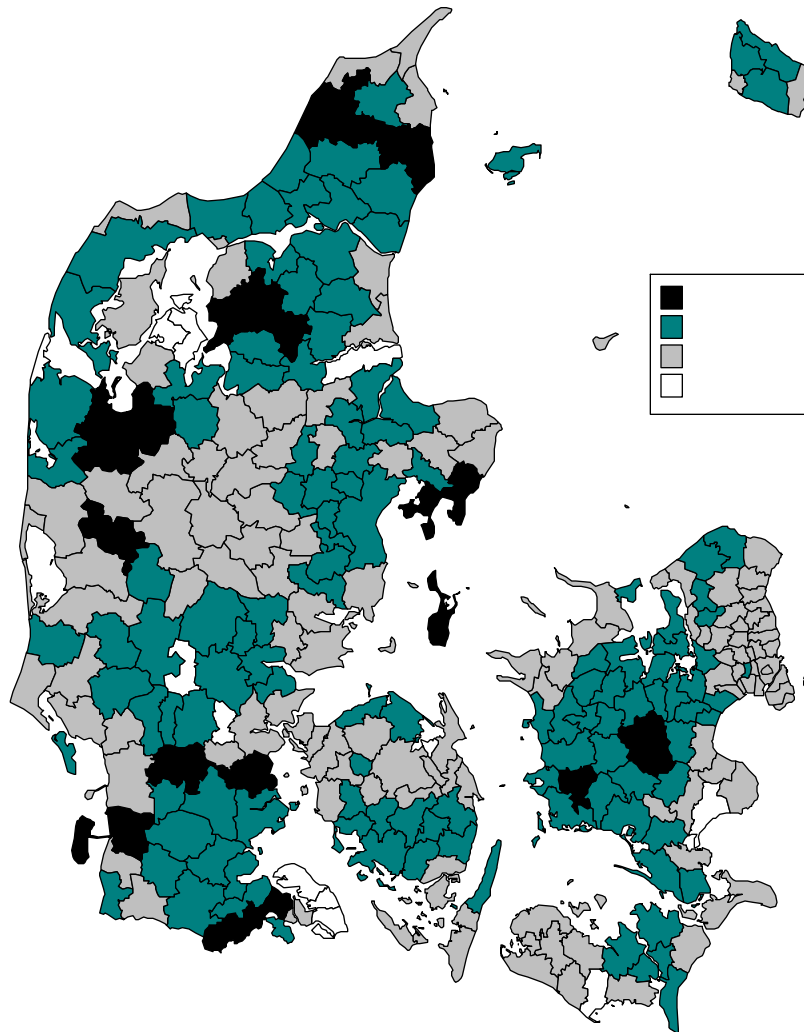
**Figure 2. Change in Employment Assessed by Place of Residence**



In LINE the earned income in each sector is proportional to employment. However, in this analysis this does not apply to agriculture where the average income per employee declines because of the declining productivity. For most sectors the geographic pattern of earned income by place of residence therefore follows employment by place of residence, see figure 3. However, because of the lower price and wage level (a decline of 2 and 6% respectively) the decline is bigger than for employment so that the income in general declines by 6-8%. It is almost the same municipalities B especially in Jutland B that are most severely affected as was the case with employment. However, a small change is seen in the income effects moving east compared to the employment effects. This is due to the fact that the average earning per employee is smallest within agriculture and biggest within industry. Since in rural areas (especially in Jutland) a change in activities from low productive to high productive sectors takes place the average productivity increases. The

relation between the decline in income and the decline in employment is thus smaller in Jutland than in the rest of Denmark. This reflects the differences between rural areas and cities because the same change of sectors does not take place in the cities. In the metropolitan area it is to a high degree the services sector that declines and this sector has a productivity close to the average of all sectors.

*Figure 3. Change in Earnings Assessed by Place of Residence*



The geographical distribution of the effects on disposable income, see figure 4, almost follows the earned income, but income taxes and transfers to some extent equalize the differences. This makes the geographic picture less clear with declines within a small interval between 5 and 6% in most municipalities. As the consumer prices decrease by about 2%, this leads to a real decrease in the disposable income of 3-4%. The equalization especially affects municipalities in Central and North Zealand.<sup>7</sup> This is due

<sup>7</sup> Zealand is the biggest Danish island situated in the eastern part of Denmark. The Danish capital is situated here.

to the fact that compensation in the form of unemployment benefit is connected to the decline in employment which is biggest in Western Denmark and not connected to the decline in income. Therefore, the nominal transfers (e.g. unemployment benefit) decrease a little bit on the Danish islands (in consequence of the nationwide declining wage adjustment of the rate of transfers) whereas the transfers increase due to higher unemployment, see table 3. This causes a weak tendency towards that municipalities in the East of Denmark B exclusive of the big cities B are more affected regarding the disposable income, while the Jutlanders get more out of the unemployment benefit.

**Table 3. Effect on Income etc. Year 2010**

Municipal group	Earnings by residence	Transfers	Taxes	Disposable income	Unemployment
	Mill. DKK	Mill. DKK	Mill. DKK	Mill. DKK	No. of people
Metropolitan area <sup>1</sup>	-30,476	166	-7,818	-20,766	15,302
5 biggest Danish cities <sup>2</sup>	-11,318	75	-2,678	-7,970	7,597
Danish islands exclusive of the Metropolitan area and the city of Odense	-12,613	-22	-2,875	-8,853	9,129
Jutland exclusive of the cities of Århus, Aalborg, Esbjerg and Randers	-27,540	993	-5,636	-18,517	22,467
Denmark in all	-81,947	1,212	-19,007	-56,106	54,495

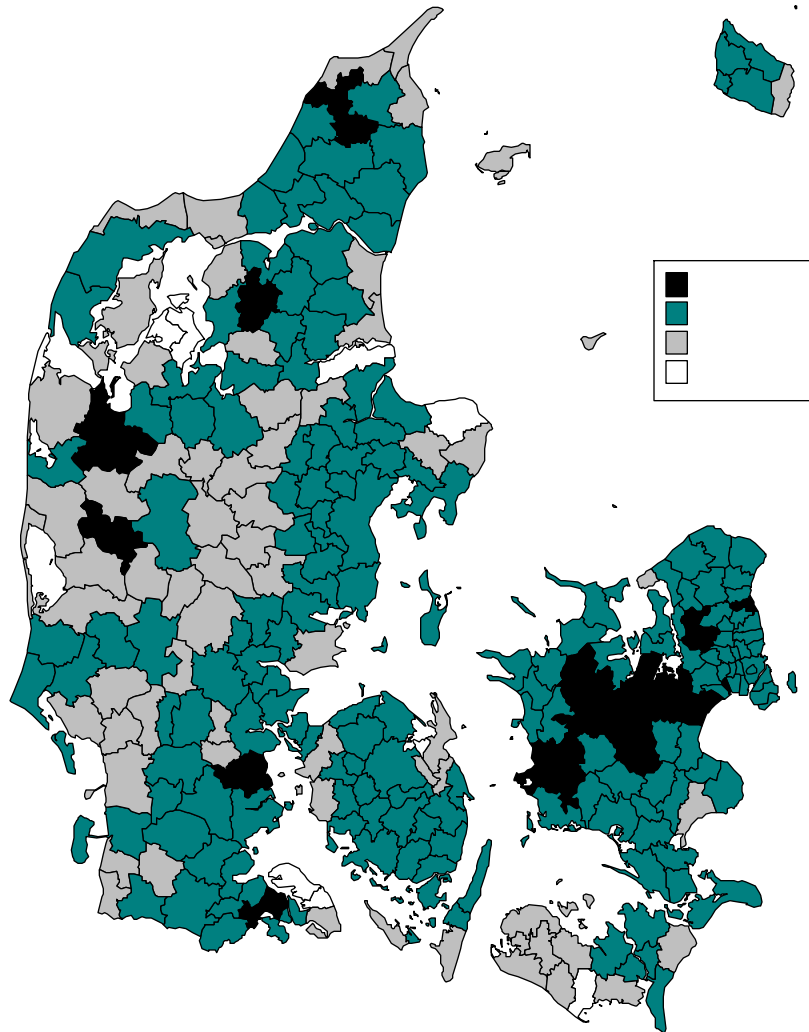
<sup>1</sup> The municipalities of Copenhagen and Frederiksberg, and the counties of Copenhagen, Frederiksberg and Roskilde.

<sup>2</sup> Århus, Odense, Aalborg, Esbjerg and Randers.

Thus, there is a weak tendency towards the geographic pattern of disposable income almost being contrary to the pattern of employment, see figure 2. Now the eastern part of the country is a little bit more affected than the western part.

In total, it is a question of a decrease in employment which affects Western Denmark relatively more than Eastern Denmark, while Eastern Denmark is a little bit more affected when it comes to disposable income.

*Figure 4. Change in Disposable Income*



### **Limitations of the Results and Future Analyses**

In several ways the chosen methods for the analyses could contribute to the results being a little too undifferentiated. The analyses have two crucial weaknesses.

First, it is a problem to use a general equilibrium model (AAGE) and a traditional macro-economic model (ADAM) in the same analysis.

The effects on agriculture are calculated using AAGE, which is very price elastic regarding international trade. Changes in cost and competitiveness are thus of great importance to production and employment. Besides, as a static model AAGE has an

immediate adaptability on the labour market so that the total employment (of the country) is not affected. A decline in employment within agriculture is immediately counter-balanced for by an increase in employment in other sectors. The results of AAGE should be regarded as long-term results B i.e. the results after the economy has fully adapted to the new conditions within agriculture. Still, when the results are referred to as the results after 13 years it is solely because the consequences are calculated with a productivity in agriculture which is a result of 13 years of low growth of productivity due to a fixed structure. Therefore, the results of AAGE are to be interpreted as a consequence of the lower productivity level after 13 years.

For non-agricultural sectors results from ADAM are used. Although ADAM has certain well-defined long-term characteristics, its basic structure is a short and medium-term model. Because of ADAM's long adjustment period and small price elasticities in international trade the model only shows a small increase in production and employment for these non-agricultural sectors so that the decline in the big cities is overestimated.<sup>8</sup> As already mentioned, in the long run ADAM has a 100% crowding-out effect on employment. However, the effect does not contribute very much to the employment result after the first 13 years, where the level of productivity in agriculture only declines gradually in relation to the baseline scenario. Here the results differ very much from that of AAGE's . Already after 13 years AAGE shows an increase in employment for some sectors and an unchanged total employment.

Thus, there is asymmetry in the analysis: Regarding agriculture we have forced through the effects from the general equilibrium model, but for the other sectors ADAM gets to be the deciding factor. Totally, this results in more negative consequences for employment, income etc. than has been found in AAGE, but also a distribution by sector which is too favourable for agricultural because in ADAM urban industries do not manage to compensate the decline in employment within agriculture during the period in question.

The reason for choosing ADAM as the model for the total agronomics is that a linkage between ADAM and AKF's municipal model, LINE, already exists, while a linkage to the SJFI model, AAGE, has not been implemented. The reason for AAGE being involved in the analyses is that ADAM's description of the agricultural sector is very rudimentary.

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<sup>8</sup> On the background of information about changes in productivity exclusively ADAM can provide an estimate of the decline within agricultural exports, but due to the relatively low price elasticities in ADAM's export relations and the long adjustment period it would only be a decline in the agricultural exports of about 3% after 13 years. This reduces the serious economic consequences by far. This emphasizes the sensitivity of the analyses regarding choice of model.



On the basis of this, in future agricultural analyses we intend to link the calculation of the regional effect directly to AAGE that provides an estimate of the consequences for all sectors and to omit analyses made by means of ADAM. Here a construction of a linkage between ADAM and LINE is required.

Another crucial weakness of the analyses is that the used version of LINE does not take into consideration that the services sector to a higher degree than other sectors is based on local demand. So the negative effects are probably more linked to the rural municipalities than found in these calculations. In other words, the decline in employment and income in the big cities is probably overestimated for this reason, too.

In future analyses the extended version of LINE (LINE 2 B under construction at present) will be used. LINE 2 will include direct effects from local demand for local activities and then the total effects on employment and income will to a higher degree be attached to the municipalities (and neighbouring municipalities) with a large agricultural and food processing industry. This will make the negative effects for big cities and the metropolitan area smaller than in the above calculations.

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