Danmarks Statistik
MODELGRUPPEN

Arbejdspapir*

Morten Werner

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Udbudsbestemt produktion i fødevaresektoren II

Resumé:

I papiret præsenteres en modificeret version af ADAM, der er opstillet og anvendt i forbindelse med SMP II projektet. I modellen bestemmes produktionsomfanget i landbruget og fødevaresektoren af producentsiden under antagelse af en eksogen eksportpris. Der ses på modelegenskaber og mulighederne for forbedringer diskuteres. Papiret bygger på kapitel 2 i rapporten "Environmental Satellite Models for ADAM", hvilket forklarer afsnits-, lignings- og tabelnummereringen.

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Nøgleord: landbrug, disaggregering af ADAM a-erhverv, Satellitmodeller

2. The agricultural sector in ADAM

In the current version of the ADAM model, production in the agricultural sector is determined from the demand side, while the output price is considered exogenous. It can be argued that this is not an appropriate description, because the agricultural sector in Denmark is small relative to a large world market and supply is restricted by land availability. This leads to the hypothesis that production is determined by the producer, who chooses the output level contingent on the export price.

This section presents the modelling of the agricultural production as determined in a modified version of ADAM. The modified version incorporates the hypothesis of exogenous prices of agricultural products in the export market, and describes the pricing behaviour of the sector in the domestic market. At the same time the model makes the importance of quotas etc. more visible within the model, and the link between the agricultural sector and the associated industry *manufacturing of food*, the *nf*-industry, is modelled explicitly. The model is made to facilitate a better description of agricultural production with and without underlying LADA-scenarios. Supply-side determined production in the agriculture is also discussed in Werner (1999).

Section 2.1 solves the theoretical problem of a sector selling to both the domestic and the export market facing an exogenous price at the export market. Section 2.2 describes the structure of the food producing industries in ADAM. Equations describing supply-side determined production are introduced in section 2.3, while section 2.4 describes equations for exports, export prices and subsidies. In section 2.5 equations for domestic prices are estimated. Some properties of a version of ADAM modified with supply-side determined production in the food producing sector are presented in section 3. Section 4 concludes.

2.1 Supply-side determined production

This section describes the behaviour of a profit maximizing sector or industry producing one output which is sold in two markets. In the first market it is assumed that the industry knows some downward sloping demand curve and faces competition from competing goods. In this market, which will be referred to as the *domestic market*, the sector chooses an output price. In the other market, the output price is exogenous and the sector faces a horizontal demand curve. This market is referred to as the *export market*.

The above implies that the sector is solving the problem:

$$\max_{X,p^d} \Pi = p^d \cdot D\left(\frac{p^d}{p^c}\right) + p^e \cdot \left(X - D\left(\frac{p^d}{p^c}\right)\right) - TC(X) \qquad \textbf{(2.1.1)}$$

where X is the level of production, while p^d is the price of the sector's output and p^c is the prices of the competing goods in the domestic market.

p^e is the exogenous price received by the sector in the export market. $D(p^d/p^c)$ is the domestic demand for the product produced by the industry given prices p^d and p^c. It is assumed that $D'(p^d/p^c)<0$ and that the price elasticity, ξ, is constant and numerically larger than 1; $TC(X)$ is the cost minimizing total costs of producing X. Finally, it is assumed that $MC'(X)>0$, where $MC(X)=TC'(X)$.

Solving the problem leads to the following first order conditions:

$$p^e = MC(X) \tag{2.1.2}$$

and

$$p^d = (1+\mu)\cdot p^e \tag{2.1.3}$$

Equation (2.1.2) is a supply function for the sector stating that the level of production is chosen so that the marginal cost of production equals the export price. Equation (2.1.3) shows that the industry chooses its domestic market price, p^d, as a mark-up on the export price, p^e. This is due to the fact that the export price can be seen as the alternative price of selling in the domestic market, since the industry can always sell to the export market at the price p^e. The constant mark-up follows from the assumptions on the elasticity[1] in the demand function.[2] Note from (2.1.3) that

$$\frac{\partial p^d}{\partial p^e} = (1+\mu) \leftrightarrow \frac{\partial p^d}{\partial p^e}\cdot\frac{p^e}{p^d} = (1+\mu)\cdot\frac{p^e}{(1+\mu)\cdot p^e} = 1 \tag{2.1.4}$$

that is, a 1 % change in the export price leads to a 1 % change in the domestic price. This is the feature of equation (2.1.3) which is used in the empirical model.

Finally, it is noticed from equation (2.1.1) that total exports from the sector are determined residually from production and domestic demand for X.

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[1] The price elasticity of demand with respect to p^d is

$$\xi = \frac{D'\left(\frac{p^d}{p^c}\right)\cdot\frac{p^d}{p^c}}{D\left(\frac{p^d}{p^c}\right)}$$

[2] The first order condition with respect to p^d *is*

$$D\left(\frac{p^d}{p^c}\right) + p^d\cdot D'\left(\frac{p^d}{p^c}\right)\cdot\frac{1}{p^c} - p^e\cdot D'\left(\frac{p^d}{p^c}\right)\cdot\frac{1}{p^c} = 0 \leftrightarrow \frac{p^e}{p^d} = 1 + \frac{D\left(\frac{p^d}{p^c}\right)}{D'\left(\frac{p^d}{p^c}\right)\cdot\frac{p^c}{p^d}} \leftrightarrow \frac{p^e}{p^d} = 1 + \frac{1}{\xi} \leftrightarrow$$

$$p^d = \left(\frac{\xi}{1+\xi}\right)\cdot p^e \leftrightarrow p^d = \left(1 - \frac{1}{1+\xi}\right)\cdot p^e \leftrightarrow p^d = (1+\mu)\cdot p^e$$

where $\mu=-1/(1+\xi)$ as ξ is constant and $|\xi|>1$ it follows that μ is a positive constant.

2.2 The agricultural and related sectors

The agricultural sector in ADAM, denoted the *a*-sector or *a*-industry below, is an aggregate of 5 industries from the most detailed level of the National Accounts. The industries are *agriculture*, *horticulture etc.*, *agricultural services*, *forestry* and *fishing*. However, the ADAM industry denoted *manufacturing food*, the *nf*-industry, which consists mainly of slaughterhouses but also dairies, bakeries and mills etc., relies heavily on the agricultural sector for inputs. This section discusses the interdependency of the *a*-sector and the *nf*-industry and the assumptions which are made in the modelling of the production in these two industries.

If one looks at the fixed price input-output table describing 1997 at the ADAM aggregation level, one finds that about 55% of output from the agricultural sector is used as input in the *nf*-industry, 15% is used by the agricultural sector itself, about 20% is sold directly to the export market, mainly as exports in SITC-group *0*, *E0*, while the remaining approximately 10% is used directly for consumption (7%) or inputs in other domestic industries. The *nf*-industry sells approximately 55% of its output in the export market, mainly *E0*, about 20% of total production is used for private consumption of food, while just over 10% of production is used by the industry itself. Looking at the *nf*-industry from the input side it is seen that 38% of the total production stems from the agricultural sector.

The very low proportion of agricultural products used by final domestic demands indicates that a large proportion of agricultural output must be processed before it is consumed. This implies that one could think of agriculture as producing two goods, one which needs processing and one that can be consumed directly. This suggests that agriculture can sell the part of its production which must be processed, either to the *nf*-industry or to foreign plants. Likewise, the sector can sell the part of its production that does not need processing to either domestic or foreign consumption. In the model presented in the following section, it will be assumed that the proportion of agricultural output which is processed in the *nf*-industry is exogenous.[3] For simplicity, it is furthermore assumed that the remainder of the agricultural production can be sold either to domestic demands or exported at the exogenous export price.

The proportion of agricultural production used as input in the *nf*-industry has been relatively stable since the mid 1970s, varying between 34% and 39% of total production in the *nf*-industry. This amounts to between 55% and 60% of agricultural production. One can think of the input of agricultural semi-manufactured products as the basic input in the *nf*-industry, while other inputs such as labour, capital, energy and other materials are gross complements to the agricultural input in the *nf*-production function. It is assumed that the *nf*-industry will in fact buy and

[3] This assumption could be justified by an argument that some proportion of agricultural production is not fit for transportation over long distances. In this case the proportion of agricultural output which needs processing in the *no*-industry is determined by, for instance, the underlying composition of agricultural production.

manufacture the agricultural output in question. In principle, the *nf*-industry can buy agricultural input in the *a*-sector or on the world market. The current version of ADAM already allows for this via substitution between input of products from the *a*-sector and inputs from imported agricultural products from SITC groups *0* and *2*, *M0* and *M2*. Approximately 55% of output from the *nf*-industry is exported, while 20% is used in private consumption of food. This implies that the *nf*-industry can be considered a one-output industry, in the sense that it produces for consumption only.

The determination of production in the *nf*-industry in the modified version of ADAM rests upon the two assumptions concerning production in the *a*- and *nf*-industries discussed above:

1) A proportion of the agricultural output must and will be processed in the *nf*-industry before it can be sold to final demands

2) Agricultural semi-manufactured products from the *a*-industry are the basic input in the *nf*-industry

Assumption 1) states that selling live pigs, raw milk etc. directly to households is not custom and that a proportion of these goods is in general not exported. The hypothesis implies that a constant proportion of the agricultural production is processed in the *nf*-industry; this proportion is assumed to change only with the composition of agricultural output. The objection to 1) is that it might be possible for the *a*-sector to sell some of these goods in the export market.

Assumption 2) states that if there is no agricultural production, then there is no production in the *nf*-industry. The objection to 2) is that the *nf*-industry could alternatively import *M0* and *M2* products for processing.[4]

2.3 Modelling production in the a-sector and nf-industry

The starting point for modelling the determination of agricultural production is the solution to the theoretical problem described in section 2.1. Two additional features are taken into account: 1) a scenario concerning production and prices in the *a*-sector might be known from the LADA-model. 2) the dependency between the *a*- and *nf*-industries discussed in section 2.2.

Concerning 1) the model is constructed such that some exogenous benchmark scenario, typically derived from some ESMERALDA/LADA scenario, determines the initial level of production in the agricultural sector, given some scenario describing factor prices and the price obtained in the export market. If the export price or the factor prices change

[4] The objections to 1) and 2) could be objects for future research.

compared to the benchmark scenario, the first order condition (2.1.2) comes into play, altering the production.

The cost of production in the baseline scenario is given from the LADA scenario, or alternatively from the factor demand system in ADAM. In both cases the production function exhibits constant returns to scale, implying that the marginal cost is constant. This introduces a problem of indeterminacy to the model, since production will be infinite if the export price is above the marginal costs, and undetermined if the export prices equals the marginal costs. There will be no export if the export price is below the marginal costs.[5]

The problem is solved by assuming that the reaction of exports of *E0* to price changes is unaltered compared to the current version of ADAM, implying that some price elasticities of production can be derived using the estimated export price elasticities used in the current version of ADAM. This practice implicitly assumes that the marginal cost depends positively on the level of production, which can be justified by assuming, for instance, that land is a fully fixed and crucial factor in agricultural production in all sub sectors (despite this not being explicitly modelled in neither LADA nor ADAM), or that for instance some costs of respecting rules in agricultural production rise when production is increased.

Given the above, and assuming some sluggishness in adjusting production to a new level, the production in the agricultural sector can be written in error correction form as in equations (2.3.1) and (2.3.2) below:

$$\log(fXaw) = \log(fXae) + \xi_l^a \cdot \log\left(\frac{pne0}{pwaw} \cdot kfXa\right)$$
$$kfXa = \frac{pwawe}{pne0e} \qquad \textbf{(2.3.1)}$$

where ξ_l^a is the long run price elasticity of production in the *a*-sector, *fXaw* is the profit maximizing level of production in the long run. *fXae*, *pne0e* and *pwawe* are agricultural production, the price received by the producer when exporting to *E0* and costs of production in the baseline scenario. *pne0* is the actual price received by the exporter and *pwaw* is the actual costs of production. Note from (2.3.1) that if *pne0*=*pne0e* and *pwaw*=*pwawe* then *fXaw* is equal to the agricultural production in the baseline scenario.

[5] In this case the level of production in the theoretical problem (2.1.1) will be determined by the domestic demand when the sector choses some profit maximizing domestic prices according with (2.1.3)

The dynamics of production are given by

$$d\log(fXa) = d\log(fXae_t) + \xi_s^a \cdot d\log\left(\frac{pne0_t}{pwaw_t} \cdot kfXa_t\right) + \gamma \cdot \left(\log(fXaw_{t-1}) - \log(fXa_{t-1})\right) \qquad \textbf{(2.3.2)}$$

where ξ_s^a is the short run price elasticity of production in the *a*-sector while γ is the speed of adjustment. Note from (2.3.2) that the actual profit maximizing level of production also in the short run is equal to the corresponding variable in the baseline scenario, as long as the actual export price and costs are unchanged relative to the baseline scenario.

The elasticities ξ_l^a and ξ_s^a are regarded as exogenous variables in the modified ADAM. This allows changing the elasticity of production, which is an advantage when analysing the effects of changing rules and quotas, since changes in rules can reduce or expand the sectors' possibilities of reacting to price changes. Especially new rules or quotas can hinder expansion of production through restrictions or higher costs of production, thereby lowering the elasticities. Furthermore it allows the user of the model to introduce the hypothesis that the elasticities are decreasing in production as a result of land scarcity. As a benchmark the output elasticities are chosen such that the price elasticities of exports, *E0*, are identical in the partial models of *E0* in the current and the modified version of ADAM.[6]

The starting point in the modelling of production in the *nf*-industry is hypothesis 1) and 2) in section 2.2. If one assumes that the underlying composition of agricultural production is unchanged, these assumptions imply that a one % increase in agricultural production raises the production of products which need processing in the *nf*-industry by 1%, thereby increasing the material inputs in the *nf*-industry by 1%.[7] In ADAM production and material inputs are proportional, hence a 1 % increase in agricultural production leads to a 1% increase in production in the *nf*-industry.

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[6] In the current version of ADAM exports of *E0* are determined by a downward sloping demand curve in the world market and the relative price of *E0* produced domestically (which is a mark-up on average unit costs) and elsewhere. In both models a higher world market price will increase Danish exports. In the modified ADAM this is due to increased production and higher domestic prices, and in the current version of ADAM due to the increased competitiveness of domestically produced goods. The benchmark output elasticities are chosen such that the effect on fixed price *E0* of a one percent increase in the world market price is identical in the two models.

[7] Agricultural products are a part of material input, *fVmnf*, in the *nf*-industry. The total material input is proportional to input of agricultural production when it is assumed that *fVmnf* is produced from inputs from various industries and import groups by Leontief technology. This is almost the case in ADAM. However, there is some substitution between energy and material as well as substitution between domestically produced and imported inputs; this leads to small deviations from the Leontief assumption. These deviations will result in minor deviations from the hypothesis of proportionality between agricultural and *nf* production when using the model.

It follows that production in the *nf*-industry is given as:

$$d\log(fXnf) = d\log(fXa) \qquad \textbf{(2.3.3)}$$

This equation states that the growth rates in production in the *a*- and *nf*-industry are equal.

For forecasting purposes, equation (2.3.3) can be used directly, as long as there are no changes in the composition of agricultural output. If one, for instance, in a policy analysis based on ESMERALDA and LADA observes changes in the composition of agricultural output, one should consider whether this is likely to change the proportion of total agricultural production which must be processed before sold to the final demands. This is the case in the experiment in section 8.2.2, where the production of pigs and cattle is reduced, while crop production etc. is unchanged. In this experiment it is assumed that the entire change in production is due to change in the part of production, which must be processed in the *nf*-industry and corrections are introduced into equation (2.3.3).

The pricing behaviour in the *nf*-industry is given by (2.1.3), as the pricing behaviour in the domestic market is independent of the production level.

2.4 Export, export price and subsidies

Having determined the production in the agricultural sector and the corresponding production in the *nf*-industry, the exported volume of *E0* from these industries is found residually from production and demands other than *E0*:

$$f<i>E0 = fX<i> - \left(\sum_h a<i><h>fX<h> + \sum_i (a<i><j> \cdot D\left(\frac{p<j>}{pcp} \right) \right) \qquad \textbf{(2.4.1)}$$

where $i = a$, *nf* and indexes *h, j* denote industries and final demands (other than E0) respectively, *faE0* and *fnfE0* are exports of SITC 0 from the *a*- and *nf*-industry respectively. The prices $p<j>$ are prices of final demand. These are functions of domestic prices in the *a*- and *nf*-industries. From equation (2.4.1) it is especially noted that industry pricing behaviour in the domestic market affects the level of exports.

An intermediate variable describing the exported volume from the *a*- and *nf*-industry is defined as:

$$fE0k = faE0 + fnfE0 \qquad \textbf{(2.4.2)}$$

The SITC0 export from the *a*- and *nf*-industry, *fE0k*, amounts to approximately 90% of total SITC0 exports, and the total exported volume *fE0* is assumed to be proportional to exports from the *a*- and *nf*-industry:

$$fE0 = fE0(-1) \cdot \frac{fE0k}{fE0k(-1)} \quad \textbf{(2.4.3)}$$

The remaining 10% of the exported volume originates from trade, *qh*, the *nn*-industry "manufacturing of beverage and tobacco" and finally, imports from SITC0, *M0*. Equation (2.4.3) implies an assumption of constant properties among the input-output coefficients *aae0*, *anfe0*, *anne0*, *aqhe0* and *am0e0*. In this way modelling of input-output coefficients is avoided, and due to the large proportion of *fE0* originating from the *a*- and *nf*-industries the assumption seems reasonable.

Returning to the problem (2.1.1) and the actual production in the agricultural sector (2.3.2), it can be seen that production is determined by some export price and the marginal costs of producing. The export price in question is the price received by the producer when exporting goods in SITC0.

In ADAM variable terms, the price received by the exporter is:

$$pne0 = pe0 - \frac{Sipe0}{fE0} \quad \textbf{(2.4.4)}$$

where *pe0* is the price received by the exporter less subsidies, while *Sipe0/fE0* is the subsidy received per exported unit.[8] The price, *pe0*, could be considered the price of Danish products in the world market. In the modified model *pe0* is considered to be exogenous and it is a compound price determined by world market prices, exchange rates and the composition of the Danish sub-SITC0 exports. Note that *pe0* cannot be considered a genuine world market price of *fE0*, since other countries might have other compositions for their SITC0 exports. That is, the price *pne0* is made up of three major components: some world market price and exchange rates, which together equal *pe0* and subsidies received by the sector. In the current version of ADAM *pe0* is calculated from the cost side.

The subsidy received by exporters of SITC0 is given from different schemes such as *Sipe0* = *Sipee* + *Sipaa* + *Sipeq*, where *Sipeq* is a residual and *Sipaa* is compensatory payments for arable crops. *Sipee* is export subsidies. In principle *Sipee* is received when exporting to markets outside the EU, and implies obtaining a price lower than some guaranteed price. Here, however, we are only looking for some rate, *tpe0*, as an approximation of the export subsidy obtained per unit exported.

[8] In ADAM Sipe0 is taxes on specific goods net of subsidies to specific goods. Sipe0 is negative as agriculture is a net receiver of subsidies. This implies that the price received by the sector when exporting, pne0, is higher than the price received at the border, pe0.

It is found that:

$$Sipee = \tau \cdot (p^{EU} - p^{W}) \cdot (1 - \alpha) \cdot fE0 + Sipeem \rightarrow$$

$$tpe0 = \frac{Sipee - Sipeem}{fE0} = \tau \cdot (p^{EU} - p^{W}) \cdot (1 - \alpha) \qquad \textbf{(2.4.5)}$$

where τ is the proportion of the price difference received as a subsidy, α is the proportion of exports to EU countries and p^{EU} is the price guaranteed by the EU, while p^{W} is the world market price. *Sipeem* is monetary equalization amounts. Equation (2.4.5) tends to lead to a rather rough estimate of the subsidy rate *tpe0*. Since τ, α, p^{W} and p^{EU} are unknown, the rate is determined simply as (*Sipee-Sipeem*)/*fE0*.

In the modified version of ADAM

$$Sipe0 = Sipaa + tpe0 \cdot fE0 - Sipeem + Sipeq \qquad \textbf{(2.4.6)}$$

is the modelling of the total subsidy received by the exporters of *E0*.

2.5 Domestic prices

Solving the problem (2.1.1) leads to the first order condition (2.1.3), where the price in the domestic market will be chosen as a mark-up on the price the exporter can obtain in the export market, *pne0*.

In order to determine the pricing behaviour in the two industries, the following equations are estimated:

$$d\log(px<i>) = \beta^{i}_{1} d\log(pne0) + \beta^{i}_{2} d\log(pne0_{-1}) + \beta^{i}_{0} \qquad \textbf{(2.5.1)}$$

i=a,nf. The model is estimated to be unrestricted and under the joint restriction $\beta_1^i + \beta_2^i = 1$ and $\beta_0^i = 0$. When these restrictions are imposed (2.5.1) has the property of (2.1.3) that a 1% increase in the price received when selling in the export market, *pne0*, implies a 1% increase in domestic prices chosen by the *a*- and *nf*-industry. The change of domestic prices take place within two years.

The equations have been estimated using data for the period 1968 – 1997. The results can be read in Table 2.5.1 and Table 2.5.2 below. The restrictions have been tested using the usual F statistic based on the RSS. When testing at a 5% significance level comparing the F statistic to the *F(2,29)*-distribution the restriction cannot be rejected, and the magnitude of the coefficients are generally understandable.

Table 2.5.1 Estimation of *pxa*

Parameter	No restrictions		$\beta_1^a + \beta_2^a = 1$ and $\beta_0^a = 0$	
	coefficient	s.d.	coefficient	s.d.
β_0^a	0.00265	(0.004609)		
β_1^a	0.85308	(0.052883)	0.89219	(0.041201)
β_2^a	0.06969	(0.052255)	0.10781	
R^2	0.9152			
RSS	0.0109		0.0115	
DW	2.3402		2.3310	

Table 2.5.2 Estimation of *pxnf*

Parameter	No restrictions		$\beta_1^{nf} + \beta_2^{nf} = 1$ and $\beta_0^{nf} = 0$	
	coefficient	s.d.	coefficient	s.d.
β_0^{nf}	0.00583	(0.003083)		
β_1^{nf}	0.79091	(0.035325)	0.83994	(0.029378)
β_2^{nf}	0.11309	(0.034907)	0.16006	
R^2	0.9559			
RSS	0.0049		0.0059	
DW	2.9664		2.7100	

In the modified version of the ADAM model, the effect of this description of domestic prices of goods from the *a*- and *nf*-industries is that world market prices will affect the domestic price level through the supply side.

The main problem when using price equations like (2.5.1) to determine domestic prices is that the *nf*-industry will be buying inputs for use in production at the price *pxa*, even though these inputs need manufacturing, as argued in section 2.3. However, there are possible ways of avoiding this problem. One way could be to disaggregate the domestic market of the agricultural sector into two sectors: the *nf*-industry and the rest. Another way could be to avoid looking at the internal deliveries among the *a*- and *nf*-industries.

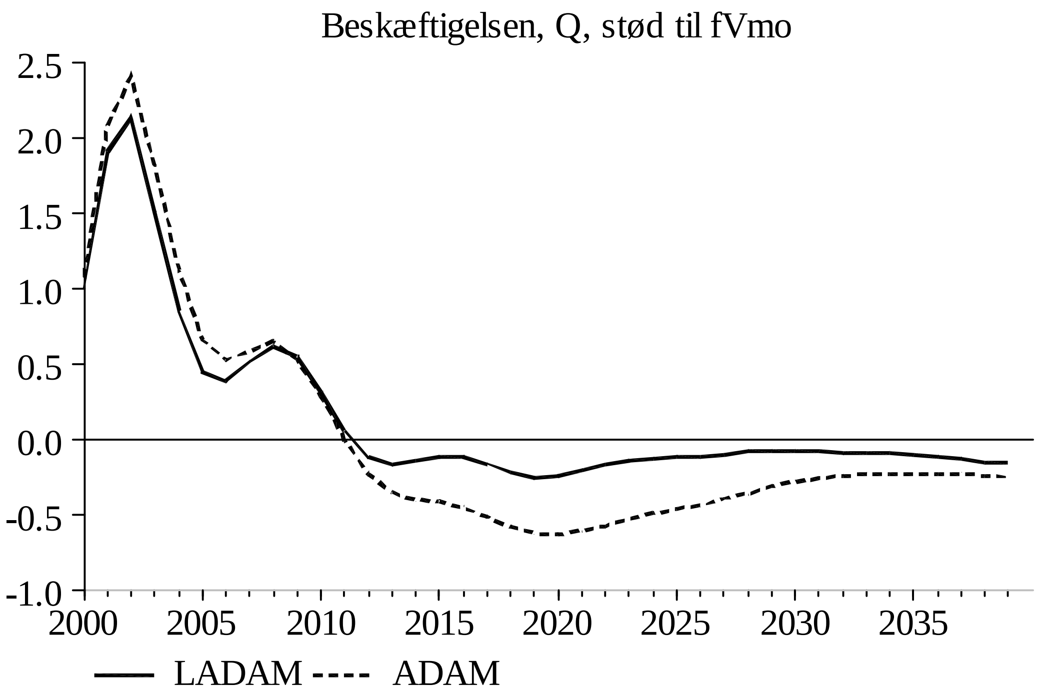
3. Properties of the modified model

In the following section the properties of a version of ADAM, where the agricultural sector has been modified as described in section 2 are examined. This model is referred to as LADAM. The elasticities of supply in the agricultural production has been chosen such that the elasticity of *fE0* exports with respect to the costs of production in the agricultural sector, *pwaw*, is unchanged compared to the partial export model in APR00. Two experiments are undertaken and the multipliers found in LADAM are compared to the multipliers from the corresponding experiment undertaken in APR00 (ADAM).

The important things to remember when analysing the differences is that the production in the food producing sector is determined by demand in ADAM, while agricultural production in the LADAM model is determined by marginal costs of production compared to the exogenous price obtain for food products in the export market, and that the production in the food processing industry is determined by the input from the agriculture.

In the first experiment the public expenditures are permanently increased by 1 bill. Danish 1995 kroner. The employment multipliers in ADAM and LADAM are shown below in figure 3.1.

figure 3.1

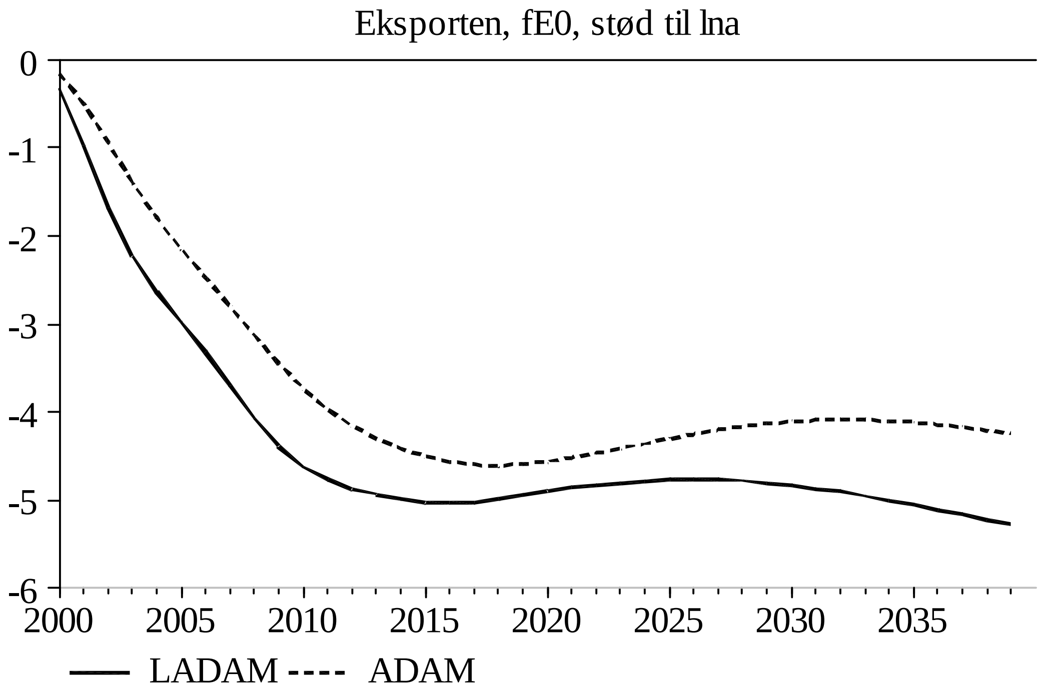


In the first 8 years the employment multiplier in LADAM is a bit lower than the corresponding ADAM employment multiplier. This follows from the fact that higher public spending does not affect production in the *a*- and *nf*-sectors. As activity in other sectors increases the factor prices rises, this causes a rise in the cost of production in the *a*-sector and thereby lower production in the *a*- and *nf*-sector. In the LADAM model *fE0* exports are declining due to lower production and increased domestic demands. Whereas *fE0* exports in the ADAM model are gradually reduced due to declining competitiveness in the export market. The effect on *fE0* exports are numerically larger in the LADAM model.

From year 9 to 13 the employment multipliers are almost identical in the two models. In the long run LADAM is characterized by considerably less "over-crowding-out" than the ADAM model.

In the second experiment nominal wages are increased by one percent over the period 2000 to 2039. The effect on *fE0* exports are shown in figure 3.2.

figure 3.2



The *fE0* exports in ADAM are reduced mainly due to higher costs of production. This leads to higher prices of domestically produced goods and thereby reduced competitiveness in the import- and export markets. In the LADAM model the higher costs implies less production in the *a*- and *nf*-sector. This tends to decrease exports. However, the domestic demand for *a*- and *nf*-production also decreases, this will tend to increase *fE0* exports. The overall effect is, as seen in figure 3.2, negative and numerically a bit larger than in the ADAM model.

4. Conclusions

It is suggested to change the model for agricultural production a long the lines outlined in this paper in the september 2001 model.

The main drawback in the modelling described above is the failure to estimate a supply function describing the agricultural production. This, however, will be a difficult task since the agricultural sector is heterogenous and heavily regulated. This also has to be remembered when using the model.

A few simple improvements could be:

- Modelling of two domestic prices, one determining the price on internal deliveries in the *a*- and *nf*-sub sectors and one describing other domestic prices

- In the model presented above the export to SITC 2 is considered to be a part of the domestic market. This market absorbs about half of the direct exports from the *a*-sector and should therefore be modelled as a part of the export market.

- Changing the production equation in the *nf*-industry to $fXnf=banf\cdot(fXa/aanf)$, where *banf* is an output-input coefficient describing the share of agricultural production, which is processed in the *nf*-industry. This change will not influence the properties of the model in forecasts or experiments, but will improve the model when simulating in historical years.