How to Derive Market Impacts of the Luxembourg Agreement on the German Beef Market – A Synthetic Uniform Model versus an Economic Country Specific Model

P. Salamon

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HOW TO DERIVE MARKET IMPACTS OF THE LUXEMBOURG AGREEMENT ON THE GERMAN BEEF MARKET – A SYNTHETIC UNIFORM MODEL VERSUS AN ECONOMETRIC COUNTRY SPECIFIC MODEL

Abstract

The paper discusses two partial equilibrium models, one is a synthetic model (GAPsi) and the other an econometrically estimated model (AG-MEMOD). While the synthetic model incorporates only price impacts and some shifts, the econometric model also reflects other influencing factors. Price formation includes policy measures as price wedges, or as explaining variables in key price equations or price transmission equations, which is also true when premiums and decoupling are regarded. When the Luxembourg Agreement is simulated, our example of beef shows that these model differences induce deviations in model results, especially concerning prices and trade.

Keywords: partial equilibrium model, CAP, Luxembourg Agreement, projections, econometric estimation
JEL-Classification: Q11, Q18

1 Introduction

Policy reforms in agriculture and analysis of their impact are recurring topics in the European Union. An overview of economic models, covering both partial and general equilibrium models in principle, can be found in van Tongeren et al. (2002). Even though the group of partial equilibrium models consists mainly of synthetic models of the SWOPSIM type, some others are econometrically based. The most well-known econometric model is FAPRI’s GOLD model, which is also partly a synthetic model, especially when the EU and its member states are regarded. For the EU member states, the econometric model AG-MEMOD (www.ag-memod.org) was developed based on the basic structure of the GOLD model (www.ag-memod.org).

The following paper deals with a comparison of the econometrically estimated AG-MEMOD model and the synthetic model GAPsi. The intention is to derive important features of partial equilibrium models and their impacts on model results. Following the introduction, in Section 2a focus is set on the respective model structures to give some insight into the interaction within both model types. Information on the required data and the model implementation is to be found in Section 3. An analysis based on questions of the current agricultural policy decisions, namely the Luxembourg Agreement, is presented in the subsequent Section 4. Here, the proposed levels of traditional agricultural policy instruments within the first pillar of the CAP partly replaced by premiums and decoupled from production are key issues. In order to focus this analysis on some methodological and technical aspects, the scope will be the EU before the enlargement in May, 2004. To allow for comparison, models and results are adjusted as much as possible. Here the focus is set on the beef sector in Germany. The final section comprises a qualification and concluding remarks.
2 Models

2.1 General approach

GAPsi is an international agricultural sector model. It is conceived not so much as a projection device but as a tool for policy simulation. The acronym, in German, stands for Common Agricultural Policy simulation. The roots of GAPsi trace back to the 1980s when Frenz (1982) analysed the effects of trade instruments and subsidies on agriculture. Further developments and details are described in Frenz and Manegold (1988), and in von Ledebur and Manegold (2004). Using a multi-product formulation, the model confronts agricultural production of goods with the processing, final consumption and trade. While the supply and demand components are kept in balance at an EU level, the model describes economic and technical relations between input and output quantities. In principle, the basic economic relationship is as follows:

\[ \Delta q_i^L = \sum_{i,j} \epsilon_{i,j}^L \frac{q_i^L}{p_j^L} \Delta p_i^L \]

where
- \( q \) = quantity,
- \( i \) = products 1, …, n,
- \( j \) = products 1, …, n,
- \( p \) = price 1, …, n,
- \( \epsilon \) = elasticity,
- \( L \) = level (produced, processed, consumed, traded).

The model formulation is comparatively static, i.e., modifications of policies, prices or quantities lead to a new equilibrium, of which prices and quantities are determined by the model. Policy instruments are implemented as price components or increments or as restrictions. Concerning crop production, harvested area and yield are considered separately thus leaving production to be determined by multiplication indicating non-linear elements. Moreover, there are certain model variants in which quadratic equations are used for modelling, e.g., (non-quota) milk supplies. So far, the model is synthetic with model parameters taken from literature, which are generally uniform across the EU regions. In general, those parameters meet theoretical requirements like symmetry, adding-up restriction, homogeneity, and no monetary illusion. As the transaction cost of trade is omitted, the model itself is non-spatial. So far, this model includes 13 regions: Germany, North-West Europe, Benelux, France, Mediterranean, Scandinavia, Poland, Hungary, Rest of CEECs, NAFTA, South-America, Oceania and Rest of the World.

Based on principle features of the FAPRI’s GOLD model, the econometric model AG-MEMOD was developed in recent years. AG-MEMOD stands for Agricultural sector in the Member states of the EU and Newly Associated States: Econometric Modelling. Here in principle, econometric country models of EU member states are interlinked in the AG-MEMOD partnership to derive the effects of policy changes in different EU countries and across the EU. The main focus was not only to analyze the impact of policy adjustments, but also to generate baselines for the agri-food sector so that future changes in the economic environment can be anticipated. Technically, AG-MEMOD is a non-linear equation system describing agricultural production and the respective markets that are usually represented by production, ending stocks, consumption, export and import. Here, one variable (in most cases export or import) is defined to ensure market clearing. The general form of the equations (2) is displayed as follows:
\[ q_i^L = a_n + \sum a_{i,j}^L p_i^L + \sum a_{n,j}^L v_n^L \]  

(2)

where  
\[ a = \text{parameter}, \]
\[ v = \text{non-price variable} \]
\[ n = \text{variable} \]

Price formation is regulated by special price linkage equations which derive local prices from key prices taking into account relations of production to consumption (3) or by a key price equation (4) which is a behavioural equation describing the price formation on the principle market of the EU. Price equilibriums in each market are found by the interactively running models for countries representing a very large part of EU agricultural output (Chantreuil et al., 2004). Concerning the key prices, they are adjusted until extra-trade export-demand equals extra-trade export-supply:

\[ p_j^c = a_0 + a_{i,j}^c p_j^k + a_{2,i}^c \frac{q_i^{c,s}}{q_i^{c,j}} + a_{3,j}^c \frac{q_j^{k,s}}{q_j^{k,d}} + \sum a_{n,j}^c v_n^c \]  

(3)

\[ p_j^k = a_0 + a_{1,i} p_j^w + a_{2,i}^c \frac{\sum q_i^{c,s}}{q_i^{c,d}} + \sum a_{n,j}^c P_{n,d}^{EU} \]  

(4)

where  
\[ C = \text{country} c, \]
\[ K = \text{key price country} k, \]
\[ S = \text{supply}, \]
\[ D = \text{demand}. \]

Basically, the approach assumes microeconomic properties like symmetry, homogeneity, adding-up restriction, and absence of monetary illusion. But due to the fact that the parameters of the models are econometrically estimated, some restrictions in this respect have to be accepted. Data on the actual performance of the agri-food industry considers developments in the economic factors on the one hand, and changes in policy measures on the other hand. Similar to GAPsi is the feature that AG-MEMOD doesn’t include transaction costs and is therefore regarded as a non-spatial model. Both GAPsi and AG-MEMOD assume that homogenous goods and trade take place in pooled world markets. Policy impacts are conducted in such a way that policy simulation results are compared with a projection generated under the ‘status quo’ conditions without a certain policy change (baseline). So these simulations show likely impacts, but are not forecasts, as weather fluctuations and many other influences additionally affect the actual outcomes. In the following section, certain aspects of GAPsi and AG-MEMOD are highlighted and compared to deduce their likely effect on model results. Here we will focus on the beef sector.

2.2 Supply

Within the synthetic model GAPsi, supply \((SS)\) and animal productivity \((Yld)\) are derived independently. To keep the formulation simple, indices which not needed for explanation are omitted. Animal productivity is assumed to be dependent on changes in domestic (consumer) prices \(\Delta P_{dom}\) and yearly changes in productivity \((EY)\). Additionally, specific annual or regional shifts can be included \((sYld)\). The animal production (6) is modelled in GAPsi based on the own price elasticity of supply \((\eta_{S_{ijr}})\) and according to producer price changes \((\Delta P_{pr_{ijr}})\). Additionally, annual economic growth \((r_{Grow})\) and (constant) transmission elasticity \((\eta_{Grow})\) factors which stand for the effect of investment in the sector are included. These products or period specific shift factors can be switched
Thus, as animal production is defined by (6), animal stocks \((QN)\) are calculated as an identity
\[SS_{ir(t)} = Yld_{ir(t)} * QN_{ir(t)} \]

\[Yld_{ir(t)} = (1+sYld_{ir(t)}Yld_{ir(t-1)}*EY_{ir(t)}*\Delta Pdom_{ir(t)}*Yld_{ir(t)}/Pdom_{ir(t)} \]  \(5\)

\[SS_{ir(t)} = (1 + \eta Grow_{ir} * rGrow_{ir}/100) * SS_{ir(t-1)} + \sum_{i,j} {\eta S_{ijr} * (SS_{ir(t-1)}/Ppr_{jr(t-1)})} * \Delta Ppr_{jr(t)} \]  \(6\)

In contrast to this, in AG-MEMOD, the production is defined by the number of slaughtered animals
and by slaughter weight. The slaughter weight (7) is determined by a trend, and to a small degree
by the share of calf slaughtering, by the premiums adjusted price and by some dummies reflecting the
German re-unification and the occurrence of BSE:

\[
CCSLWDE = 265.1075 -7.535129 * (CCKCVDE/BCKTTDE) +0.014416
((BPRMDE/CIFICIDE/GDPDDE)+(CCMBP*EXREDE/GDPDDE/CCSLWDE(-1)))
+ 1.110522 TREND70 + 19.99237 DUM-L91 + -3.569838 DUM-D91
- 1.983612 DUM-XBSE2  \]  \(7\)

where

- **CCSLWDE** = slaughter weight.
- **CCKCVDE**/**BCKTTDE** = calf slaughter in Germany,
- **BPRMDE** = beef producer price,
- **CIFICIDE** = price index beef production,
- **GDPDDE** = general price index,
- **CCMBP**/**EXREDE**/**GDPDDE** = male beef premium in relation to the general price index,
- **TREND70** = trend variable starting in the year 1970,
- **DUM-L91** = dummy variable for change in level beginning in 1991,
- **DUM-D91** = trend starting in year 1991 (to compensate for re-unification),
- **DUM-XBSE2** = dummy for the years with BSE impacts.

In contrast to the situation by slaughter weight, the schemata to acquire the number of slaughterings is
more complex as it includes three components: cow slaughtering, calf slaughtering and other cattle
slaughtering. These different types of slaughtering are endogenous. As an example, the slaughtering of
other cattle is described which is influenced by a bundle of variables including other endogenous
variables explaining developments in the cattle stock, economic variables like price relations and
premiums, and dummy variables concerning the German re-unification. The cattle stock variables and
the prices are endogenously determined by separate equations.

\[
CCKOTDE = 666.4216 + 0.268595 (CCCCTDE(-1)+ CCSMTDE(-1)) - 0.038808 CCCCTDE(-2)
+ 96.11325 DCCCTDE(-1) - 3.28073 BCCCTDE(-1)
+ 0.390203 CCPRMDE/PKPRMDE
- 2.117113 BCQSCDE 116.3595 (CCMBP * EXREDE/GDPDDE)
+ 312.1457 (CCMBP(-1)*EXREDE(-1)/GDPDDE(-1))
- 0.264927 DUM-T91 + 1.93036 DUM-XBSE2  \]  \(8\)

where

- **CCCCTDE** = beginning stocks of cattle,
- **CCSMTDE** = imports of cattle,
- **DCCCTDE** = beginning stocks of dairy cows,
- **BCCCTDE** = beginning stocks of suckler cows,
CCPRMDE/ PKPRMDE = price relation beef to pigs,  
BCQSCDE = suckler cow quota,  
CCMBP*EXREDE/GDPDDE = male beef premium in relation to the general price index,  
DUM-T91 = trend starting in year 1991 (to compensate for re-unification),  
DUM-XBSE2 = dummy for the years with BSE impacts.

As can be seen, the matrix of influencing factors in AG-MEMOD is much more detailed than in the synthetic model GAPsi. This is both a blessing and a curse as this more complex structure of AG-MEMOD also has to be estimated. Signs of the variables came up as expected, but only when some explaining variables were removed, and high levels of significance of the estimated variables have occasionally been missed. Problems were caused by policy variables when they had to be rejected due to too low significance, like the suckler cow premium.

2.3 Demand

Within GAPsi, per-capita food consumption in year t is a function of per-capita consumption in year t-1, of the changes in real income per head (Inc_r), and real product prices (Pcs_jr), with η_inc_r being the income elasticity (eq. 9).

\[
Ccs_{ir} = sDcs_{ir} * Dcs_{ir(t-1)} + \eta_{Inc_{ir}} * (Dcs_{ir(t-1)} / Inc_{r(t-1)}) * \Delta Inc_{ir} + \sum_j {\eta_{Dcs_{ijr}} * (Dcs_{ijr(t-1)} / Pcs_{jr(t-1)}) * \Delta Pcs_{jr}}
\] (9)

Regarding demand elasticities (η_Dcs_{ir}), cross-price elasticities of demand are assumed to be zero except for the different meats (i and j), for which own- and cross-price elasticities are determined within a special module using a maximum entropy approach. The problem faced here is that demand of a single meat type is clearly not independent from demand of another meat types, and, also has to be seen in the context of total food demand. Consequently, whenever the effects of changes in meat prices on the demand for meat are to be calculated, the price elasticities have to take account of those interdependencies. In fact, they have to meet quite a number of restrictions which are difficult to observe simultaneously unless they were to be estimated by a comprehensive econometric system of consumer expenditure. Such data are, however, not available and the elasticities derived from different sources (synthetic character of GAPsi) are not likely to meet the postulated restrictions altogether. The principle of the entropy approach in this context is to start with a matrix of coefficients representing a plausible structure of price-quantity reactions and to formulate the theoretical requirements as restrictions (Frenz and Manegold, 1988). By solving the system in consideration of the restrictions, the matrix will be adjusted to simultaneously meet the conditions at the least possible overall deviation from the old structure (Folmer, 1993, Graef and Blien, 1989, Heitmann, 1998).
Beef Demand price elasticities

<table>
<thead>
<tr>
<th>Beef Demand price elasticities</th>
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<tbody>
<tr>
<td>( \eta_{Dcs_{beef, beef, DEU}} )</td>
<td>-0.70</td>
</tr>
<tr>
<td>( \eta_{Dcs_{beef, lamb, DEU}} )</td>
<td>0.018232</td>
</tr>
<tr>
<td>( \eta_{Dcs_{beef, pork, DEU}} )</td>
<td>0.132920</td>
</tr>
<tr>
<td>( \eta_{Dcs_{beef, poultry, DEU}} )</td>
<td>0.049866</td>
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</table>

Beef productivity elasticity

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<tbody>
<tr>
<td>( \eta_{Y_{Beef, DEU}} )</td>
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</tbody>
</table>

Derived Beef supply price elasticity

<table>
<thead>
<tr>
<th>Derived Beef supply price elasticity</th>
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<tbody>
<tr>
<td>Beef – beef</td>
<td>0.600000</td>
</tr>
<tr>
<td>Beef – lamb</td>
<td>-0.020000</td>
</tr>
<tr>
<td>Beef – pork</td>
<td>-0.050000</td>
</tr>
<tr>
<td>Beef – poultry</td>
<td>-0.050000</td>
</tr>
</tbody>
</table>

Table 1: Supply and demand parameters used in GAPsi

AG-MEMOD’s per capita demand is structured in a similar way but includes only cross price effects for poultry. Here demand equations were independently estimated without regard for limits in overall consumption. So the per capita consumption of beef as well as of other meats is explained by income developments, own as well as cross prices, a trend, and some dummy variables. Cross-price variables for meats other than chicken had to be rejected due to wrong signs. The trend reflects the declining consumption trend for red meat of the last thirty years:

\[
\log(BVUPCDE) = 1.546996 -0.043313 \log(BVPRMDE/GDPDDE) + 0.154995 \\
\log(BRPRMDE/GDPDDE) + 0.119628 \log(RGDPDDE/POPDE) - 0.315182 DUM-XBSE2 - 0.014934 DUM-T91 - 0.137567 DUM-D94 - 0.199048 DUM-D95 - 0.010467 TREND70
\]

(10)

where

- \( BVUPCDE \) = per capita consumption of beef,
- \( BVPRMDE \) = wholesale price of beef,
- \( GDPDDE \) = general consumer price index,
- \( BRPRMDE \) = wholesale price of chicken,
- \( RGDPDDE/POPDE \) = per capital real income,
- \( DUM-D94 \) = single year dummy for the year 1994,
- \( DUM-D95 \) = single year dummy for the year 1995,
- \( TREND70 \) = trend variable starting in the year 1970.

2.4 Market clearing

Neglecting eventual changes in carry-over stocks, foreign trade or net export demand is defined as the difference between regional supply and regional domestic human consumption within GAPsi. Net exports can be restricted by limits resulting from the international WTO agreement. Overall world supply \( (SS_{\text{int}}) \) equals overall world demand for food \( (Dcs) \), feed \( (Dfd) \), if available for seed \( (Dds) \) and net export \( (Dex) \) but with world net exports adding up to zero (11). This overall market clearing in GAPsi is technically implemented by minimising the difference between world supply and world demand. The obtained price-quantity equilibrium is determined internally in the model.

\[
\sum_r \{Dcs_{\text{int}} + Dfd_{\text{int}} + Dds_{\text{int}} + Dex_{\text{int}}\} = \sum_r \{SS_{\text{int}}\}
\]

(11)
Unlike GAPsi, AG-MEMOD’s food markets consist of at least five components (production, demand, imports, exports and stocks) which are determined by four separate equations. To ensure market clearing, one component is defined as market closure and calculated by an identity (12). This concept is identical for all EU countries, but the market closure variable may vary according the country regarded. In the case of beef in Germany, exports are defined as a market closure variable whereas imports and beef stocks are endogenously determined by different equations.

On the EU level, net export supply must be equal to specified net export demand, otherwise price adjustments will guarantee the market equilibrium. The concept is comparable to the approach of GAPsi at a regional level.

\[ SPR + SMT + CCT(-1) - UDC - UXT - CCT = 0 \]  \hspace{1cm} (12)

where
- \( SPR \) = production,
- \( SMT \) = imports,
- \( UDC \) = total domestic demand,
- \( UXT \) = exports.

### 2.5 Price formation

With regard to prices, GAPsi differentiates between miscellaneous price levels starting with a uniform world market price. Any region, including the EU as a single market, has its own border price, either a c.i.f. or a f.o.b. price, which is dependent on the region’s foreign trade status. Further prices regarded are domestic market prices, producer prices, and consumer prices. The product specific price wedges include transaction costs and may correct for quality differences. Trade barriers also cause price differentials. The price system implemented in GAPsi additionally allows the depiction of impacts of some CAP instruments and can be summarised as in Figure 1. Since all regional prices are expressed in national currency, the annual exchange rates are accounted for exogenously. For practical reasons prices in the EU member states and acceding countries are expressed in Euros, while the prices in other regions are in US $. So under the CAP, the producer price plus the coupled share of premiums (see also OECD, 2001) equal the incentive price which drives supply in GAPsi. After decoupling of the premiums, it is assumed that they affect the incentive producer’s price to only a reduced share. As mentioned, agricultural policy instruments are implemented as adjustments in the price system.

![Figure 1: Price system in GAPsi](image_url)
In the combined AG-MEMOD only three prices are generally included, producer prices for primary products, wholesale prices for processed products and world market prices for externally traded products. At the moment world market prices are exogenously implemented. At the individual country level, commodity prices are linked to key prices at the EU level. These are further used to clear the markets in the combined EU model. For example, the key prices for beef are endogenously determined in the German model.

\[
BVPRMDE = 311.1426 + 266.0278(BVPNE*EXREDE/BVPIN*EXREDE) + 0.354823(BVPIN*EXREDE) - 0.0861186(CCMBP(-1)*EXREDE(-1)/CCSLWDE(-1)) + 0.0698032(BVSPRDE(-1)) + 0.006315BVUDCDE + 0.011134 (BVSXL- BVTRQ)
\]

(13)

where

- \(BVPRMDE\) = German price for beef,
- \(BVPNE*EXREDE\) = world market price for beef,
- \(BVPIN*EXREDE\) = intervention price for beef resp. basic price,
- \((CCMBP(-1)*EXREDE(-1)/CCSLWDE(-1))\) = male bovine premium per slaughter weight,
- \(BVSPRDE(-1)\) = production of beef,
- \(BVUDCDE\) = domestic demand for beef,
- \(BVSXL- BVTRQ\) = difference between export limits of subsidized exports and tariff rate quotas of beef.

These key prices are then engaged in the price determination of the beef markets in other EU countries (e.g., in France). This implies that German key prices combined with other endogenous variables like the German self-sufficiency rates determine ‘domestic’ prices for beef in France. For each commodity and year, net export supply will be calculated as the difference between estimated variables of domestic supply (production and beginning stocks) and estimated variables of domestic demand (domestic consumption, waste and ending stocks). The sum of net export supplies across all EU member states determines the EU net export supply. The EU commodity markets will close by equalising EU net export supply with the EU net export demand which are determined through WTO commitments, relative EU market prices and world market prices. Supply and demand in the member states and therefore in the entire EU, will change until an equilibrium is attained on the EU market. In summary, AG-MEMOD is solved through an iterative process, which brings all EU commodity markets in all years into equilibrium with respect to supply of exports on the one hand and demand for exports on the other hand.

### 2.7 Policy instruments

As mentioned above, the main agricultural policy instruments, as well as the related trade policy instruments, are in general implemented in GAPsi by adjustments of increments in the price system. Specific conditional rules guarantee that under certain market conditions, market organisations rules apply to the domestic market (of the EU). This applies in particular to the prices ‘lower bound’ of safety-net, basic or intervention prices. Quantitative restrictions on production or trade are introduced by upper limits on the relevant variables, which cause adjustments in other variables of the market balance. For example, minimum access and export commitments concerning subsidized exports can only be regarded as net-trade restrictions. In the case of the beef market, the following instruments are included: beef intervention-price or basic price, average beef premium, beef subsidised export limit, beef tariff rate quotas, and to a certain extent, the beef intervention purchases.
In contrast to this approach, in AG-MEMOD, most policy instruments are implemented as separate explanatory variables within equations and have been estimated econometrically. Premiums are modelled as price increments in only very few cases. With beef as an example we have introduced the following policy instruments: beef intervention-price or basic price, suckler cow quota, special beef premia quota, suckler cow premium, male bovine premium represented by the special beef premium (bull, 1st payment), beef subsidized export limit, beef tariff rate quotas.

Concerning the German beef market, the appraisal of the impact of the decoupling within a single farm payment (SFP) of the CAP is difficult to achieve. Originally the direct income transfers were coupled and were regarded either as production cost subsidies or as an integral part of producer incentive prices. An overview of concepts and also of empirical research concerning decoupling is presented in several publications (Andersen, 2004; Gohin at al., 2001; OECD, 2001). Often in these studies it is argued that decoupled payments still have some impact on production, so they are not completely decoupled from production (e.g., Burfisher and Hopkins, 2003, Westcott and Young, 2003). Whereas the impact of premiums and decoupling have a limited impact on the crop sectors, animal premiums significantly affect livestock production. To calculate the supply inducing effect of the new SFP, the approach proposed by FAPRI (Binsfield, 2004), which uses ‘decoupling coefficients,’ is applied within AG-MEMOD. This coefficient indicates to what share the premiums for the different sectors are decoupled. In principle this coefficient can take into account both the official choice of the individual EU member states as well as estimates of their historical impacts on supply. This coefficient may vary according to the sector regarded. It generates a sector specific value for the new payment, which is then used as an explanatory variable in the supply functions. If the value of the ‘decoupling coefficients’ is well determined, a sensitivity analysis can be applied which reflects different assumptions about the coefficient (see Tabeau and van Leeuwen, 2005).

Within GAPsi, the ‘decoupling coefficients’ approach is implemented in a way compatible with the applied price system. Within the price system, the (coupled) premiums are treated as increments with other shifts which might allow for higher prices at the producer level than at the domestic market level. The decoupling in GAPsi was therefore implemented assuming that a share of the former direct payments that are transferred as income within the SFP to farmers remain coupled to the production. In GAPsi, a uniform ‘decoupling coefficient’ of 0.5 was provisionally adopted as there exists a certain uncertainty how the farmers will react across countries and products to the SFP (see Figure 1). If detailed information is available here, the decoupling coefficient will be differentiated.

2.8 Feedback to other markets and other countries

Within GAPsi and AG-MEMOD most market interactions are modelled by cross-prices in production and demand. These refer also to the interaction between feedstuff and the livestock sector. Some exceptions can be found concerning the interactions between the dairy sector and the beef sector within AG-MEMOD. Here the milk production, or rather the dairy quota, influences the dairy cow stock which has an impact on several other variables, e.g., slaughtering and slaughter weight. Inside the EU the interaction between the different member states is governed by the relevant key-price equations, respectively the price transmissions equation. Trade between members states is not hampered by taxes or transaction costs, which also applies to GAPsi. Here an unique price is assumed throughout the EU in the base year, but different price changes in the member states might occur due to policy impacts. Prices are endogenously solved at the world market level induced by the market clearing of the pooled world market for each product, taking consideration of exchange rates, transaction costs and some policy instruments. Trade of each model region of GAPsi is simply represented by its resulting net trade. Due to this, specific bilateral trade arrangements can not be explicitly simulated in GAPsi.
3 Model implementation: data, parameters, exogenous variables

The GAPsi’s database includes quantities of annual data from 2000 onwards which were exclusively obtained from FAOStat. Prices and additional indicators were generated based on FAO-ESC, OECD, USDA, CAP-Monitor, the German Statistical Office as well as from the German Federal Ministry of Consumer Protection, Food and Agriculture. As GAPsi is synthetic model, parameters are taken from literature, other models (e.g., Swopsim) or own modelling experience. But meat demand elasticities (with regard to own price, cross prices and income) are calibrated using a maximum entropy approach (see above). Parameters used in the German beef sector can be found in Table 1.

In contrast to GAPsi, AG-MEMOD is primarily based on data derived from EUROSTAT’s NewCronos. Data of prices and policy variables is supplemented by different sources like the EU Commission, ZMP, Oilworld, CAP-Monitor, the German Statistical Office as well as the German Federal Ministry of Consumer Protection, Food and Agriculture. Because of the econometric estimation of model parameters, data, if available, starts with the year 1973. Exchange rates and inflation as well as overall economic growth and annual population figures are exogenous to the models and established by different sources. Parameters’ estimates were based in principle on annual data for the period 1973–2000. But econometric estimation was hampered by the German re-unification process which often caused structural breaks in the data series. Different types of dummy variables were employed to offset effects of structural breaks: a single dummy for the years before or after the re-unification to cover short-term disruptions, a level dummy for the period after the re-unification to capture enduring shifts in agricultural markets or production, and additional trends to indicate converging or diverging processes between agriculture in West Germany and East Germany. Parameters were derived by single equation Ordinary Least Square (OLS) estimators. Estimators were primarily chosen by the ‘Goodness of Fit,’ standard deviation, and other test variables, but results which contradict economic theory with, e.g., wrong signs, had to be rejected. Parameters for policy variables were sometimes hard to attain so some of quality criteria had to be eased. Also several estimates were eliminated when they induced infeasible solutions for the country model or the combined one. One of the main reasons for altering the initially proposed model specifications lay here, namely to overcome problems of poor estimation results. But also the new equations had to be consistent with economic rationale. At the same time, simplicity on the one hand, and policy relevance on the other had to be regarded. Therefore, these estimation results are certainly not to be seen as final ones. Finally, estimation results obtained were tested in the sense that the ‘projective behaviour’ of each equation within the complete system should seem to be plausible. Estimation of parameters was carried out with EVIEWS 4.0.

Both models are programmed in GAMS and use CONOPT as a solver. Although both models are technically recursive dynamic, additional deviations in results may occur because GAPsi’s projections are generated in a step-wise approach whereas AG-MEMOD’s are solved in one step over the whole projection period.

4 Simulations and results

Based on the two partial equilibrium models, simulations were conducted that show the impact of the adjustments regarding CAP instruments under the Luxembourg Agreement compared to the Agenda 2000. The simulations covered the period between 2004 and 2010 – a fair medium term projection period. In addition to the already agreed upon cuts in intervention prices and the distribution of additional quotas cuts in intervention prices for butter and skimmed milk powder, and especially the decoupling of premiums, were regarded. In both models similar approaches were carried out. While policy measures on the dairy market were expected to have indirect effects on the beef market due to coupled production, the effect of decoupling was particularly complex to estimate since its amplitude
and rhythm differs among member countries. We followed the approach principally described above. When the premiums become part of the single farm payment, they will be decoupled, but it must be expected that parts of the decoupled premiums will still be treated as an ‘incentive’ to production. Therefore production decisions will react more pronouncedly to changes in market conditions. Table 2 summarises the framework of the simulations for the beef meat market.

<table>
<thead>
<tr>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
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<td>328.2</td>
<td>328.2</td>
<td>311.8</td>
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<td>205.5</td>
<td>205.5</td>
<td>205.5</td>
<td>185.0</td>
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<tr>
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<td>75.0</td>
<td>75.0</td>
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<td>27 953</td>
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<td>German suckler cow quota</td>
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<td>639.5</td>
<td>639.5</td>
<td>639.5</td>
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</table>

1) The postponement of the additional quotas was not simulated.

Table 2: Policy assumptions for simulations (prices in €/t; quotas in t)

In Figure 2, which was generated by the two different models, the projected beef market conditions in Germany are depicted. In general, quantity projections of supply and demand on the beef market are in line. Domestic supply of beef as well as demand declined a bit more within GAPsi. Both models differ more clearly with regard to the underlying price projections as can be seen in Figure 2. GAPsi projected constant domestic prices as well as constant producer incentive prices. In contrast in AG-MEMOD, producer prices show a decline of about –5% at the end of the period regarded, reflecting the less pronounced drop in production than in GAPsi. Fluctuations of net-trade were much more distinctive under AG-MEMOD, as net-trade reflected changes in exports, in imports as well as in variations in stocks.

Simulating the Luxemburg Agreement led to a pronounced decrease in the producer incentive prices in GAPsi, whereas the domestic price basically remained unchanged (Figure 3). So this reaction was directly induced by the decoupling because the premiums had been modelled as increments of the producer incentive price, while the domestic price in GAPsi changed only marginally due to adjustments in the market situation. In GAPsi, this decline in the producer incentive price directly induced a drop in production. That lower production counteracted a further decline in the domestic market price and the consumption remained virtually unchanged. AG-MEMOD told a different story. Coupled premiums were an integral part of the beef market price formation. They were to be interpreted as production cost subsidies. When these premiums were decoupled, the producer prices were increased to partly make up for rising production costs due to the loss of the direct subsidies. But those raised prices were not high enough to totally compensate for the loss of the premium. Therefore, after a short period when the cattle herd was de-stocked and the production increased because of the de-stocking, the beef production declined again. Both the magnitude of the production decline in GAPsi and AG-MEMOD were within the same range when compared. But consequently, as cattle stocks were not regarded in GAPsi, the results did not show any impact of the de-stocking process in production. In summary, the impacts of the Luxembourg Agreement were a bit more pronounced in GAPsi than in AG-MEMOD. In both models, the demand for beef was only negligibly affected, and due to higher prices in AG-MEMOD consumption declined marginally. While the results of the model GAPsi showed a smooth adjustment of the net trade (net-export) index to the market development, the net-trade index of the projections of AG-MEMOD indicated a more abrupt adjustment of the trade.
figures which follow the development of the production figures. That different model behaviour was related to the market closure in AG-MEMOD. This closure was implemented by allowing one of the trade figures (here beef exports) to adjust residually to given exogenous world market conditions so that variables reflect variations in all quantitative market variables. Secondly, the relatively low effect on net-trade in GAPsi was caused by the fact that GAPsi clears all markets, minimising the difference between supply and demand of markets over all model regions, allowing GAPsi to find smoother paths for net-trade in all model regions.

5 Qualification and Conclusions

AG-MEMOD and GAPsi are partial equilibrium models of a different nature, where GAPsi is a synthetic model and AG-MEMOD, in contrast, is an econometrically estimated model. Due to their different natures, distinctions are to be found in the general approach as well as in the outlay of the models. The synthetic model in general incorporates above all price-related impacts and some shifts, while the econometric model also includes other influencing factors like the composition of animal stocks. These features have their impacts on the model results allowing for more detailed information along the time path within AG-MEMOD whereas GAPsi shows a more stable movement.

Price formation in GAPsi comprises a system which includes policy measures in the form of price wedges, whereas AG-MEMOD’s price formation is based on an key-price equation, or respectively price transmissions. Here policy instruments are directly modelled as explaining variables. This
approach enables AG-MEMOD to react to adjustments in all included policy variables. On the other hand it is generally required that parameters of the policy variables have to be estimated in concordance with economic principles. Here GAPsi provides a much more direct implementation, as only parameters of wedges are to be calibrated. A disadvantage in the case of AG-MEMOD is that endogenous treatment of the world market still has to be included to allow for feedback effects between the world market and the EU. Here GAPsi allows for interaction with several third countries or regions.

To improve policy impact analysis, a standard approach for implementing newly established policy variables which cannot be econometrically estimated might prove helpful. Due to the fact that erratic disturbances often occur in agricultural markets, e.g., weather fluctuations, an assessment of related risks might improve the results of both models. These differences in the models, as well as some shortcomings, have induced certain deviation in the model results which are more marked when trade and prices are regarded. So the projections of the beef market show a higher decline when GAPsi is used, but when the Luxembourg Agreement is simulated, impacts are quite comparable.

In total, the reactions to policy changes in the time path seem to be more flexible when AG-MEMOD is used. A wider range of deviations occur concerning net-trade. Here aspects of different variable sets and the missing stock changes in GAPsi are to be highlighted. Distinctions in the price reaction have already been mentioned above. Due to the pricing system in GAPsi, the incentive price will here indicate a somewhat contradictory result so that AG-MEMOD will reflect the situation more precisely. So both models can simulate the Luxembourg Agreement with quite reasonable results, but both models have advantages and shortcomings.

References


Binfield, J.; Meyers, W. and Westhoff, P. (2005), Challenges of incorporating EU enlargement and CAP reform in the GOLD model framework, 89th EAAE Seminar paper, FAPRI, University of Missouri, Columbia, Missouri, USA.


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