Estimation of impact of EU agricultural policies on the world market prices

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Abstract

According to world market studies, the influence of policy measures on the world market price in one or in a limited number of countries is, in general, much less significant than the influence of multilateral policy changes. To investigate the impact of EU agricultural policies on world market prices, we attempt to model the transmission between EU policy and world prices directly via world market price equations, as part of the AGMEMOD model.

Keywords: **EU commodity markets, price transmission, partial equilibrium**

1. Introduction

Agricultural policy changes can have significant impacts on world market prices. According to world market studies, the influence of policy measures on the world market price in one or in a limited number of countries is, in general, much less significant than the influence of multilateral policy changes (see van Meijl at al. 2003, section 5.3.). For example, the OECD (2004) predicted a very limited impact of the 2003 CAP reform on world prices. They are expected to increase from 0.6% on average for crops to about 3% on average for butter. However, some EU policy changes are expected to raise the world market prices significantly. The EU sugar sector reform (complete elimination of export subsidies) resulting from a WTO restriction would imply an increase of the world sugar price by 9% - 12% on the long term (see Poonyth et al, 2000) and the implementation of the Bio fuel Directive with 11.5% obligatory blending rate is predicted to increase the real oilseed and sugar prices by almost 10% (see Banse et al, 2007).

To investigate the impact of EU agricultural policies on world market prices, we attempt to model the transmission between EU policy and world prices directly via world market price equations, as part of the AGMEMOD[1] modelling structure. In the current AGMEMOD model, the EU agricultural markets communicate with the exogenous rest of the world via two variables: the world prices and the net-exports of the agricultural products. The endogenization of the rest of the world could be done by the comparison of the EU net-export supply with the potential rest of the world demand. Since the world market price (indirectly) influences both the EU and the rest of the world net-exports, it can be seen as an equilibrating variable for EU net-exports supply and demand. Therefore, instead of adding the rest of the world net-exports demand equation to the model, we propose to add the reduced-form of the world market price equation derived form the rest of the world net-exports demand equation for EU agricultural products. As a result, the world market price is specified as a function of EU net-exports

[1] AGMEMOD is the acronym of Agricultural Member States Modelling. The AGMEMOD Partnership is funded by the European Commission RTD & by the Partnership's Member Institutes.

and could also be influenced by demand shifters as the world GDP and population growth as well as by policy variables (as export subsidies and TRQs).

The world market price equations are estimated for grains, oilseeds, meat and dairy products using the Seemingly Unrelated Regression method.

The rest of the article is organized as follow. Section 2 presents the AGMEMOD modelling structure and the price transmission process in the current version of the model, emphasizing the problem induces by such a process. The endogenization of world prices proposed in this article is discussed in section 3. The fourth section presents the dataset used for the estimation of world price equations and the resulting long term elasticities, while final section concludes.

2. Interaction between World and EU Markets in AGMEMOD

In this section we briefly describe the AGMEMOD modelling system, emphasizing the prices transmission in the current AGMEMOD model. More explicit information on the specific country modelling is to be found in various papers (Erjavec and Donnellan, 2005; Chantreuil, Hanrahan and Levert, 2005; Von Ledebur, Salamon and Weber, 2005).

AGMEMOD model is an econometric, dynamic, multi-product partial equilibrium model wherein a bottom-up approach is used. Based on a common country model template, respectively adjusted country level models were developed to reflect the specific situation of their agriculture and to be subsequently combined in a composite EU model. This approach seeks to better capture the inherent heterogeneity of the agricultural systems existing across the EU while still maintaining analytical consistency across the country models via as close as possible adherence to template. The maintenance of analytical consistency across the country models is essential for the aggregation, and also it facilitates the comparison of the impact of a policy across different Member States.

All country models follow a country model template that was constructed to allow single use as well as composite use within the framework of the unique EU model. In general, it consists of different supply and market modules of those commodities that reflect widely the product coverage of the respective country. In general, cereal and oilseeds with their derived products (oils and cakes), livestock (cattle, beef, pig, pig meat, poultry, sheep and goats), dairy (raw milk, fluid milk, butter, skimmed milk, cheese, whole milk powder and other dairy products), potatoes, sugar beets and sugar are reproduced. For each of these commodities agricultural production as well as the market

components supply, demand, trade, stocks and domestic prices are derived by econometrically estimated equations. Figure 1 illustrates the modelling structure of a commodity market at the country level. Different domestic markets are linked to other domestic markets by substitution or complementarily parameters in production or consumption.

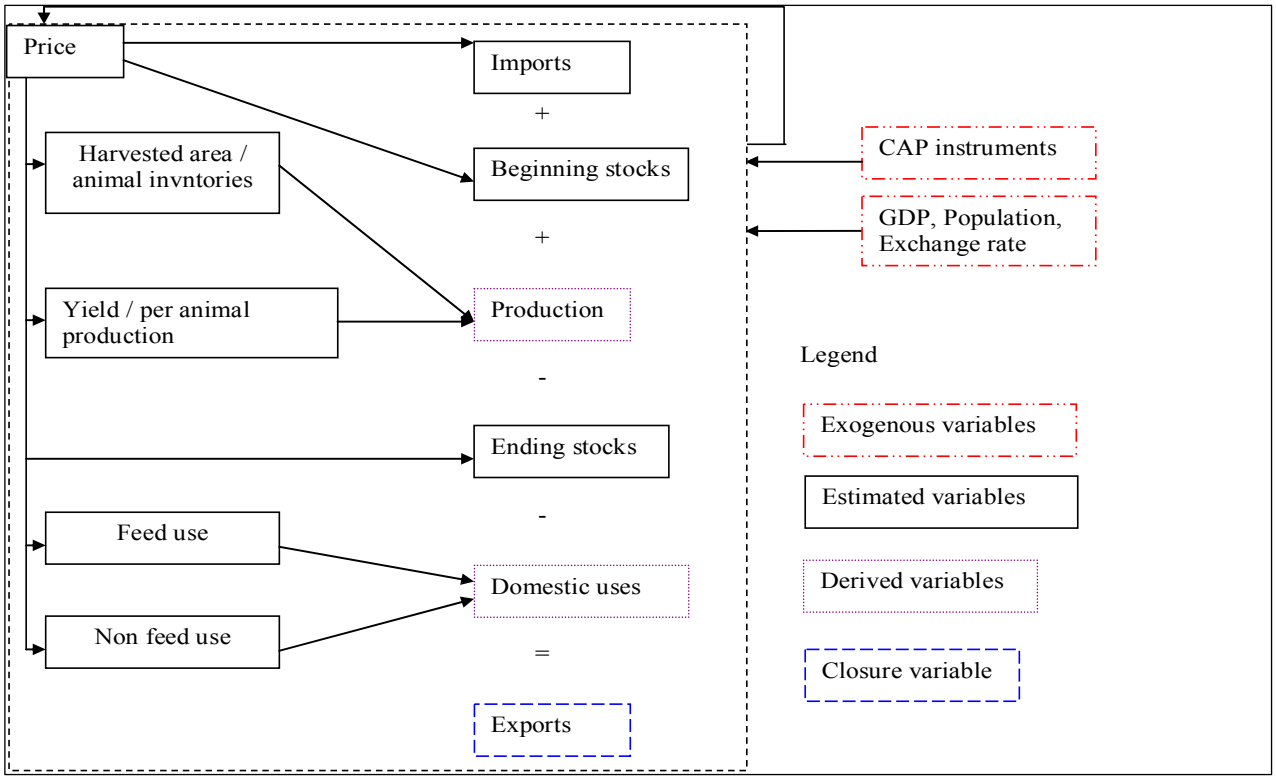

Figure 1.Commodity modelling structure

Furthermore, interactions between crops and livestock's sub-models are captured via calves' uses and feed uses (see Figure 2). The supply and utilization balance is ensured via a closure variable that might differ from a commodity model to another and from a country to another, but for main country commodity markets the closure variable is the exports variable. In general, in all country models main important agricultural markets are presented by laying out supply, import, export, human and feed consumption, stocks and prices. These models also cover a detailed set of agricultural policy instruments in each Member State. Hence, the tools developed allow for the generation of projections and scenario simulation results for each individual country, assuming that variables endogenous to other countries models' are exogenously determined.

To complete the building of the AGMEMOD composite models for each of the commodities modelled it is necessary to add an equation describing the equilibrium for each commodity market at both the Member State and EU levels. This condition implies that production plus beginning stocks plus imports equal domestic use plus ending stocks plus exports. In a closed economy, this supply and use

equilibrium condition is sufficient to determine endogenously the equilibrium country market prices, matching supplies and demands. Given that our model does not represent a closed economy, the rest of the World can have important impacts on the economy modelled. To account for such impacts we have chosen to use price linkage equations to account for the relations between Member States, and between the European Union and the rest of the World.

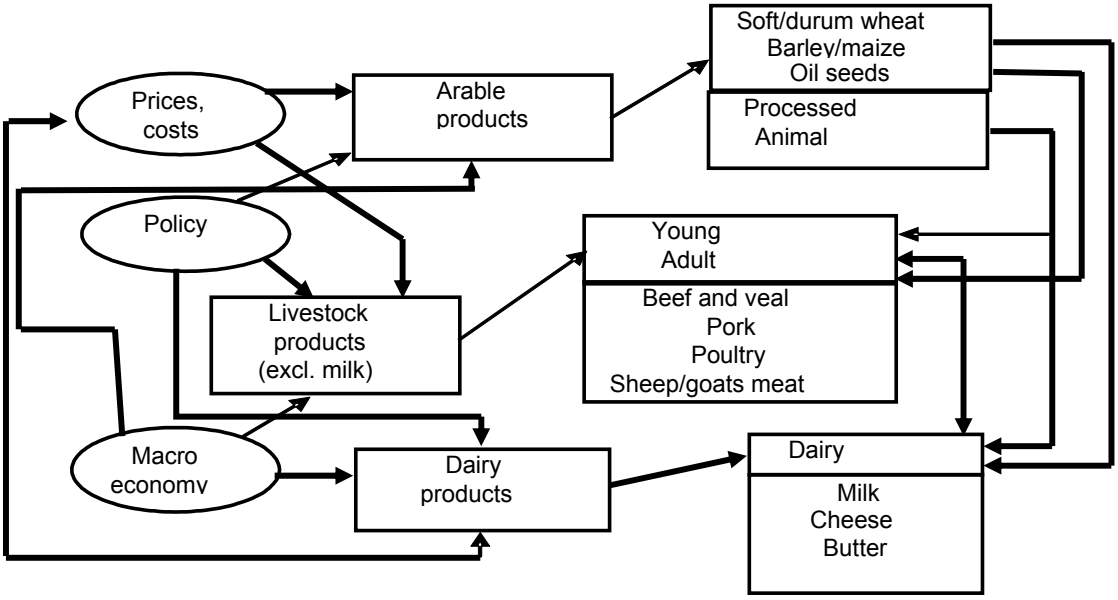

Figure 2. Linkage between commodity markets

When the national level market is not consider as the key market in the Europe Union, the price linkage equations used in the model can be written as

$$p_{j,t} = f\left(Kp_{j,t}, p_{j,t-1}, ssr_{j,t}, Kssr_{j,t}, V\right)$$

where $p_{j,t}$ is the national price of culture j in year t, $Kp_{j,t}$ is the key price of culture j in year t, $ssr_{j,t}$ is the self sufficiency ratio (domestic use divided by production) for commodity j in the country concerned, $Kssr_{j,t}$ is the self sufficiency rate for the same commodity in the key price market, and V a vector of exogenous variables which could have an impact on the national price.

When the national price is the key price, the price linkage equations used in the model can be written as

$$Kp_{j,t} = f\left(Wp_{j,t}, EIp_{j,t}, Kp_{j,t-1}, Essr_{j,t}, V\right)$$

where $Wp_{j,t}$ is the corresponding world price, $Elp_{j,t}$ the corresponding European intervention price, $Essr_{j,t}$ is the EU self-sufficiency rate for commodity j, and V a vector of variables which could have an impact on the key price (exchange rates, tariff rate quota levels and subsidized export limits).

3. Endogenization of World prices

The AGMEMOD modelling structure offers some advantages at the cost of one disadvantage. Actually, the AGMEMOD model allows us to generate projections for all variables for all agricultural markets at the Member States level and at the EU level, assuming that the impact of the rest of the World on EU markets is taking into account via exogenous world prices. Furthermore, the key prices equations are related to international trade by net trade, prices and trade measures. Nevertheless, there is no feed back accounting for the impact of EU markets on the rest of the World. In other words the AGMEMOD modelling approach is theoretically based on the "small country" assumption. The lack of feed back to the rest of the World should be solved to improve the quality of projections of the model. In other words, World prices should become endogenous, dropping the "small country" assumption.

Figure 3 illustrates a logical and simple way to avoid problems induced by the "small country" assumption. Actually, given the AGMEMOD geographical coverage and modelling approach, adding a rest of the World "country model", following the modelling structure previously presented, is a simple procedure to migrate AGMEMOD model from EU markets modelling to World markets modelling.

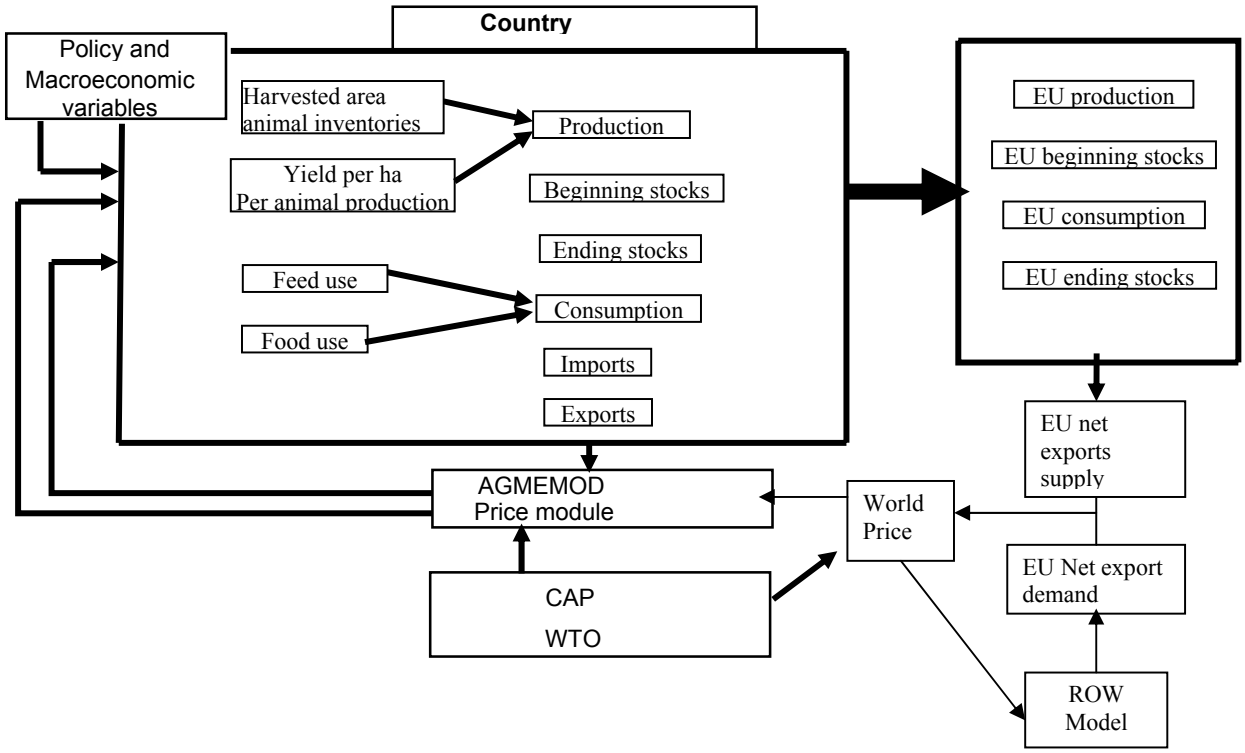

Figure 3. Interaction between EU and Rest of the World markets

Hence, this modelling structure is able to generate projections for the EU net exports supply and the EU net exports demand. Matching this supply and this demand, for all considered commodity markets, world prices can be determined as the endogenous equilibrium prices. Formally this equilibrium condition can be written:

$$UXN_{j,t} = UXD_{j,t}$$

with

$$UXN_{j,t} = \sum_{i} SPR^{i}_{j,t} + CCT^{i}_{j,t-1} - UDC^{i}_{j,t} - CCT^{i}_{j,t}$$

and

$$UXD_{j,t} = f\left(EIp_{j,t}, (Wp_{1,t},...,Wp_{j,t},...Wp_{n,t}), V\right)$$

Where, UXD_{jt} is the EU next export demand for commodity j in year t, UXN_{jt} is the EU net exports supply for commodity j in year t, SPR^{i}_{jt}, CCT^{i}_{jt-1}, UDC^{i}_{jt} and CCT^{i}_{jt}, are the production, the beginning stock, the domestic use and the ending stock of commodity j in year t in given country i, ($Wp_{1,t},\ldots, Wp_{j,t},\ldots,Wp_{n,t}$) the vector of world prices of commodity markets considered and V a vector of variables which could have an impact on the EU net export demand (such as exchange rates, tariff rate quota levels, subsidized export limits, world population and world GDP).

For each commodity j, UXN_{jt} is determined via an identity using endogenous variables of the AGMEMOD model, which are expressed as functions of the national prices, EU key prices and world prices.

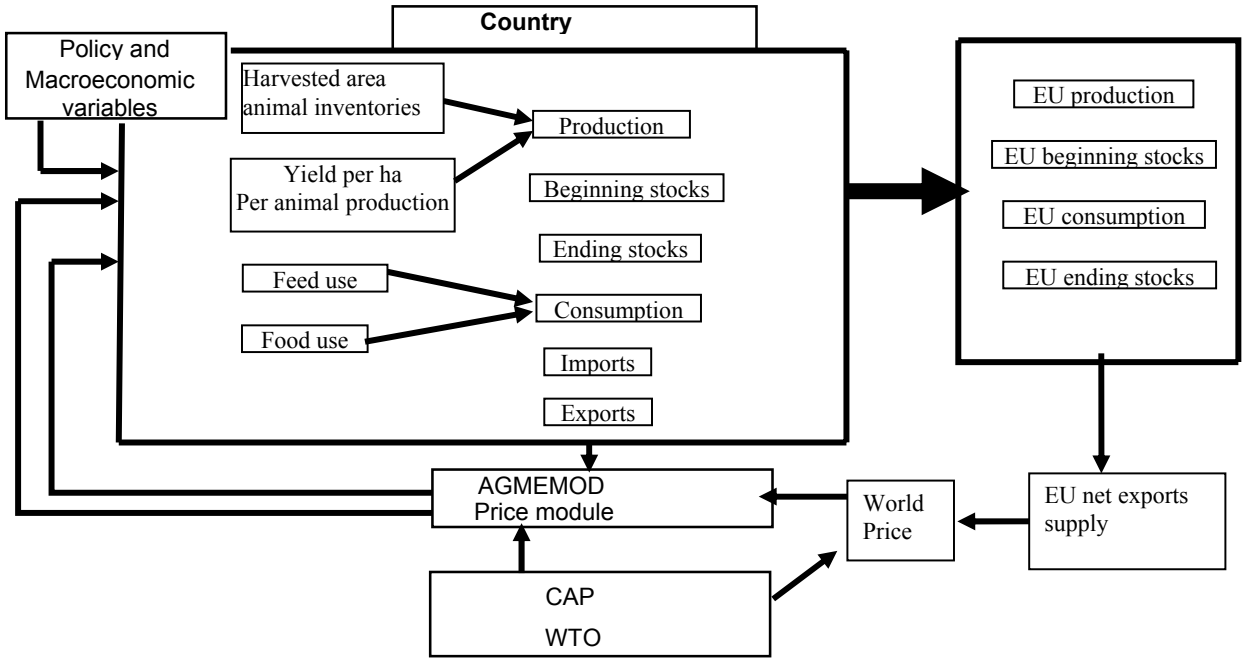

Figure 4. Interaction between EU and Rest of the World markets in AGMEMOD model

Of course, AGMEMOD model has no claim to make forecasts for World markets, such as AGLINK-COSIMO, FAPRI and WEMAC models. Nevertheless, the world prices' endogenization, presented above, states that the equilibrium condition can be written as follow:

$$Wp_{j,t} = f\left(\left(UXN_{1,t},...,UXN_{j,t},...,UXN_{n,t}\right),\left(Wp_{1,t},...,Wp_{j-1,t},Wp_{j+1,t},...Wp_{n,t}\right),EIp_{j,t},V\right)$$

Figure 4 illustrates the modelling approach used accounting for the feed back of EU markets on the rest of the World markets and in particular on world market prices.

To account for the feed back of EU markets on the rest of the World markets and in particular on world market prices, the previous functional form is used for all considered world prices and allows us to measure the impact of EU markets and EU agricultural policy on world market prices.

In order to estimate the world price equations, we have used the Seemingly Unrelated Regression method, decomposing the set of world prices in two blocks - Grains and Oilseeds (GO)

$$GO \equiv \begin{cases} Wp_{1,t} = f\left(\left(UXN_{1,t},...,UXN_{j,t},...,UXN_{6,t}\right),\left(Wp_{2,t},...,Wp_{j,t},...Wp_{6,t}\right),EIp_{1,t},V\right) \\ ... \\ Wp_{j,t} = f\left(\left(UXN_{1,t},...,UXN_{j,t},...,UXN_{6,t}\right),\left(Wp_{1,t},...,Wp_{j-1,t},Wp_{j+1,t},...Wp_{6,t}\right),EIp_{j,t},V\right) \\ ... \\ Wp_{6,t} = f\left(\left(UXN_{1,t},...,UXN_{j,t},...,UXN_{6,t}\right),\left(Wp_{1,t},...,Wp_{j,t},...Wp_{5,t}\right),EIp_{j,t},V\right) \end{cases}$$

and Meat, Dairy and dairy commodities (MD)

$$MD \equiv \begin{cases} Wp_{1,t} = f\left(\left(UXN_{1,t},...,UXN_{j,t},...,UXN_{8,t}\right),\left(Wp_{2,t},...,Wp_{j,t},...Wp_{8,t}\right),EIp_{1,t},V\right) \\ ... \\ Wp_{j,t} = f\left(\left(UXN_{1,t},...,UXN_{j,t},...,UXN_{8,t}\right),\left(Wp_{1,t},...,Wp_{j-1,t},Wp_{j+1,t},...Wp_{8,t}\right),EIp_{j,t},V\right) \\ ... \\ Wp_{8,t} = f\left(\left(UXN_{1,t},...,UXN_{j,t},...,UXN_{8,t}\right),\left(Wp_{1,t},...,Wp_{j,t},...Wp_{7,t}\right),EIp_{j,t},V\right) \end{cases}$$

4. Impact of EU agricultural policies on world market prices

As noted above, the AGMEMOD country models are econometric, dynamic, multi-product, partial equilibrium commodity models. The commodity coverage of the current version of the model extends to markets for grains, oilseeds and to the markets for their associated meals and oils, root crops,

livestock and milk and dairy. Most of the equations in the model are estimated using annual data from the period 1973-2004, or over shorter periods when data are not available. The AGMEMOD database is used in this article for the estimation of world price equations. In order to accomplish this task, another dataset is necessary. This dataset comprises macro-economic and world prices data. The related annual data were obtained from OECD, ERS-USDA and FAPRI databases. The commodity markets considered in this article are presented in table 1.

Table 1. Commodity markets

Soft wheat and durum wheat (WH)	Beef and veal (BV)
Barley (BA)	Pig meat (PK)
Maize (CO)	Sheep meat (LM)
Rapeseed (RS)	Skim milk powder (NF)
Sunflower seed (UF)	Whole milk powder (WF)
Soybean (SB)	Butter (BU)
	Cheese (CD)
	Poultry meat (PO)

The following figures, illustrate the trade situation of UE for the commodity markets considered over the period 1973-2004.

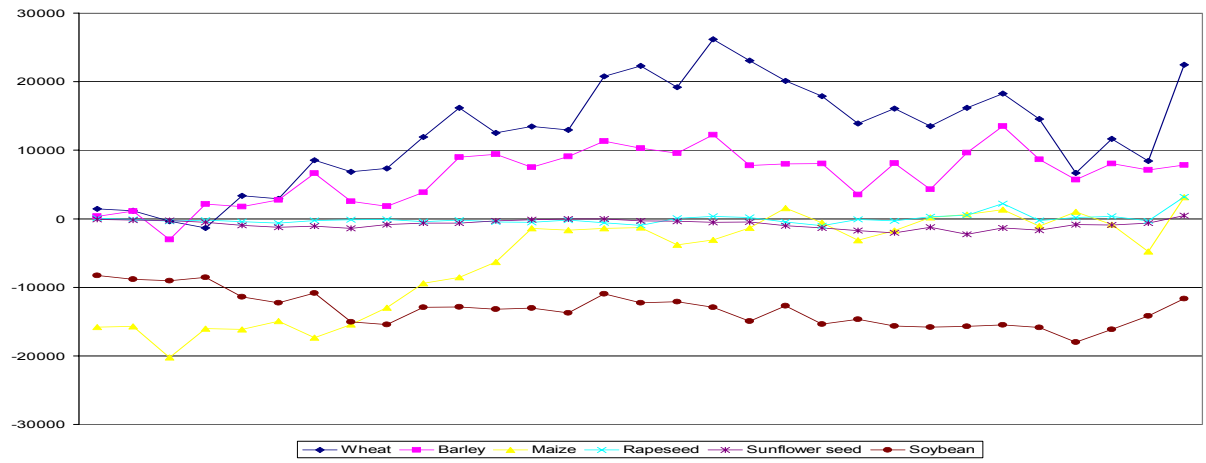

Figure 5. Crops EU net exports

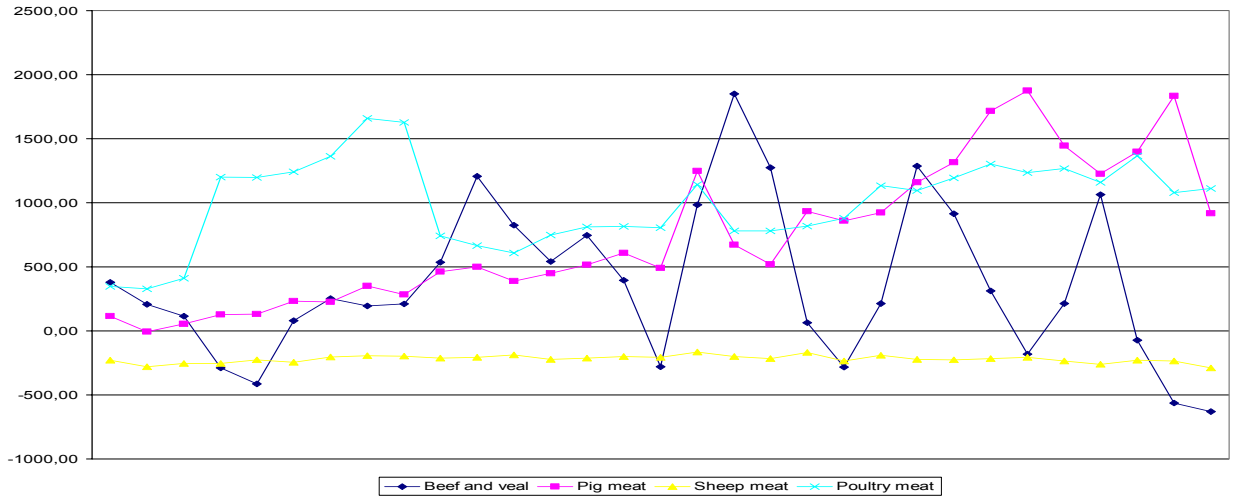

Figure 6. Meat EU net exports

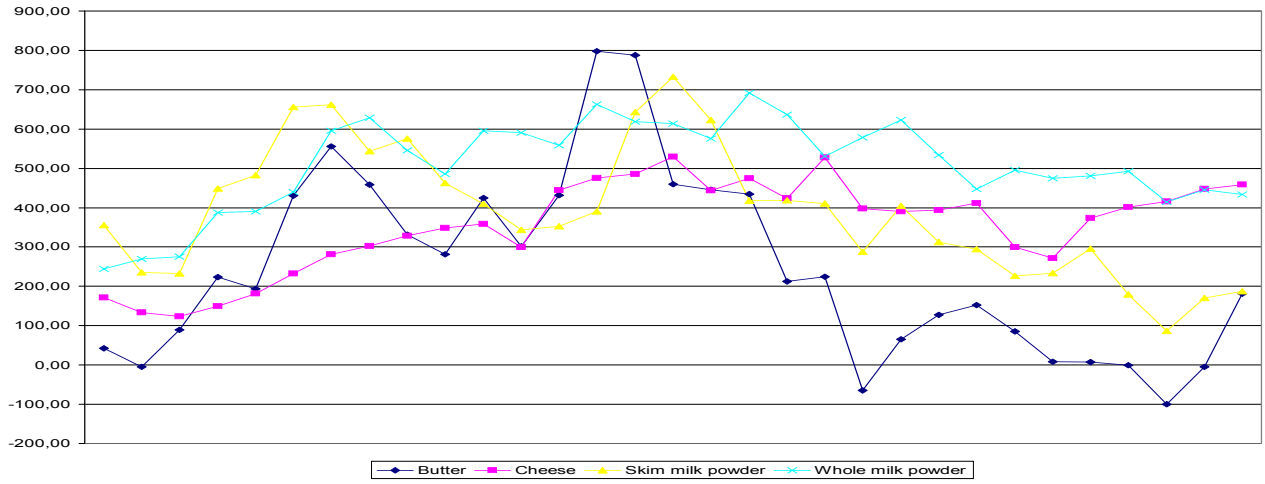

Figure 7. Dairy commodities EU net exports

The UE net trade situation for a large number of the considered commodity markets is historically stable. Actually, UE is a net exporter for wheat, barley, pig meat, poultry meat, cheese, skim milk powder, butter and whole milk powder and a net importer for maize, sunflower seed soybean and sheep meet. For the remaining commodity markets, the net trade situation varies over the historical period. After a long period with a net importer status, UE is becoming a net exporter for rapeseeds, while it is the reverse for beef and veal.

In order to give an appropriate answer to the question of the impact of UE agricultural markets and policies on world market prices, elasticities have been calculated using the estimation results discussed above. All results are summarized in the next sub-sections.

The estimation results coupled with this calculation show that the long-term elasticity of world market prices in respect to the corresponding EU net-exports equals 0.529 for wheat, - 0.027 for barley, - 0.008 for maize, - 0.012 for rapeseed, - 0.244 for sunflower seed and 0.053 for soybean.

The long-term elasticity of world market prices with respect to the corresponding EU TRQ equals - 3.332 for wheat, 5.235 for barley, 0.382 for Maize, while the long-term elasticity of world market prices with respect to the corresponding EU subsidized exports limits equals 2.897 for wheat, - 4.551 for barley and - 0.128 for Maize.

For meat and dairy world prices, the estimation results coupled with this calculation show that the long-term elasticity of world market prices in respect to the corresponding EU net-exports equals - 0.021 for beef and veal, - 0.292 for pig meat, - 0.195 for lamb meat, 0.116 for poultry meat, - 0.108 for butter, - 0.048 for cheese, - 0.031 for skim milk powder and - 0.252 for whole milk powder.

For these meat and dairy commodities world prices, the long term demand shifters elasticities have a non negligible influence on the world market prices. The long-term elasticity of world market prices with respect to the EU TRQ equals 0.000054 for beef and veal, 0.009 for poultry meat, - 0.197 for sheep meat, 0.472 for pig meat, 0.143 for cheese, - 0.211 for butter and - 0.121 for skim milk, while the long-term elasticity of world market prices with respect to the corresponding EU subsidized exports limits equals – 0.127 for beef and veal, 0.084 for poultry meat, - 0.235 for pig meat, - 0.168 for cheese, 0.102 for butter, 0.074 for skim milk powder and 0.001 for whole milk powder.

5. Concluding comments

In order to avoid the lack of feedback to the Rest of the World of the AGMEMOD model, we proposed in this article a modelling approach investigating the impact of EU agricultural policies on world market prices. Instead of adding the rest of the world net-exports demand equation to the model, we propose to add the reduced-form of the world market price equation derived form the rest of the world net-exports demand equation for EU agricultural products. The proposed specification allows us to investigate the impact of EU agricultural markets and policies on world market prices.
Our results show that EU agricultural markets have a limited influence on the world market prices, while policy shifters have a non negligent impact on the world market prices. Furthermore, the policy shifters' impacts are more important for crops world prices than for other sectors.

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