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**Measuring competition between non food and food demand on world grain  
markets : Is biofuel production compatible with pressure for food  
production ?**

Catherine BENJAMIN  
Magalie HOUÉE-BIGOT

*Department of Economics INRA, Rennes, France*  
INRA, Economie et Sociologie Rurales, rue Adolphe Bobierre,  
CS 61103, F-35011 Rennes-Cédex. France

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Email [Catherine.benjamin@rennes.inra.fr](mailto:Catherine.benjamin@rennes.inra.fr). [magalie.houee@rennes.inra.fr](mailto:magalie.houee@rennes.inra.fr)

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## **Introduction**

The flow of agricultural products between countries is conditioned by several factors including domestic and trade policy tools for the main competing exporters countries, and macroeconomic variables (such as real income per capita, rate of population growth, etc). Important structural changes are occurring on world agricultural markets that will have an impact on the long term competitiveness of countries and regions. These changes include developments in biofuels production linked to policy incentives, and rapid growth in income and population numbers in some developing countries (such as India and China).

An important issue is to identify the factors that are going to modify the balance between the supply and demand for agricultural products in the long term. In this paper, we will take the example of arable crops. These markets allow an interesting analysis since they are directly concerned with the evolution of biofuels. One important question is thus to measure the competition between food demand and non food demand.

The recent launch of public schemes in favor of the production of biofuels in many countries (for instance in the United States, in the European Union and in China) is likely to have a profound impact on policy on the equilibriums of agricultural markets for commodities linked to biofuels. It is an acknowledged fact that biofuels have a positive effect in helping to reduce emissions of greenhouse gases. These plant-derived fuels represent new outlets for certain agricultural commodities. Although they are more expensive to produce than traditional fuels, there is considerable support from the authorities for the production of biofuels. However, the achievement of these goals, which represent a real breakthrough, will be no easy matter, and will require trade-offs to be made. On the basis of the sectors in place today, one vital requirement if this policy is to be effectively implemented, will be the management of competition in the food sector for the use of farmland.

The objective of this study is to evaluate the effect of these policies on the world markets. Furthermore, we will study the impacts of these policies and the consequences of changes in some developing countries. The contribution made by this research is that it takes into account not only the price effects caused by the impact of these policies promoting biofuels but also the effects on areas created by the farmland resource constraint (limited areas of farmland are available). To achieve these aims, we use a multi-market partial equilibrium model representing the main countries operating on arable crop markets. From a

tool which generates medium-term annual projections for world cereal and oilseed markets, assuming that agricultural policies remain unchanged. It can also be used to assess the respective roles of traditional operators and emerging countries on world agricultural markets.

The WEMAC model is also a simulation tool that can be used to simulate the effects of alternative policy scenarios on cereal and oilseed markets. These scenarios include alternative agricultural, domestic and trade policies, changes in agriculture and external conditions such macroeconomic shocks. The results of the simulation indicate the impact of these alternative scenarios on the equilibrium of world cereal and oilseed markets.

*Specification details of the WEMAC model: The current country and commodity coverage*

The whole model consists of a set of country or regional sub-models with linkages established across countries and commodities. The structure of each regional sub-model consists of the following behavioral equations: production (harvested area, yield), demand (food use, feed use, stocks), price linkages (prices transmission mechanism between domestic and world prices), trade flows (import and export equations). The behavioral equations are completed by a set of accounting identities to represent market balances. At the world level and for each commodity, a balanced situation between global imports and global exports is imposed; this constraint allows us to specify the world price. The country coverage includes all the major producing and consuming countries of arable crops: Argentina, Brazil, Canada, China, European Union (EU-25), India, United States, Ukraine, Russia and a 'North Africa and Middle East' block. Countries which are not explicitly modeled are included in an endogenous aggregated block, 'Rest of the world. The model is based on econometric estimates of behavioral equations. Most of the equations in the model are estimated using annual data from the period 1970-2001. The data comes from the USDA's PS&D database and EUROSTAT for the European Union. The structure of the WEMAC model and its characteristics are given in detail in the following text box.

The model is characterized by a number of key features with respect to existing models, which should be highlighted from the start. First, the behavioral equations are estimated on the basis of historical data, rather than being calibrated. One key specificity is the econometric estimation of behavioural equations. One of the shortcomings linked to reference partial equilibrium models when forecasting changes in agricultural commodity markets is undoubtedly the "degree of subjectivity" involved in the adoption of behavioural equation parameters. These models are often called "empirical" models, meaning that the parameters either come from a review of available literature or are calibrated on what experts have said (van Tongeren and van Meijl, 2001). Secondly, as one aim of the WEMAC model is to provide quantitative evaluations of policy reforms, special attention is paid to modeling domestic and trade policy tools for the main producing countries, separating the effect of prices and that of other policy instruments. One of the major characteristics of current WEMAC modelling is that rather than being limited to an aggregate representation of the European Union as a whole, it actually provides information on each major European country, providing country-level estimates for France, Germany, Italy, Spain and the United-Kingdom.

### **Empirical analysis and Results of simulation**

We have implemented two kinds of scenarios : the first one named "the non food demand scenario" and the second one called "the food demand scenario". In the second scenario, we examine two points: the affect of a false appreciation of stocks in China and then the effect of a decrease of the economic growth in India.

Results of simulation are compared to the baseline. The baseline assumes a continuation of policies that are in place and policy changes that had been announced within existing programs in early 2005 (like the Farm Act of 2002 in the United States, and the 2003 CAP reform). Thus, the baseline projections assume trade policies as agreed in the Uruguay Round Agreement on Agriculture. The baseline offers an assessment of arable crop markets covering cereals and oilseeds over the period 2005 to 2015. The model generates projections over a ten year period with specific assumptions concerning key macro economic variables as well as agricultural and trade policies.

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country with minimal trade barriers is chosen as a residual supplier and in general, the residual supplier is the United States.

from the United States, traditionally the world's leading maize exporter, would fall over the period 2005-2015, to the benefit of Argentina.

Maize exports from Argentina are expected to rise by more than 5.8 million tons between 2005 and 2015, to reach 19.5 million tons in 2015. Adjustments in market shares in favor of South American countries are linked to the assumption about the dollar-peso exchange rate. The Argentine currency should continue to weaken in relation to the dollar, leading to more competitive exports (OECD, 2005). The leveling off (and even decrease) of maize exports from the United States would be due to two points; firstly, the increase in the utilization of cereals for livestock feed and secondly, the development of non-feed/food demand.

The world maize price is expected to rise between 2005 and 2015, as a result of the strong increase in consumption in relation to production. Year on year variations would be relatively low. The world maize price is expected to reach \$121.95/t in 2015.

*- Non food scenario*

The non food scenario corresponds to the implementation of the mandate of incorporation in the United States (284 million hectolitres of biofuels in 2012). Two alternatives are studied: in the first case (variant A), we suppose constant arable crops area and in the second (variant B), we suppose an increase in arable crops area of 3 million hectares.

(insert table 1)

On the American market, the support for the biofuels would increase the production of corn of about 3% in the first case and about 5% in the case of an increase in arable crops area. The increase in corn production arises from the rise in the harvested area: +2.7% in the variant A and +5.45% in the variant B. The corn consumption would increase of more than 8%: 8.13% in the variant A and 9.59% in the variant B. The corn consumption would increase more in the variant B than in the variant A because of the effect on domestic prices. In fact, the growth of corn price would be lower in the variant B (see below). Impacts on corn supply and demand would send back directly on trade. Corn exports would strongly decrease -21.65% in the first alternative and -13.62% in the second alternative.

(insert table 2)

The effects on domestic prices are the same than those on world prices. The increase in corn consumption would lead to a rise in corn price (+15.92% in the variant A and +9.15% in the variant B). Soft wheat and soybean domestic prices would increase in the first case due to the

The deceleration of the growth would strongly decrease the Indian corn imports, thus involving a considerable effect on the world price. The food scenario shows that a deceleration of the growth in India would involve a fall in the world price of common wheat of 11%.

In addition, this scenario also shows the impact of an error of measure in China. We analyse results on corn market. We suppose an appreciation of the supply of corn in China: increase of 5%.

(Insert table 6)

(Insert table 7)

The appreciation of the offer of corn in China, translated here by an increase in the offer of corn of 5%, would involve a reduction in the corn imports of China. Corn net imports would reach 1.6 million tons in 2015 instead of 9 million tons in the baseline. Impacts on Chinese market would decrease corn world price of 5.15%.

Results of these different scenarios on the cereals world prices are summed up in this table.

(Insert table 8)

In the non food scenario, cereals world prices would increase of about +5% for wheat and +17% for corn. In the food scenario, soft wheat world price would decrease of -11% and corn world price would decline of -5%. Effects of food scenario could be as strong as those of non food scenario.

These results of simulations show that even if the incentives to the production of biofuels have strong impacts on the world markets, changes on the assumptions of growth of emergent countries, for example, are also of great importance since the world markets of the field crops are affected as much.

Table 1. U.S. maize market, comparison EPA scenario to the baseline (results in 2015).

(Thousand metric ton)	Baseline	EPA scenario Variant A	EPA scenario Variant B
Harvested area	26029	26738 (+2.72%)	27449 (+5.45%)
Production	260720	268542	275375

(Thousand metric ton)	Baseline	Food scenario India
Production	89266	88647 (-0.69%)
Domestic use	98410	92063 (-6.45%)
Net import	9142	3479 (-61.94%)

Table 5. Food scenario in India: effects on cereals world price (results in 2015).

(U.S.\$/t)	Baseline	Food scenario India
Soft Wheat	151.95	134.69 (-11.36%)
Corn	121.95	120.94 (-0.83%)
Soybean	249.94	249.84 (-0.04%)

Table 6. Food scenario in China: effects on corn market in China (results in 2015).

(Thousand metric ton)	Baseline	Food scenario China
Production	152866	160509 (+5.00%)
Domestic use	161491	161748 (+0.16%)
Net import	9035	1650 (-81.74%)



two points : the effect of an erroneous assessment of stocks in China and then the impact of an fall in economic growth in India.

We compare the results of the simulation to the baseline. The baseline assumes a continuation of policies that are in place and policy changes that had been announced within existing programs in early 2005 (like the Farm Act of 2002 in the United States, and the 2003 CAP reform). Thus, the baseline projections assume trade policies as agreed in the Uruguay Round Agreement on Agriculture. The baseline offers an assessment of arable crop markets covering cereals and oilseeds over the period 2005 to 2015.

The nonfood scenario corresponds to the implementation of the mandate of incorporation in the United States (284 million hectolitres of biofuels in 2012). Two alternatives are studied: in the first case, we suppose a constant arable crop area and in the second, we suppose a 3 million hectare an increase in the arable crops area. On the American market, support for biofuels would increase the production of corn by about 3% in the first case and by about 5% in the case of an increase in the arable crop area. Corn consumption would increase by more than 8% (between 8 and 10% depending on the two alternatives). Corn exports would decrease sharply by -19% in the first alternative and by -11% in the second alternative. The effects on world markets would be a rise in the prices of corn (+16% in the first case and +10% in the second), a rise in the prices of corn of 3% in the first case and a decrease of 1% in the second case. In the first case, increase in corn production would be the result of the increase in the corn area which would be achieved at the expense of other crops. In the second case, the arable crop area increases and so the increase in the corn makes no difference to the wheat area.

The food scenario shows that a deceleration of the growth in India (2.25 per annum instead of 5.5%) would involve a fall in the world price of common wheat of 11%. Indeed the deceleration of the growth would strongly decrease the Indian corn imports, thus involving a considerable effect on the world price. In addition, this scenario also shows that an error of appreciation of the offer of corn in China, translated here by an increase in the offer of corn of 5%, would involve a reduction in the corn imports of China and a fall in the world price of corn of more than 5%.

These results of simulations show that even if the incentives to the production of biofuels have strong impacts on the world markets, changes on the assumptions of growth of emergent

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