Wheat differentiation and response to policy reform in the EU

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Abstract: Agenda 2000 reduces the bias that favors low quality wheat production in European Union (EU), but also improves access for imports of high quality wheat. Therefore, this paper uses a partial equilibrium displacement model that differentiates wheat according to its origin and end use to investigate the impact of Agenda 2000 on wheat supply and demand in France.

To investigate the impact of Agenda 2000 on the European Union (EU) wheat supply and demand, this study uses a partial equilibrium displacement model that differentiates wheat according to its origin and end use. Several policy changes have reduced wheat price in the EU. These include the Agenda 2000 cut in the EU cereal intervention price and the special deal struck by the EU and United States (US) within the framework of the Uruguay Round agreement stating that the duty-paid price for imports into the EU should not exceed the intervention price by more than 55%. The EU reference price for cereal imports is now at the CIF world price of top-grade wheat and durum, eliminating market protection for high-quality milling and durum wheat. We expect that these duty adjustments would encourage imports from North America and put pressure on milling premiums for EU producers of high-quality wheat. On the other hand, the cut in the EU cereal intervention price and the use of stricter intervention criteria on wheat is expected to encourage European producers to shift their production towards a higher quality of wheat.

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Most of the past studies that have considered product differentiation to analyze the effects of policy changes have allowed for imperfect substitutability in terms of origin only and include Abbot and Paarlberg (1986), Babula (1987), Figueroa and Webb (1986), Honma (1983), Johnson, Grennes and Thursby (1977), Penson and Babula (1988), Sarris (1983), Suryana (1986) and Webb, Figueroa, Wecker and McCalla (1989). Some more recent studies have in addition allowed differentiation by end uses and include Alston, Gray and Sumner (1994), Haley (1995) and Sumner, Alston and Gray (1994). All of these studies have applied the Armington framework to incorporate these two types of differentiation in the demand system of their models despite the separability and homotheticity restrictions implied by this framework (Alston, Carter, Green and Pick, 1990).

To avoid these strong Armington restrictions, this study uses an almost ideal demand system (AIDS) to differentiate wheat according to its origin and end use in a three-stage budgeting procedure. To analyze differential effects of changing either reference prices or intervention prices in the European Community, de Gorter and Meilke (1987) have also used an AIDS specification but have limited its application on distinguishing domestic and import supplies only. To analyze the U.S. Export Enhancement Program, Haley (1995) has also used a three-stage procedure to differentiate wheat by end use and by country of origin but has applied it with the Armington specification. This study also differentiates wheat by end use to characterize the EU institutional and world price transmission and the domestic wheat supply system. In sum, the novelty of this study is using a complete model that differentiates the EU wheat market according to sources of supply and end uses by (1) differentiating wheat demand according to its end use in the second stage and according to its origin in the third stage of a three-stage budgeting procedure, (2) departing from the Armington restrictions by using an AIDS specification and (3) introducing end-use differentiation in the price transmission and supply system of the model. Because of data limitations, this model is applied to the French wheat market for which supply and demand could be disaggregated by end use and origin.

This paper is organized as following. First, from annual series of market, intervention, reference, world prices and excess supplies, institutional support price transmission elasticities are estimated for France, for each wheat category, and for the main substitutes in wheat consumption and main competing products in production using a varying-parameter transmission model suggested in Surry (1992). Second, the behavioral model from which the partial equilibrium displacement model is drawn is briefly presented. Third, constant own- and cross-price elasticities of demand and supply are estimated for France for each wheat category, from annual series of market prices and reconstructed consumption and production volumes. Fourth, a partial equilibrium displacement model (Davis and Espinoza, 1998) represents the behavior of the European country's markets for wheat of different origins and end uses and incorporates the estimated elasticities and other parameters. Fifth, cereal intervention price cuts and arable area direct acreage payment increases as planned in the Agenda 2000 are simulated on these markets subject to the market access and export competition provisions agreed in the Uruguay Round.

Data

The data used in this study is collected from years 1980 until 1999 and come from different sources, including the European statistics office, EUROSTAT, United States Department of Agriculture (USDA), Canadian Wheat Board (CWB), International Grain Commission (IGC), the French statistics office, INSEE, the French cereal professional organization ONIC and several other private organizations. The major difficulty in a study such as this one is to obtain quality differentiated information when the data only contains undifferentiated information. Quality differentiated information can be inferred by recouping information at different levels. First of all, by end-use. Industrial uses require starch rich wheat, which are a main characteristic of class 2 wheats. Bread making in France uses classes E, 1 and 2 wheat while bakery and feed use class 3 wheat. Second of all by availability. Surveys have been conducted which indicate which varieties have been planted and which qualities of wheats have resulted from those cultures. Third, by origin of imports and exports. Here, trading firm expert knowledge enabled us to approximate the quality of imports and exports to each origin and destination country according to their needs in different qualities. Putting this information together, and making additional assumptions of the quality distribution of stocks, enabled the quantities to be distributed in different quality classes. French market prices are inferred by the export price at different ports. Indeed, certain ports specialize in certain qualities of wheat. For example, Eure et Loire specializes in class 1, Rouen in class 2 and Champagne in class 3 wheat shipments. No prices could be found for class E wheat since it is not exported, and because the market for the French product of this class is too marginal. Therefore the price considered for this wheat is a quantity weighted average of the American DNS and Canadian CWRS prices.

The Wheat Market

Since the late eighties, wheat is recognized in the economic literature as a differentiated product according to its characteristics, which define its end-uses, for example see Veeman (1987), Larue (1991). Following the USDA and the CWB, ONIC introduced quality standards and labeling to establish differentiated market niches for wheat. Table 1 shows representative categories of wheat in France, the United-States and Canada classified according to biochemical, physical and end-use criteria.

Table 1 Representative categories of wheat in France, the United-States and Canada

	Hard		Soft		Feed
	Spring	*Winter*	*Winter*	*White*	Wheat
Country					
France	Elite (E)	1 [a]	2 [b]	2	3 [c]
USA	DNS, HRS	HRW	SRW	WW	
Canada	CWRS	CWRW	CESRW	CEWW	
Reference variety	DNS	HRW	SRW		Maize [d]
Criterion					
Protein	≥13%	11-13%	10-11%	10.5-11.5%	<10.5%
W [e]	≥300	≥160	≥130	≥130	-
Hagberg [e]	≥220	≥220	≥180	≥180	-
Use	Bread flours	European loaf breads	Biscuits, cakes, pastries		Feed
Quality [f]	High	Medium	Low		Feed

[a] Also referred to as Superior Bread Making Wheat

[b] Also referred to as Common Bread Making Wheat

[c] Also referred to as Other Usage Wheat

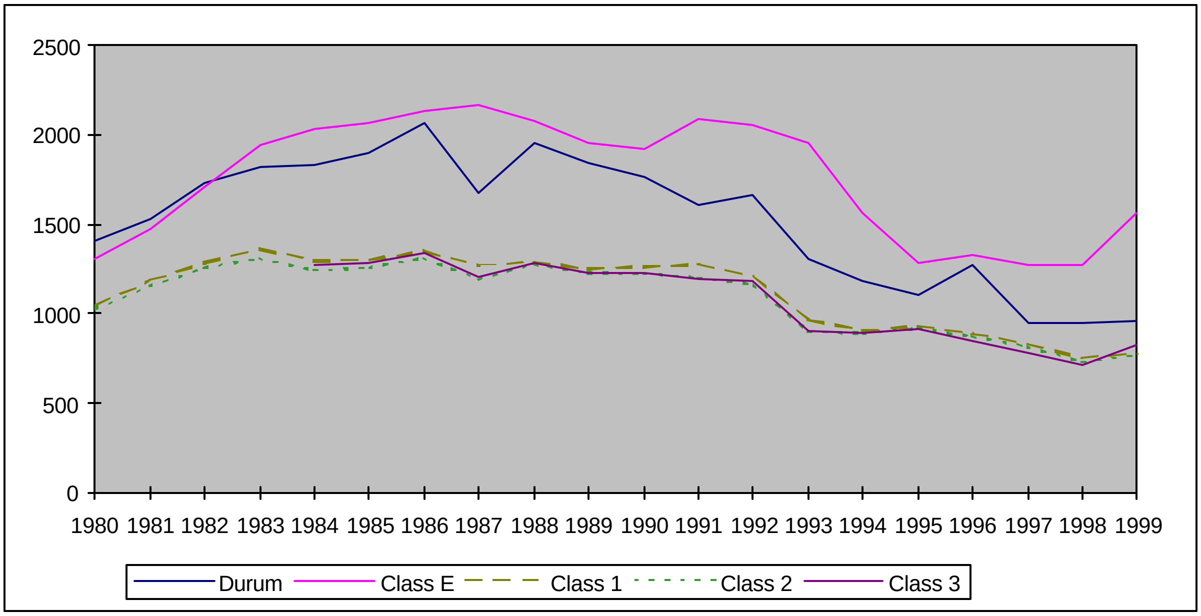
[d] Also FOB Rouen and FOB London

[e] W (bread-making strength) measured in 10^{-4} joules, Hagberg measured in seconds

[f] Larue, 1991

Figure 1 to Figure 3 show the evolution of prices of the different categories of wheat in the French market since 1980. Figure 1 shows that prices of class 1, 2 and 3 wheats evolve closely together, price of elite wheat is between 50 to 100% higher than the other wheats and the price of Durum wheat fluctuates between the prices of elite wheat and the other wheats.

Figure 1. Market prices for different classes of wheat in France (nominal French francs) [1]



[1] All prices are in French francs. 6.56 FF = 1 Euro = 0.876USD.

Figure 2 shows a 40% drop in the now called reference price since the implementation of the Common Agricultural Policy (CAP) reform in 1992. At the new reference price determined by Agenda 2000, spring wheats such as the DNS wheat enter the EU market without duties. Winter wheats such as HRW and SRW are also likely to enter the EU market without duties depending on their CIF prices and exchange rate between the US dollar and the Euro.

Figure 2. World prices for different classes of US wheat in France (nominal French francs)

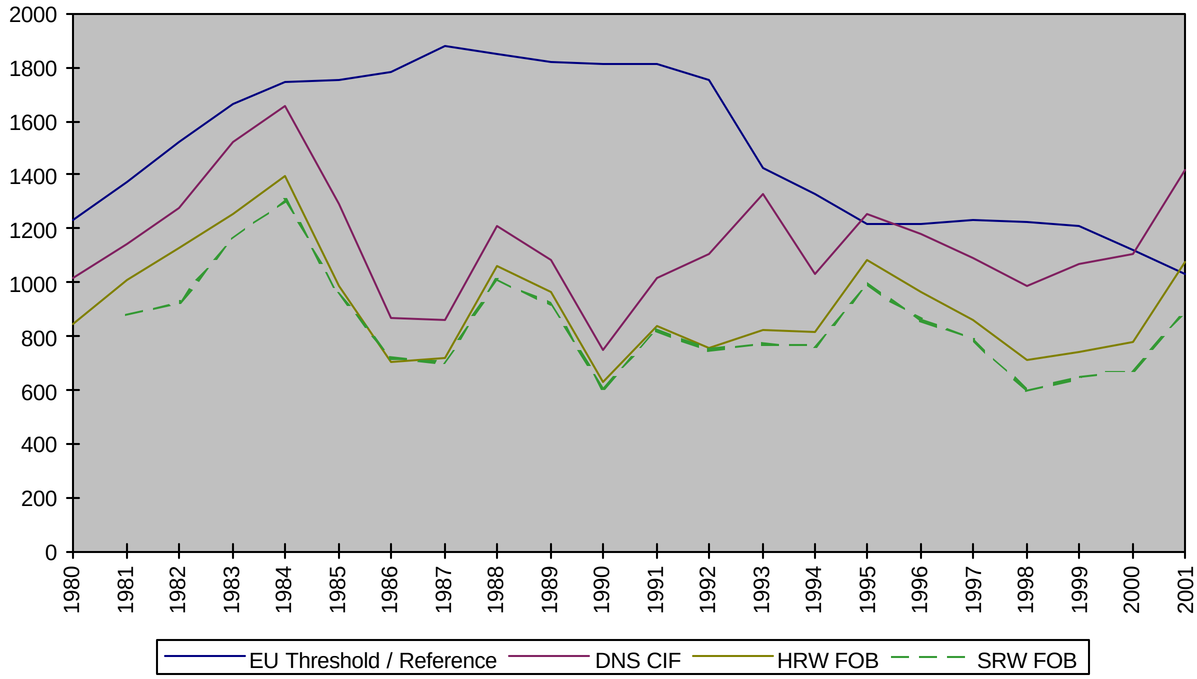
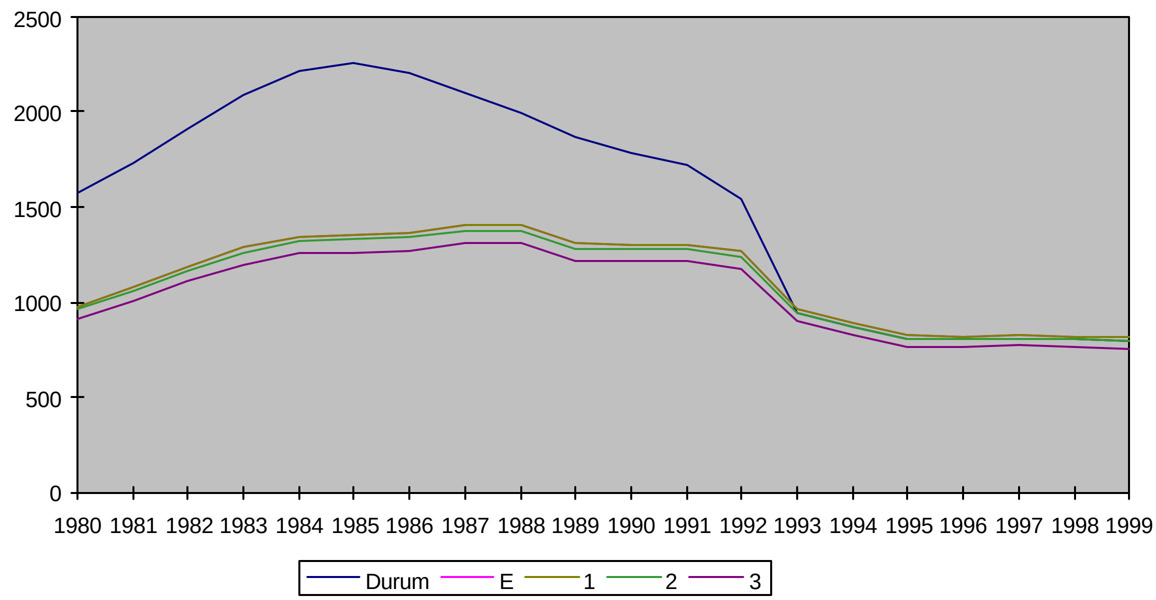


Figure 3 shows the reduction of the intervention prices by wheat category since 1992. The intervention price of durum wheat decreases since 1985 and joins the price of class 2 wheat in 1993, as a result of the 1992 CAP reform. The intervention price of high quality wheat (classes E and 1) is set at 5% above the intervention price for class 2 wheat, while intervention price of class 3 wheat is set at 10% below the intervention price of class 2 wheat.

Figure 3. Intervention prices for different classes of wheat in France (nominal French francs)



Institutional Price Transmissions

This study simulates a policy change through a system of demand and supply behavioral equations. This system consists of price and direct payment response functions and is briefly described in the following section. The problem described in this section is the one of feeding policy price changes in this system. As Colman (1985) pointed out, simply assuming that changes in agricultural policy prices cause equal changes in market prices, in other words, that price transmission is perfect, is not satisfactory. Recognizing the fact that in the EU, market prices normally fluctuate between institutional floor and reference prices according to market conditions, Surry (1992) generalized Colman's approach to determine the impact of those institutional prices on market prices. The model has built in flexibility to take into account situations where the market price is bound by either the floor or the reference price as well as the case where it lies somewhere between those two limits. A world price is added to the equation, although theoretically it should not affect the internal market price, since, as Surry (1992) shows, policy decisions are not independent from it. Adapting his equation to our model, this can be written as:

$$p^{k}_{ijt} = g^{k}_{ij0} - g^{k}_{ij1} S^{k}_{ijt-1} + g^{k}_{ij2} p^{k}_{ijt-1} + g^{k}_{ij3}\left[p^{kc}_{ijt} + \frac{p^{kf}_{ijt} - p^{kc}_{ijt}}{1+e^{\left(s^{k}_{ij} + s^{k}_{ij} XN^{k}_{ijt}\right)}} \right] + g^{k}_{iw} p^{w}_{it}$$

where k represents the country, i the product differentiated by end use, j the country of origin, which in this equation is the same as k, and t the time index. p^{k}_{ijt} is the domestic market price, S^{k}_{ijt} the end of period stocks of product i, p^{kf}_{ijt} and p^{kc}_{ijt} the institutional floor and reference prices, and p^{w}_{it} the world price. XN^{k}_{it} represent net exports and the function $L = 1 \big/ 1 + e^{\left(s^{k}_{ik1} + s^{k}_{ik2} XN^{k}_{ikt}\right)}$ is a logistic trade regime selecting function. This function lies in the interval $[0,1]$. Values $L = 0$ correspond to a net import situation where the reference price is the market-directing price while $L = 1$ corresponds to the situation where products are bought at floor or intervention price. Intermediate values correspond to situations somewhere between these two extremes.

Table A1 in the annex presents the estimation results of the transmission coefficients for durum, E, 1, 2 and 3 class wheat as well as for maize, rapeseed, sunflower and protein crops. This table shows that all transmission coefficients except that for protein crops are significant and generally lie somewhat above one half except for rapeseed and protein crops. World prices are never significant for wheat and always significant for the other crops and take values between 0.2 and 0.4 except for protein crops. It is not surprising that world price is significant for oilseeds, as these markets have received little protection from the outside market within the CAP framework. As mentioned above, these transmission prices serve as a link between policy changes and the behavioral model. Corresponding to the transmission coefficients, elasticities are calculated for 1999 as follow:

Institutional price transmission elasticity:

$$e_{ik3}^{k} = \frac{g_{ik3}^{k}\left[p_{ikt}^{kc} + \frac{p_{ikt}^{kf} - p_{ikt}^{kc}}{1+e^{\left(s_{ik}^{k} + s_{ik}^{k} XN_{ikt}^{k}\right)}}\right]}{p_{ikt}^{kc}} = \frac{g_{ik3}^{k} POL_{ikt}^{k}}{p_{ikt}^{kc}} \text{ with } t = 1999$$

where $POL_{ikt}^{k} = p_{ikt}^{kc} + \frac{p_{ikt}^{kf} - p_{ikt}^{kc}}{1+e^{\left(s_{ik}^{k} + s_{ik}^{k} XN_{ikt}^{k}\right)}}$ with $t = 1999$.

World price transmission elasticity:

$$e_{ik3}^{k} = \frac{g_{iw}^{k} p_{it}^{w}}{p_{ikt}^{kc}} \text{ with } t = 1999.$$

These results are shown in Table 2. As expected, elasticities of institutional variables are larger for lower quality wheat than for higher quality wheat.

Table 2 Institutional and world price transmission elasticities

	Wheat class					Substitute / competing products			
Short term elasticity	Durum	E	1	2	3	Maize	Rapeseed	Sunflower	Protein crops
institutional variables	0.65	0.43	0.53	0.86	0.79	0.83	0.14	0.63	-0.13
world price	0.11	0.10	0.00	0.00	0.00	0.21	0.35	0.55	-0.49

Source: from table A1, Annex

The Behavioral Model

Before specifying the equations of the behavioral model, the demand and supply systems are briefly introduced.

Demand of Durum and Wheat Class E, 1, 2 and 3

The model considered is a three-stage budgeting procedure as suggested in Haley (1995). In the first stage, country requirements, in this case, of milling wheat are determined. In the second stage, total demand for milling wheat is broken down among the different classes of milling wheat, and substitution among those classes is assumed to occur. In the third and last stage, the choice is made concerning the supplier, whether of domestic or foreign origin. Again some substitution among the different suppliers is assumed to occur. Figure 4 illustrates the three stages of decision considered and indicates as well the main sources of supply of the different classes of wheat.

Figure 4. Three-stage demand for milling wheat

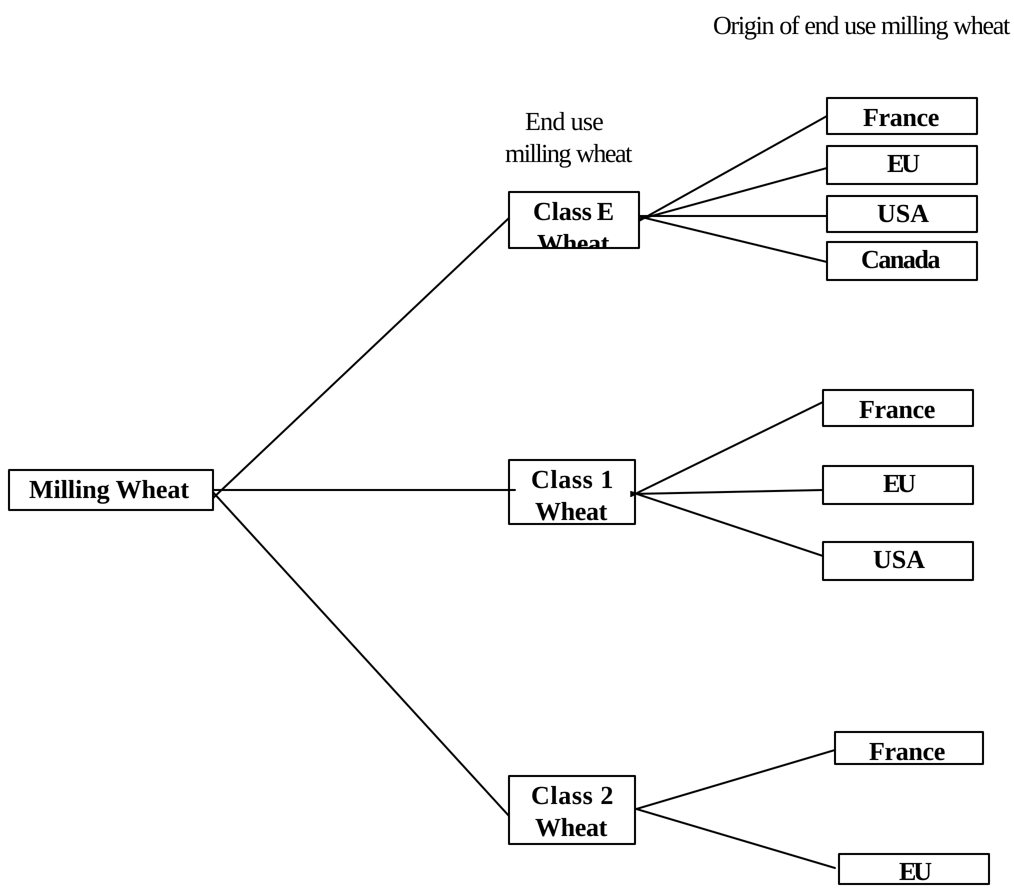
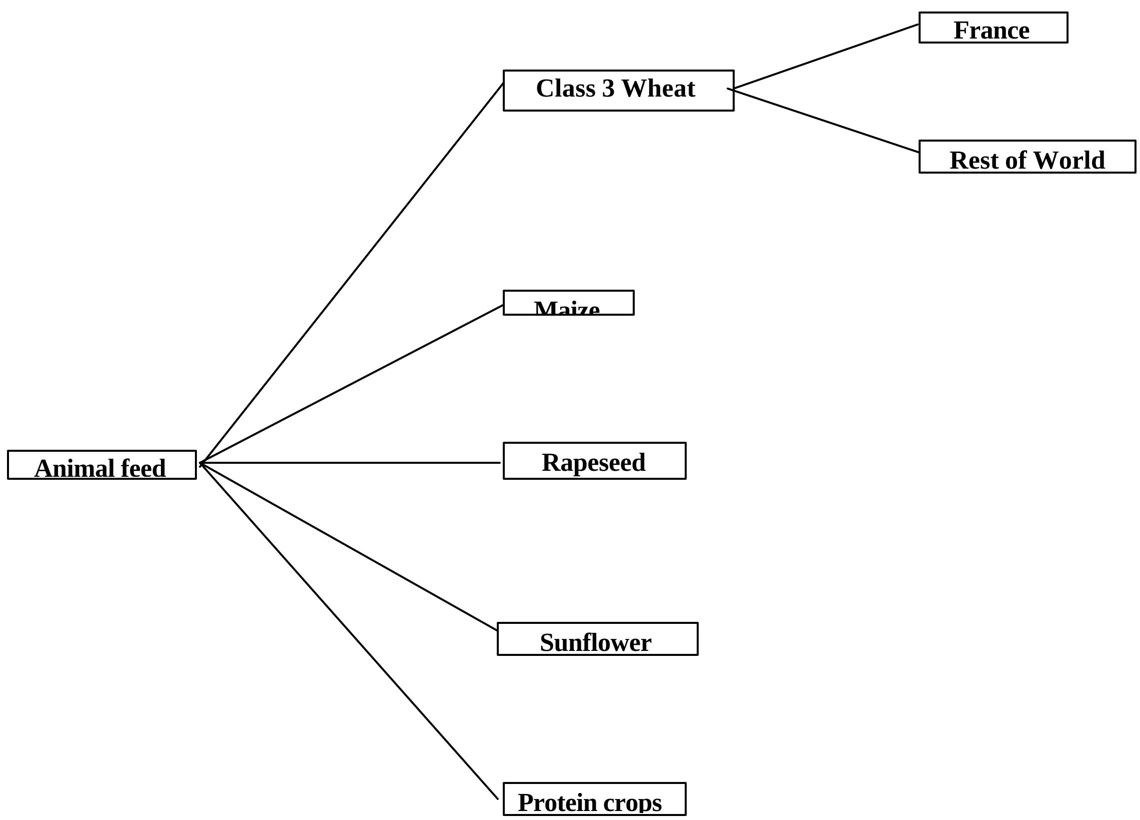


Figure 4 shows the setting for class E, 1 and 2 wheat. Durum wheat and class 3 wheat are not included in this figure as they belong to two different and independent markets. Durum wheat belongs to a market of its own, so that stages 1 and 2 are in fact identical. Class 3 wheat is mainly used for animal feed and is in competition with feed substitutes as represented in Figure 5. Feed wheat is also distinguished by origin.

Figure 5. Three-stage demand for Class 3 feed wheat



Supply of Durum and Wheat Class E, 1, 2 and 3

In terms of supply, production technology, type of soil and climate mainly define competitiveness for land among the different type of agricultural production. Although there are certainly differences in competitive possibilities of production of the different classes of wheat, the analysis in this paper only considers rapeseed and protein crops as competitive crops to estimate the supply elasticities for each class of wheat because of lack of available degrees of freedom in the regressions. Durum wheat is treated differently in that maize and sunflower are considered as main competitive crops in this case.

The Equations

The behavioral model equations are defined according to the end use and origin differentiated demand of wheat at each decision stage. In stage one, a global budget is defined for all the products of a given category. In stage two, the budget is allocated among the different components or classes (depending on the case) of that category. In stage three, a demand is set for the different origins of the produce. The total budget allocated to milling wheat in country k in stage one can be expressed as follows:

$$Y^k_{millingwheat} = \sum_{i,j} p^k_{ijt} D^k_{ijt}, \quad i = E, 1, and 2,$$

where, following Armington's definitions, the demand for the differentiated product i produced in country j is denoted D^k_{ijt} and p^k_{ijt} denotes its price.

In stage two, this budget is allocated to the different classes of wheat. Let C^k_i denote the set of indexes of class i milling wheat of all origins demanded in country k at time t, $Q^k_{it} = \sum_{j \in C^k_i} D^k_{ijt}$ the quantity of class i

wheat and its price index given by $p_{it}^{k} = \sum_{j\in C_i^k} p_{ijt}^{k} D_{ijt}^{k} \Big/ \sum_{j\in C_i^k} D_{ijt}^{k}$. Then the budget allocated to class i wheat can simply be expressed as $y_{it}^{k} = p_{it}^{k} Q_{it}^{k}$. The change in demand of class i wheat in stage two is expressed as follows:

$$\frac{\partial Q_{it}^{k}}{Q_{it}^{k}} = \sum_{j\in C_i^k} e_{ij}^{k} \frac{dp_{ijt}^{k}}{p_{ijt}^{k}} + h_{iy}^{k} \frac{\partial y_{it}^{k}}{y_{it}^{k}}$$

, where e and h are respectively the price and revenue elasticities of demand of class i wheat.

In stage three, the demand for a wheat of particular origin is expressed as follows:

$$\frac{\partial D_{ijt}^{k}}{D_{ijt}^{k}} = \sum_{l\in C_i^k} l_{ijl}^{k} \frac{\partial p_{ijt}^{k}}{p_{ijt}^{k}} + m_{iy}^{k} \frac{\partial y_{ijt}^{k}}{y_{ijt}^{k}}.$$

In the case of feed wheat, the relations are identical except that C_i^k now denotes feed wheat and all its substitutes in demand. These demand equations are functions of changes in own price and in the budget allocated to this class of wheat.

The equations for the change in supply are written as follow:

$$\frac{\partial O_{it}}{O_{it}} = \sum_{j=1}^{N-1} x_{ij} \frac{\partial \bar{p}_{jt}}{p_{jt}} + \sum z_{ij} \frac{\partial \bar{r}_{jt}}{r_{jt}} + \sum_{k=1}^{l} t_{ik} \frac{\partial n_{kt}}{n_{kt}},$$

where the supply in country k for good i (produced in country k) is denoted O_{ikt}^{k} and r_{ikt}^{k} is the direct acreage payment defined in Moro and Sckokai (1999) as $r_{it}^{k} = a_{it}^{k} + b_{it}^{k} \frac{c_{it}^{k}}{1-c_{it}^{k}}$, where a_{it}^{k} is product i 's per hectare specific direct payments, b_{it}^{k} is the set-aside premium and c_{it}^{k}, the fixed set-aside percentage. These are functions of changes in own price and of prices of the substitutes of good i for consumption, and of prices of the competing products to cultivation in production. This formulation allows for adjusting supply responses to the additional acreage response from the arable area direct acreage payments implemented in the EU since 1992. x_{ij}, z_{ij} and t_{ik} are respectively the elasticities of prices, direct acreage payments and of fixed inputs to production. The paper now turns to the description of the determination of the different demand and supply elasticities.

Demand Elasticities

Two different techniques are used to estimate the different elasticities for milling and feed wheat. In the case of milling wheat, conditional demand elasticities are calculated within the multi-stage budgeting scheme corresponding to Figure 5 presented above using the AIDS model described below, and, in the case of feed wheat and its substitutes or complements, derived demand elasticities are calculated following the translog procedure presented in Davis and Jensen (1994). Each of these two methods is now described in turn.

AIDS Model

Following Alston, Carter, Green and Pick (1990), import and domestic demand elasticities of different milling wheat classes and substitutes of our model are estimated using the almost ideal demand system (AIDS) model. Armington's model was not used in spite of its wide use since it is generally found that the homothetic and separability hypotheses on which it relies are not verified in practice. The AIDS model has been widely used in various demand and import demand studies, (for example see De Gorter and Meilke 1987; Moschini, Moro and Green, 1994; Moschini 1996; Mohanty and Peterson, 1999). The advantages of this model are: (i) its flexibility which enables a quasi exact representation of consumer preferences at least at a given point, in contrast for example to the Rotterdam model, and (ii) the eventual direct use of its estimates to test for the theoretical conditions imposed on demand equations (i.e., adding up, symmetry, homogeneity and concavity restrictions), and (iii) a resulting non linear Engle curve which allows for income elasticity to vary according to income levels.

In the AIDS model, the budget share $w_{ij}^k = \frac{p_{ij}^k \; q_{ij}^k}{\sum_j p_{ij}^k q_{ij}^k}$ of demand from country k of a product i differentiated by its origin j is specified as follows:

(1) $w_{ij}^k = a_{ij} + \sum_l g_{ijl} \log p_{il}^k + b_{ij} \log(y_i^k / P_i^k), \; j, l = 1, ..., n,$

where n is the number of sources of supply including domestic and foreign origins,

p_{il}^k is the market price in country k of products i supplied from origin l,

$y_i^k = \sum_j p_{ij}^k q_{ij}^k$ is the total expenditure in country k of the products i from the j origins,

P_i^k is a general price deflator specified as follows:

(2) $Log \;\; P_i^k = a_{i0} + \sum_l a_{il} \log p_{il}^k + \frac{1}{2} \sum_j \sum_l g_{ijl} \log p_{il}^k \log p_{ij}^k \cdot$

According to Deaton and Muellbauer (1980), the general price deflator can be approximated by the Stone index specified as follows: $\log P_i^k = \sum_l w_{il}^k \log p_{il}^k$.

The adding up, symmetry homogeneity and symmetry conditions respectively require that

$\sum_j a_{ij} = 1$, $\sum_j b_{ij} = 0$, $\sum_j g_{ijl} = 0$, $\sum_l g_{ijl} = 0$, and $g_{ijl} = g_{ilj}$. The negativity condition is verified if the Slutsky matrices of the terms of substitution $s^k_{ijl} = \frac{y^k_i}{p^k_{ij} p^k_{il}} c^k_{ijl}$ or equivalently of c^k_{ijl} are negative semi-definite.

The demand for classes E, 1 and 2 are estimated in a three stage budgeting system. In the first stage of budgeting, total expenditure is fixed for all products in the system. In the second budgeting stage, demand is determined for the three classes of wheat, and in the third stage, conditional on the total amount spent for that particular class of wheat, the decision is made how to allocate the budget among the different supply origins. Durum wheat is estimated separately from and differently than the other 3 wheat classes as justified by Mohanty and Peterson (1999) who point out the very little amount of substitutability between durum and the other classes of wheat.

The Translog Derived Demand Model

In contrast to milling wheat, feed wheat enters as one component of animal feed. It can be substituted for and its use depends on a multitude of factors such as the price of meat and the price of feed substitutes. Although the model follows the same graphic representation as that of milling wheat, it is not possible to argue for the choice of a budget allocated to each of the feed components given to animals for feed. Therefore, the estimation relies on a technique that takes into account the derived demand rather than a specific budget allocated to each product category. For this purpose, feed wheat's derived demand is obtained by differentiating a translog profit function. The translog function is chosen mainly because of the flexibility of the function and is specified as follows:

$$s_i = \frac{p_i q_i}{\pi} = \alpha_i + \sum_{i'} \beta_{ii'} \ln p_{i'} + \sum_m \delta_{im} \ln z_m \text{, with } i, i' = 1, \ldots, n, \; \beta_{ii'} = \beta_{i'i},$$

where s_i is the profit share of i, z_m is the vector of fixed factors, and $p_{i'}$ is the vector of all input and output prices of the system.

The derived demand system finally distinguishes four products, which are class 3 wheat, maize, rapeseed, and protein crops. Other main products such as sunflowers and barley have not been taken into consideration in the demand system because of data availability problems (barley) and because of lack of sufficient degrees of freedom during estimation.

Estimation

This paper uses the non-linear least square (NLSQ) estimation method to estimate the demand system in order to compute the maximum likelihood estimates of non linear or linear multivariate equations with cross equation constraints.

Since both the AIDS and translog are market share demand models, the sum of all shares is necessarily equal to one. For each demand system estimated, one of the equations is dropped to avoid the problem of singularity. The estimates are invariant in the equation dropped, and its coefficients are calculated at the end of the estimation procedure, making use of the homogeneity constraints. As suggested by Berndt and Savin

(1975), each system is corrected for autocorrelation by using the same autocorrelation coefficient for each equation. During the estimation procedure, the theoretical demand constraints, especially homogeneity, symmetry and concavity are imposed to all complete demand systems. The negativity condition is imposed on all systems following the recommendation of Diewart and Wales (1987). This is based on the Cholesky decomposition. This method consists in decomposing the symmetric Slutsky matrices of substitution c_{ij} into two triangular matrices A such that $c_{ij} = -AA'$, and where A' is the transpose matrix of A. When imposing concavity, equation (2) is substituted into equation (1) resulting in a highly non-linear model not always very easy to estimate.

The elasticities are calculated as follows:

For the conditional demand elasticities, following Green and Alston (1990), the formulas are:

$\boldsymbol{h}_{ij} = -\boldsymbol{d}_{ij} + (\boldsymbol{g}_{ij} - \boldsymbol{b}_i w_j)/w_i$, with $\boldsymbol{d}_{ij} = 1$ for $i = j$, and $\boldsymbol{d}_{ij} = 0$ for $i \neq j$, and $\boldsymbol{h}_i = 1 + \frac{\boldsymbol{b}_i}{w_i}$

where $\boldsymbol{h}_i$ is the expenditure elasticity and $\boldsymbol{h}_{ij}$ is the uncompensated price elasticity. The compensated elasticity of demand n^*_{ij} is derived from the Slutsky equation. For the derived demand system, the elasticities are calculated as follows:

$\boldsymbol{h}_{ij} = s_j + \boldsymbol{b}_{ij}/s_i$ for cross elasticities, and $\boldsymbol{h}_{ii} = -1 + s_i + \boldsymbol{b}_{ii}/s_i$ for own-price elasticities.

An asymptotic student test is used to test the significance of the estimates of the elasticities at different levels of significance.

Results and Interpretation

The elasticities in Table 3 are almost all significantly different from zero at a 5% level of significance. Most exceptions occur in class 1 wheat. Expenditure elasticities indicate normal goods for French and EU class 2 wheat, neutral goods for USA class E wheat and EU class 1 wheat, and inferior goods for USA class 1 wheat, EU class 3 wheat and Canadian class E. The inferiority of certain goods can be explained because of substitution relationships between the different products of the system in such a way that an increased in the total expenditure of the system results in a reallocation depending on the relative preference of consumers for different products. Consumers can therefore choose to increase consumption of a good to the detriment of another one in the system.

Table 3 Third stage uncompensated end use and origin differentiated demand elasticities for wheat and substitutes in France

	Origin					
	France	*European Union*	*United-States*	*Canada*	*Rest of world*	Expenditure
Durum Wheat						
France	-0.48***	-0.43***			-0.05***	0.96***
	(0.00)	(0.00)			(0.02)	(0.00)
European	-0.44***	-0.59***			0.01	0.96***
Union	(0.00)	(0.00)			(0.40)	(0.00)
Rest of World	-1.68***	0.10			-0.03	0.96***
	(0.00)	(0.83)			(0.96)	(0.00)
Class E wheat						
France	-2.23	0.54***	-0.14	-0.15		1.99***
	(0.29)	(0.00)	(0.95)	(0.40)		(0.00)
European	1.65***	-2.57***	0.70***	0.04		0.22***
Union	(0.00)	(0.00)	(0.00)	(0.90)		(0.00)
United-States	0.14	3.40***	-4.71	1.19		-0.02
	(0.99)	(0.00)	(0.74)	(0.30)		(0.94)
Canada	-1.00	4.59***	10.67	-3.05**		-11.21***
	(0.92)	(0.01)	(0.25)	(0.07)		(0.00)
Class 1 Wheat						
France	-1.04***	0.001			0.02	1.02***
	(0.00)	(0.75)			(0.32)	(0.00)
European	1.70*	0.006			-1.31	-0.39
Union	(0.06)	(1.00)			(0.20)	(0.427)
United-States	1.25	-2.22			-5.08	-4.05**
	(0.86)	(0.20)			(0.48)	(0.05)
Class 2 wheat						
France	-1.00***	0.01***				1.00***
	(0.00)	(0.00)				(0.00)
European	-0.31***	-0.40***				0.71***
Union	(0.02)	(0.00)				(0.00)
Class 3 wheat						
France	-1.01***	0.002				1.01***
	(0.00)	(0.19)				(0.00)
European	1.99***	-1.42***				-0.57*
Union	(0.00)	(0.00)				(0.09)

Source: from table A2, Annex

[1] figures in parenthesis are standard errors, ***: 1% of significance, **: 5% significance, *: 10% significance.

Table 4 Second stage uncompensated end use and origin differentiated demand elasticities for wheat and substitutes in France

	Class 3 wheat	Maize	Rapeseed	Protein crops
Class 3 wheat	-0.81***	0.54***	0.04	0.24
	(0.01)	(0.01)	(0.77)	(0.34)
Maize	0.49***	-0.78***	0.39**	-0.10
	(0.01)	(0.00)	(0.05)	(0.46)
Rapeseed	1.64	-0.79	1.48**	-2.33**
	(0.34)	(0.46)	(0.07)	(0.09)
Protein crops	0.10	1.15***	-1.81***	0.56**
	(0.77)	(0.02)	(0.00)	(0.07)

Table 3 shows that own price elasticities have expected negative signs. Wheat markets differ quite considerably from one another in consumption behavior, especially class E wheat from the others. Table 4 shows that class 3 wheat, maize and rapeseed are substitutes for one another on the French market. This is not surprising since these products are all used to supply energy in animal feed. Maize and rapeseed appear to be complements, although the elasticities are non significantly different from zero.

Compared to the elasticities found in Mohanty and Peterson (1999), the one presented here are generally higher than the one's found in the paper. This is not surprising since here wheat is disaggregated according to its different qualities, and it is to be expected that each class taken separately respond more than the product considered as a whole.

Supply Elasticities

Supply elasticities are computed from estimates derived from a normalized quadratic profit function following Moro and Sckokaï (1999) applied to dynamic supply systems. These include per hectare production direct payments specified as follows:

$$q_{it} = a_i + \sum_{i'=1}^{N-1} a_{ii'} \bar{p}_{i't} + \sum_{i'=1}^{N-1} d_{ii'} \bar{r}_{i't} + \sum_{k=1}^{l} j_{ik} n_{kt}$$

Where N denotes the total number of product and variable factors in the system,

$\bar{p}_{i't}$ is the normalized product or input price,

$\bar{r}_{i't}$ is the direct payment to production

v_{kt} are the fixed factors in production

numeroter les equations

Because of the poor result obtained with this specification, we use a general dynamic specification of this equation following the procedure of Wickens and Breuch (1988) obtained as follows:

$$q_{it} = -d\left[\sum_{k=1}^{p} l_k \Delta_k q_t - d\left(\sum_{k=0}^{p} d_k\right) X_t + \sum_{k=1}^{p} d_k \Delta_k X_t\right] + du_t$$

where: $d = 1/(1 - \sum_{k=1}^{p} l_k)$

Δ is the difference operator,

d_0 is the vector of parameters in the static normalized quadratic supply system.

In the final estimated system, one lag is introduced on market prices and quantities only, based on the hypothesis that farmers produce according to former prices and former quantities. Because of the fact that production direct payments are known before the production decision process, no lag is introduced on these prices.

Because of lack of data on variable input and on some fixed factors, only product prices and direct acreage payments are included in the regressions. Also because of small degrees of freedom and multicollinearity problems among market wheat class prices, we cannot estimate one unique supply system made up of the four wheat classes and their competitive products. The five individual systems are estimated separately, and rapeseed and protein crops are included in willing and feed wheat equations while sunflower and maize are included in the durum equation.

The estimation of each of the five systems is performed using the least square method of estimation, which provide consistent maximum likelihood estimates. The homogeneity, symmetry and convexity conditions are imposed to the different systems. Convexity is imposed by using the Cholesky decomposition as described in the demand system.

In the supply equations for wheat E, 1, 2 and 3, prices and direct payments are normalized with the protein crops price, while for durum wheat, sunflower price is used to normalize the prices. The elasticities are computed for the year 1998, simply by differentiating the supply equations with respect to prices and compensatory payments.

Results and Interpretation

Table 5 shows that own price elasticities of supply are always positive and significantly different from zero most of the times. The same holds true for elasticities of direct acreage payments to production. The most important results in terms of their influence on the simulation results are the large values of elasticities associated to the direct acreage payments of production of colza and protein crops. The elasticities are large and the direct payments to production of those products dropped quite significantly.

Table 5 End use differentiated supply price elasticities for wheat and competitive products in France

Wheat Class	Price					Acreage payment				
	Wheat	*Colza*	*Protein crops*	*Maize*	*Sunflower*	*Wheat*	*Colza*	*Protein crops*	*Maize*	*Sunflower*
Wheat E	0.02	1.29				-2.59	-2.03	2.59		
	(0.94)	(0.88)				(0.79)	(0.38)	(0.78)		
Wheat 1	1.81**	-1.33***	-0.48			1.14***	-0.53***	-0.56		
	(0.02)	(0.01)	(0.50)			(0.01)	(0.01)	(0.27)		
Wheat2	0.003	-0.02	0.01			-1.54***	0.16	1.75***		
	(0.991)	(098)	(0.98)			(0.02)	(0.39)	(0.01)		
Wheat 3	2.22***	1.34***	-3.60***			2.41***	-0.86***	-1.50***		
	(0.00)	(0.00)	(0.00)			(0.00)	(0.00)	(0.00)		
Durum wheat	2.45***			-0.66	-1.80*	4.17***			-2.02***	-1.25***
	(0.04)			(0.52)	(0.8)	(0.00)			(0.00)	(0.00)

Source: from table A3, Annex

The Partial Equilibrium Displacement Model

The price transmission elasticities derived earlier in the paper are used to calculate the price change induced by a change in institutional floor and reference prices as follow:

$$\frac{\partial p_{ikt}^{k}}{p_{ikt}^{k}} = \varepsilon_{ik3}^{kf} \frac{\partial POL}{POL} + \varepsilon_{ikw}^{kf} \frac{\partial p_{iwt}^{k}}{p_{iwt}^{k}}$$

In turn, the price difference calculated from the transmission elasticities are fed into the demand and supply system to yield demand and supply changes induced by the change in policy. This can be expressed as follows:

$$\frac{\partial D_{ijt}^{k}}{D_{ijt}^{k}} = \sum_{l \in C_i^k} \eta_{il}^{k} \frac{\partial p_{ilt}^{k}}{p_{ilt}^{k}}$$

$$\frac{\P O_{ikt}^{k}}{O_{ikt}^{k}} = x_{ik}^{k} \frac{\P p_{ikt}^{k}}{p_{ikt}^{k}} + \sum_{c \in C_i} z_{ck}^{k} \frac{\P p_{ckt}^{k}}{p_{ckt}^{k}} + t_{ik}^{k} \frac{\P r_{ikt}^{k}}{r_{ikt}^{k}}$$

These equations serve as a basis for the analysis of a policy change on domestic supply and demand of cereals and substitutes as well as changes on foreign produced wheat. The change in domestic excess supply is expressed as:

$$\Delta NP_{ikt}^{k} = \frac{\P O_{ikt}^{k}}{O_{ikt}^{k}} O_{ikt}^{k} - \frac{\P D_{ijt}^{k}}{D_{ijt}^{k}} D_{ijt}^{k} \text{ with } t = 1998$$

where ΔNP_{ikt}^{k} represents the change in domestic excess supply. Excess supply will either be stocked or exported while excess demand will either lead to a decrease in stocks or an increase in imports of that good.

Agricultural Policy Instruments and Simulation

Table 6 shows the main elements of the simulated policy scenario. As planned in Agenda 2000, cereal intervention prices are cut and arable area direct acreage payments are increased. EU trade is also subject to market access and export competition provisions agreed to in the Agricultural Agreement of the Uruguay Round.

Table 6 Agricultural policy instruments and simulation scenarios

Instruments	Policy Scenario	
Agenda 2000		
Cereal intervention price	-15%	
Cereal reference price	Less than 155% times intervention price	
Average per hectare specific direct payments:		
Wheat and maize	+16%	
Rapeseed and sunflower	-33%	
Protein crops	-8%	
Set aside premium	-8%	
Fixed set aside percentage	-17%	
Uruguay Round Trade Agreements	EU	France
Minimum wheat market access (in tons)	1 767 000	390 000 [a]
Zero tariff wheat contingent (in tons)	350 000	77 000 [a]
Maximum volume of subsidized exports (in tons)	14 400 000	7 000 000 [b]
Maximum value of exports subsidies (billion French francs)	8.44	3.83 [c]

[a] The EU commitment is distributed to France according to its share of consumption in the EU. France's contingent=22% EU contingent.

[b] The EU commitment is distributed to France according to its share of exports in the EU in volume, i.e. France's contingent=56% EU contingent.

[c] The EU commitment is distributed to France according to its share of exports in the EU in value, i.e. France's contingent=45% EU contingent

Pour MURIEL: quels sont les chiffres UR POUR LA france…

Simulation Results and Interpretation

Price, Demand and Supply Changes

Table 7 shows the effects of Agenda 2000 policy on institutional prices. Intervention prices where reduced by 15%, and assuming that the new reference price is set at 155% times the intervention price, the reference price for durum wheat is reduced by 17% and the reference price for the different classes of wheat is reduced by values ranging from 12 for high quality wheat to 18% for low quality wheat. Notice that the reference price only takes effect if the CIF price of a cereal is below the reference value. If not, the good enters the EU without import levies. Table 7 shows that wheat and maize production also benefit from a 16% increase in direct payment to production, while oilseeds and protein crops receive a sharp decrease in production direct payments of 32 and 10% respectively. These changes in institutional prices are transmitted to market prices as shown earlier in the paper, and the new reference prices transmit directly to extra-European imports as long as their CIF price is below the reference price. Price transmission is assumed to be the same for France's domestic market prices and intra-European import prices (of the same class product) as these prices are affected by the same policy changes throughout the European Union.

Table 7 Institutional Price Changes

Values in French francs

Institutional price	Initial value [a]	Final value [b]	% Change	Initial value [a]	Final value [b]	% Change
	Intervention price			**Reference price**		
Durum wheat	797	678	-15%	1263	1050	-17%
Class E wheat	813	691	-15%	1212	1071	-12%
Class 1 wheat	813	691	-15%	1212	1071	-12%
Class 2 wheat	797	678	-15%	1212	1050	-13%
Class 3 wheat	757	644	-15%	1212	998	-18%
Maize	797	678	-15%	904	904	0%
Rapeseed	0	0	0%	1064	1064	0%
Sunflower	0	0	0%	0	0	0%
Protein crops	702	702	0%	0	0	0%
	Set aside direct acreage payments			**Crop specific hectare direct payments**		
Durum wheat	2631	2421	-8%	2631	3052	16%
Class E wheat	2631	2421	-8%	2000	2320	16%
Class 1 wheat	2631	2421	-8%	2000	2320	16%
Class 2 wheat	2631	2421	-8%	2000	2320	16%
Class 3 wheat	2631	2421	-8%	3628	4209	16%
Maize	2631	2421	-8%	2329	2701	16%
Rapeseed	2631	2421	-8%	3071	2057	-33%
Sunflower	2631	2421	-8%	3573	2394	-33%
Protein crops	2631	2421	-8%	2890	2658	-8%
	Effective set aside rate			**Compensatory direct payments**		
Durum wheat	10.6%	8.8%	-17%	2943	3285	12%
Class E wheat	10.6%	8.8%	-17%	2312	2554	10%
Class 1 wheat	10.6%	8.8%	-17%	2312	2554	10%
Class 2 wheat	10.6%	8.8%	-17%	2312	2554	10%
Class 3 wheat	10.6%	8.8%	-17%	3940	4442	13%
Maize	10.6%	8.8%	-17%	2641	2935	11%
Rapeseed	10.6%	8.8%	-17%	3383	2291	-32%
Sunflower	10.6%	8.8%	-17%	3885	2627	-32%
Protein crops	10.6%	8.8%	-17%	3201	2892	-10%

[a] 1998 for maize, rapeseed and protein crops, prices in French francs per ton

[b] The final value is given by the maximum of 155 percent of the intervention price and the CIF Rotterdam.

Table 8 shows that all wheat and maize domestic market prices drop following the change in policy while oilseed and protein crops domestic market prices do not change. It is therefore not surprising to find a general increase in demand for all wheat consumed in France as it appears in Table 9 below. Some estimated cross elasticities do, however, predict a decrease in intra-European and Canadian class E wheat imports, as well as a decrease in intra-European imports of class 3 wheat, however these decreases are more than compensated by increases in demand of alternative sources.

Table 8 Changes in Market and Entry Price

Values in French francs

Product	Origin	Initial value	Final value	% Change
Durum wheat	*France*	960	861	-10%
	Intra-EU	1310	1174	-10%
	Extra-EU	1263	1050	-17%
Class E wheat	*France*	1559	1472	-6%
	Intra-EU	1077	1017	-6%
	USA	1229	1071	-13%
	Canada	1279	1071	-16%
Class 1 wheat	*France*	778	716	-8%
	Intra-EU	1352	1245	-8%
	USA	1229	1071	-13%
Class 2 wheat	*France*	771	678	-12%
	Intra-EU	1077	948	-12%
Class 3 wheat	*France*	820	721	-12%
	Intra-EU	1352	1188	-12%
Maize	*France*	904	800	-11%
Rapeseed	*France*	1241	1241	0%
Sunflower	*France*	1342	1342	0%
Protein Crops	*France*	7200	7200	0%

Table 9 Changes in demand

Values in '000 tons

Wheat Class	Origin	Initial value	Final value	% Change
Durum	*France*	*440*	*481*	*9%*
	Intra-EU	*495*	*548*	*11%*
	Extra-EU	*18*	*21*	*16%*
Class E	*France*	*70*	*80*	*14%*
	Intra-EU	*191*	*183*	*-4%*
	USA	*21*	*26*	*21%*
	Canada	*3*	*0*	*-100%*
	Rest of world [a]	*2*	*2*	*0%*
Class 1	*France*	*5136*	*5543*	*8%*
	Intra-EU	*23*	*23*	*1%*
	USA	*1*	*2*	*83%*
Class 2	*France*	*581*	*650*	*12%*
	Intra-EU	*16*	*17*	*9%*
Class 3	*France*	*10482*	*11758*	*12%*
	Intra-EU	*23*	*22*	*-7%*

[a] Not included in simulation

Supply side results appear in Table 10. Among wheats, supply of class 3 wheat is less affected by policy change than the other classes of wheat. However, high quality wheat supply (classes E and 1) increases proportionately more than lower quality wheat (classes 2 and 3), although class 2 wheat is the single class that benefits the most from the policy change. Durum wheat is more favorably affected by the new policy than the other wheats.

The last two columns of Table 10 show the decomposition of the change in terms of price and direct payment effects separately. As expected, change in supply induced by domestic market price decrease is negative. Low quality wheat production decreases proportionately more than high quality wheat production. Interestingly, according to the estimates, direct payments to production more than offsets the price effects leading to a net increase of production in all classes of wheat.

Table 10 Changes in supply

Values in '000 tons

Class of Wheat	Initial value	Final value	Total % change	% Change accounted for price change	% Change accounted for change in direct payments to production
Durum	1542	1917	24%	-9%	33%
Class E	93	104	12%	-5%	17%
Class 1	9590	10565	10%	-7%	17%
Class 2	13667	15520	14%	-12%	26%
Class 3	12112	12856	6%	-13%	20%

Since we have an increase as well in demand and as in supply, the net effect on imports and exports is not known in advance, and so the purpose of this study. Table 11 shows an overall decrease in imports of class E wheat, however, an increase in extra-European imports. Class 1 wheat imports increase slightly, the difference imported from outside the European Union. Class 2 wheat intra-European imports increase and class 3 wheat intra-European imports decrease. The market for class 3 wheat shows an impressive drop in exports. Exports increase in all the other classes of wheat. The increase in durum wheat exports is quite noticeable.

Table 11 Changes in imports and exports

Values in '000 tons

	Exports			Imports		
	Initial exports	Final exports	% Change	Initial imports	Final imports	% Change
Durum wheat	1102	1436	30%	513	569	11%
Intra-EU	524	683		495	548	11%
Extra-EU	578	753		18	21	16%
Class E wheat	23	24	6%	217	211	-3%
Intra-EU	23	24		191	183	-4%
Extra-EU	0	0		27	28	6%
Class 1 wheat	4454	5022	13%	24	25	4%
Intra-EU	1291	1455		23	23	1%
Extra-EU	3164	3567		1	2	72%
Class 2 wheat	13087	14869	14%	16	17	9%
Intra-EU	7836	8903		16	17	9%
Extra-EU	5251	5966		0	0	0%
Class 3 wheat	1630	1098	-33%	23	22	-7%
Intra-EU	976	657		23	22	-7%
Extra-EU	654	440		0	0	0%
Total intra-EU	10650	11722	10%	748	793	6%
Total extra-EU	9647	10726	11%	46	51	11%
Total extra-EU (10^6 French francs)	7600	7570	-0.5%	60	61	2%

More importantly, overall extra-European exports increase by 11% due to Agenda 2000. The question that arises is whether or not France can respect the Uruguay Round trade limits imposed it. Of course, the limits are imposed on the European Union as a whole, so, in order to answer this question, the burden of trade restrictions on France were distributed proportionately to its share of exports in 1999. According to these figures, France cannot export more that 7.5 million tons of subsidized wheat. In 1999 it already exported 9.6 million tons and our model predicts that it will export 10.7 million tons in 2000-2001, an increase of 11%. The problem is that we do know how much French exports were actually subsidized. However, our figures indicate that, in any case, the trade restrictions will be more binding than in the past. France will either have to find markets for its non-subsidized exports or rely on intervention stock purchases to absorb the surplus. However, there are some indications of some offsetting factors that could come as a help to meet the Uruguay Round commitments. For example, it is not clear that supply in other EU countries will respond as much as in France to the new policy, since not all countries, especially in the north, have such favorable production environment to high quality wheat. So, as market prices fall and as supply increases proportionately more in France than in other European countries, first of all, France can find a larger outlet in the EU for its excess supply due to a general increase in demand, and being a relative more important producer within the EU, we would have allocated to France a greater share of the Uruguay Round export commitments than we currently do. Another offsetting factor could reside in the increasing trend in world prices denominated in the European currency, not so much because of an increase in foreign wheat prices per se, but because of the low value of the European currency. This means that, all things equal, the EU doesn't need to spend as much to subsidize its exports enabling it to sell more before reaching the UR export commitments

It is worth noting at this point that the increase in exports is an undesirable side effect of the direct payments to production. These estimates confirm what many researchers have hinted in the past (Guyomard, Le Mouel and Surry (1993), Moro and Sckokai (1999)), that direct payments to production are not completely decoupled from production. In terms of value of exports, France exceeds the share of exports assigned to him.

Conclusion

This paper analyses the effects of Agenda 2000 on supply, demand and trade of origin and end-use quality differentiated wheat in France. The policy change is to bring a reduction in wheat prices, therefore increasing demand and in principle decreasing supply, however, direct transfers to production more than offsets the price effect and so, in the end, supply increases as well. The overall effect on imports and exports is positive as well. Exports increase about as much within the EU than outside the EU. However, extra-EU imports increase more than intra-EU imports. The increase in intra-EU imports will help France keep up with its minimum entry requirements as defined in the Uruguay Round Agreements, however the increase in exports will be more difficult to meet.

The results of this paper can be enhanced by making use of a dynamic AIDS model as proposed in Mohanty and Peterson (1999) jointly with the dynamic supply system to distinguish short and long term effects. Future work on this paper will include a sensitivity analysis on key parameters such as demand and supply elasticities, using a stochastic partial equilibrium displacement model as proposed in Davis and Espinoza (2000). Another direction of improvement will be to expand the model to other key EU countries such as Germany, United Kingdom and Italy and, eventually, to the whole EU.

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Annex

Table A1. Institutional and world price transmission [a, b]

	Dependent Variables								
	Wheat Class					*Substitute / competing products*			
Coefficient	*Durum*	*E*	*1*	*2*	*3*	*Maize*	*Rapeseed*	*Sunflower*	*Protein crops*
Constant	324	-134	167*	178	102	-18.7	-148	1030***	522
	(275)	(221)	(100)	(130)	(112)	(156)	(321)	(384)	(377)
Previous period	0.391	-3.04	0.0285**	0.0494	0.023	-0.0036	1.01***	1.06	0.0913
stocks	(0.664)	(2.03)	(0.0147)	(0.0479)	(0.0262)	(0.0325)	(0.411)	(0.893)	(0.994)
Previous period	0.0459	0.369***	0.371	0.148	-0.109	0.0789	0.584***	0.0627	1.1***
price	(0.248)	(0.136)	(0.265)	(0.323)	(0.257)	(0.304)	(0.147)	(0.142)	(0.408)
Transmission	0.617***	0.667***	0.514**	0.714***	1.02***	0.837***	0.371**	0.501***	-0.266
	(0.176)	(0.209)	(0.228)	(0.236)	(0.249)	(0.317)	(0.176)	(0.0803)	(0.376)
Export regime	-0.468		-10.9		-2.08	-2.65**			
	(2.34)		(26.5)		(1.7)	(1.25)			
Net exports	0.00237		0.0013		-				
	(0.00443)		(0.00371)		0.000638				
					(0.00179)				
World Price	0.0876	0.139				0.232**	0.396***	0.295***	-0.0503*
	(0.153)	(0.113)				(0.109)	(0.136)	(0.122)	(0.0303)
Number of observations	19	19	19	18	15	18	18	19	18
Log Likelihood	-115	-112	-102	-997	-79	-103	-124	-129	-116
R^2	0.92	0.92	0.94	0.87	0.95	0.91	0.94	0.96	0.91
Adjusted R^2	0.86	0.88	0.91	0.83	0.92	0.89	0.91	0.94	0.88

[a] Standard errors in brackets

[b] *, **, *** Indicate significance at 10, 5 and 1% levels respectively

Table A2. Different wheat class demand coefficient estimates[(a)]

Wheat class	Source	Intercept	Price (P) coefficient				Expenditure coefficient	Statistics	
			P1	P2	P3	P4		R^2	Durbin Watson
DURUM WHEAT	1=France	0.126	0.242	-0.216	-0.026		-0.019	0.992	1.41
		(0.00)	(0.00)	(0.00)	(0.02)		(0.20)		
	2=EU	0.483		0.208	0.007		0.008	0.997	1.37
		(0.00)		(0.00)	(0.39)		(0.59)		
	3=Extra-EU			0.091	0.018		0.011	0.986	1.23
				(0.00)	(0.14)		(0.00)		
CLASS E	1=France	0.520	-0.375	0.482	-0.032	-0.074	0.512	0.996	0.28
		(0.00)	(0.732)	(0.00)	(0.98)	(0.43)	(0.00)		
	2= UE	0.388		-0.728	0.248	-0.002	-0.304	0.995	1.98
		(0.00)		(0.00)	(0.01)	(0.90)	(0.00)		
	3=USA	0.082			-0.316	0.098	-0.085	0.848	1.00
		(0.00)			(0.786)	(0.30)	(0.01)		
	4=Canada	0.010				-0.022	-0.123	0.901	0.972
		(0.44)				(0.20)	(0.00)		
CLASS 1	1=France	1.125	-0.020	0.002	0.018		0.021	0.762	0.85
		(0.00)	(0.26)	(0.73)	(0.33)		(0.00)		
	2= UE	-0.050		0.005	-0.006		-0.007	0.717	0.78
		(0.01)		(0.03)	(0.21)		(0.00)		
	3=US	-0.075			-0.012		-0.018	0.800	1.09
		(0.11)			(0.57)		(0.02)		
CLASS 2	1=France	0.990	0.006	-0.006			0.003	0.998	0.455
		(0.00)	(0.00)	(0.00)			(0.00)		
	2= UE	0.010		0.006			-0.003	0.972	1.00
		(0.00)		(0.00)			(0.00)		
CLASS 3	1=France	0.996	-0.002	0.002			0.007	0.854	0.85
		(0.00)	(0.18)	(0.18)			(0.00)		
	2= UE	0.004		-0.02			-0.007	0.901	0.54
		(0.00)		(0.18)			(0.00)		
FEEDING	1=Class3	0.391	-0.075	0.045	-0.040	0.070		0.459	0.38
		(0.00)	(0.56)	(0.57)	(0.43)	(0.47)			
	2=Maize	0.412		-0.082	0.0104	-0.067		0.020	0.37
		(0.00)		(0.09)	(0.00)	(0.26)			
	3=protein crops	0.141			-0.138	0.074		0.732	0.38
		(0.00)			(0.00)	(0.11)			
	4=Rapeseed	0.056				-0.077			
		(0.00)				(0.32)			

Estimated by Rabelais Yankam, Université Catholique de Louvain

[(a)] Figures in parenthesis are asymptotic p-values

Table A3. End use differentiated supply price estimated coefficients for wheat and Competitive in France[a, b]

	Supply Systems									
	E	*Colza*	*1*	*Colza*	*2*	*Colza*	*3*	*Colza*	*Durum*	*Maize*
Intercept	682	34.40	22.24***	-3.61	-6743	3549	37480***	14818***	-1177	38300***
	(0.66)	(0.99)	(0.02)	(0.70)	(0.61)	(0.63)	(0.00)	(0.00)	(0.16)	(0.00)
Adjustment	-0.977***		-1.355***		-1.61**		-0.451***		-7.49***	
coefficient	(0.00)		(0.00)		(0.01)		(0.00)		(0.01)	
Current price coefficients										
Wheat	1.607		23***		3.00		17101***		3643**	
	(0.94)		(0.01)		(0.99)		(0.00)		(0.04)	
Competitive	76.43	3634***	-8.82***	7.21**	-86	2439	5344***	1670***	-1136	354
	(0.88)	(0.01)	(0.01)	(0.02)	(0.98)	(0.46)	(0.00)	(0.01)	(0.53)	(0.73)
One lag price *Coefficients*										
P1(-1)	-541.15	-3348***	234**	-5.29	-40323**	-957	-24413***	-8815***	-4900	24134
	(0.39)	(0.01)	(0.03)	(0.58)	(0.02)		(0.00)	(0.00)	(0.20)	(0.29)
P2(-2)	385.94	423.53	-13.56	0.39	49804***	1835.16	-18077***	-6771***	2353.85	-5318
	(0.73)	(0.86)	(0.139)	(0.96)	(0.00)	(0.79)	(0.00)	(0.00)	(0.58)	
Production Direct payments coefficients										
r1	-96.76	8112***	4.93***	3.57**	-5285***	3589***	5876***	2927***	2363***	4492***
	(0.79)	(0.00)	(0.01)	(0.04)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
r2	-51.89	-225	-1.35***	0.81**	371.59	266	-1439***	-28.64	-1132***	-556
	(0.38)	(0.11)	(0.01)	(0.02)	(0.39)	(0.46)	(0.00)	(0.81)	(0.00)	(0.13)
r3	68.83	-4890***	-1.62	-2.82**	4280***	-2010**	-2608***	-1266***	-549***	-1049***
	(0.277)	(0.00)	(0.27)	(0.02)	(0.01)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)
R^2	0.898	0.969	0.967	0.778	0.816	0.936	0.942	0.977	0.993	0.952
DW	1.87	1.8	1.83	1.45	1.13	1.46	2.4	2.06	2.33	2.01

Estimated by Rabelais Yankam, Université Catholique de Louvain

[a] Standard errors in brackets

[b] *, **, *** Indicate significance at 10, 5 and 1% levels respectively