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MODELLING THE IMPACT OF 2003 CAP REFORM ON CROP PRODUCTION

THE CASE OF DURUM WHEAT IN ITALY

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Abstract

This paper aims to summarize some of the major results emerging from simulating the impact of the CAP reform (the so-called Fischler Reform or Luxembourg Agreement, LA) within the AG-MEMOD model of the agri-food sector in Italy. The paper shows in detail how the model generates impacts when alternative policy scenarios (Agenda 2000 vs. LA) are specified. As major evidence of this impact in the Italian case, the crop sector is dealt with in detail. In particular, the case of supplementary payments for durum wheat clarifies how the reform may specifically affect Mediterranean agriculture and how alternative specifications of the regime change in durum wheat support may relevantly affect the impact.

Keywords: Common Agricultural Policy, Italian Agriculture, Commodity Market Models
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CONTENTS

1. Introduction

This paper presents the results emerging from the application of baseline and alternative Common Agricultural Policy (CAP) scenarios into the Italian econometric country model, developed as part of the AG-MEMOD ("Agricultural sector in the Member State and EU: econometric modelling for projection and analysis of EU policies on agriculture, forestry and the environment") EU research project[2]. The Italian AG-MEMOD model is an econometric, dynamic, multi-product partial equilibrium model including the main commodities of Italian agriculture (Esposti and Lobianco, 2004). This model is a part of the EU AG-MEMOD composite model that consists of a combination of all Member States' models running together. Therefore, the model aims to represent all the cross-commodity and cross-country effects induced by an external change and, in particular, by changes in the CAP support to any commodity. This structure allows replicating all the complex direct and indirect implications of the recent CAP reform.

The dynamic character of the model allows for multi-annual projections over time. Firstly, for any considered specific agricultural commodity, equations modelling supply, demand, international trade, price and stocks formation are estimated. Then, once all the equations are estimated over the observed time series, projections may be generated for all endogenous variables, as far as projections of the relevant exogenous variables are included. Alternative scenarios, in fact, refer to alternative specifications of the projections for these latter variables, policy variables included, which are assumed fully exogenous. Interactive running of different commodity and country models generates projections of equilibrium prices in all markets. Changes in equilibrium prices drive changes in all other relevant endogenous variables, such as commodities domestic supply and use, export and import and, in aggregate terms, overall agricultural value of output, inputs use and income.

Two main policy scenarios are compared: the CAP according to Agenda 2000 (also called the *baseline scenario*) and the CAP as reformed by the Luxembourg Agreement in June 2003 (also called the *alternative* or *LA scenario*). The effect of this reform is displayed, by comparing results emerging from the two scenarios, the rest of exogenous variables remaining the same. Although projections generated by the model can not be considered forecasts of the likely levels of prices, production levels, etc., as many unpredictable (and not modelled) factors usually strongly affect agricultural markets, they are still expected to correctly identify the direction and the intensity of the changes induced by the CAP reform on each commodity market.

The paper is organised as follows. The second section comments the major characteristics and the general structure of the Italian AG-MEMOD model, also discussing the general methodology here followed to estimate the model equations. The third section describes the CAP scenarios here adopted. For the LA scenarios, alternative specifications about the durum wheat supplementary payments are introduced. The fourth section presents the 2003-2010 projections generated by the model under the alternative CAP scenarios. Commodity markets projections are generated and commented together with projections of overall major components of the Economic Accounts for Agriculture. The final section summarizes the main results and provides a short comparison of the AG-MEMOD model results with other studies concerning the impact of the CAP reform on Italian agriculture.

[2] Details about the AG-MEMOD research can be found at the project web-site: http://www.tnet.teagasc.ie/agmemod

2. The Italian AG-MEMOD model

2.1. The AG-MEMOD modelling approach

The general AG-MEMOD modelling strategy is depicted in figure 1. The EU aggregate model is built by combining the EU country models, which are, in turn, obtained by merging single commodity sub-models. Rest of the world variables (mainly world market prices) are entered exogenously, whereas aggregate components of the Economic Accounts for Agriculture (EAA) for any country are directly derived by the respective commodity models.

Therefore, to achieve the complete EU model, the first stage implies the estimation of commodity country models in parallel across the EU countries. Commodity models across countries are based on a common template and are estimated on historical data using the same variables definition and data sources. A set of exogenous variables (including macrovariables, policy measures and key-prices) enters any commodity market. Once estimated, all the country commodity markets are translated into GAMS format and solved, that is for any commodity the "supply and use" identity is imposed by computing the closing variable. Then, all solved country models can be combined into one aggregate EU GAMS model which is in turn solved by imposing the supply and use identity in any market through the net EU export variable.

Commodity market models are dynamic for the presence of lagged variables among regressors.[3] Therefore, any country model in GAMS format, as well the combined EU model, can generate projections of the model endogenous variables, by feeding the model with projections of the exogenous variables, using the estimated parameters and imposing the markets closure for any projected year. These projections are generated by solving the estimated model in a recursive way for the projection period; that is, the equilibrium in a period is the starting point to solve the next equilibrium. Since policy (CAP) measures belong to the vector of exogenous variables, these projections are generated over a set of alternative values of these measures, in other words over a set of alternative policy scenarios. The comparison of the endogenous variables projections, as well as of derivative variables, across these alternative scenarios provides evidence on the impact of policy reform. These projections can be generated either country by country the rest of EU held exogenous (the *stand-alone country models*), or within the whole *EU combined model*, where the projections of all endogenous variables for all countries are generated by the closure of the EU model itself.

In each commodity model there must be one endogenous variable closing the model by setting supply and use identity. Generally, this closure variable is the import level, though in few cases it may be exports or the change in stocks (Esposti and Lobianco, 2004). When the country models are run together in the EU composite version, the supply and use identity must be respected in all countries as well in the EU; in any market the endogenous variable closing the EU model (thus, levelling EU supply and demand) is the net export.

For any commodity, a country model is explicitly linked to the other countries through a price transmission relationship, where a EU key-price drives price formation in any country. The EU key-price is usually set as the price observed in the most important national market for that commodity. So, for any commodity a key-market is identified (Esposti and Lobianco, 2004). Moreover, in any country, commodity models may be linked among them on either the

[3] Here, by dynamic model we just mean the presence of recursive structure in many equations as they depend on lagged values of other model variables; this allows to generate projections. However, no specific dynamics is admitted in optimising behaviour by agents and only purely adaptive expectations implied by recursivity are assumed. Moreover, in econometric terms, no dynamics implied by possible lagged structure in the error terms (or in its variance) of the estimated equations is admitted.

supply or demand side, according to land allocation behaviour, technical relations or to complementarity/substitutability on the demand side. These cross-commodity relations may be also quite complex and may differ across countries (for the Italian case, they are described in details in Esposti and Lobianco, 2004). Figure 2 depicts the general rules for the integration and closure of any country and EU commodity model. Eventually, this modelling strategy aims to emphasize at the maximum possible extent the cross-country and cross-commodities effects of any external change, policy variables included, in such a way to have a more realistic and complex representation on how markets react to CAP reforms.

In such a way, the Italian AG-MEMOD model describes the equilibrium formation on the following commodity markets: grains (soft and durum wheat, barley, maize), oilseeds (rapeseed, soybean, sunflower for seeds, oil and meal use), livestock (cattle and beef, pig, broiler, other poultry, sheep), milk and dairy products (cheese, butter, whole milk powder, skim milk powder), root crops (sugar beet, potatoes), and Mediterranean crops (olive oil, oranges, tomato, tobacco). Thus, the stand-alone Italian country model consists of 28 commodity sub-models.

Nevertheless, when combined with the other countries in the combined EU model, only some commodities have been included. There are two major reasons for this. On the one hand, some products are quite specific of the Italian agriculture, thus are not present in other countries, at least on the supply side. On the other hand, the major purpose is to evaluate the 2003 CAP reform, which indeed involves just part of the mentioned commodities. Therefore, we will present results concerning a sub-group of 22 commodities, that are modelled both in the Italian and in the aggregate EU model; these are also named GOLD commodities:

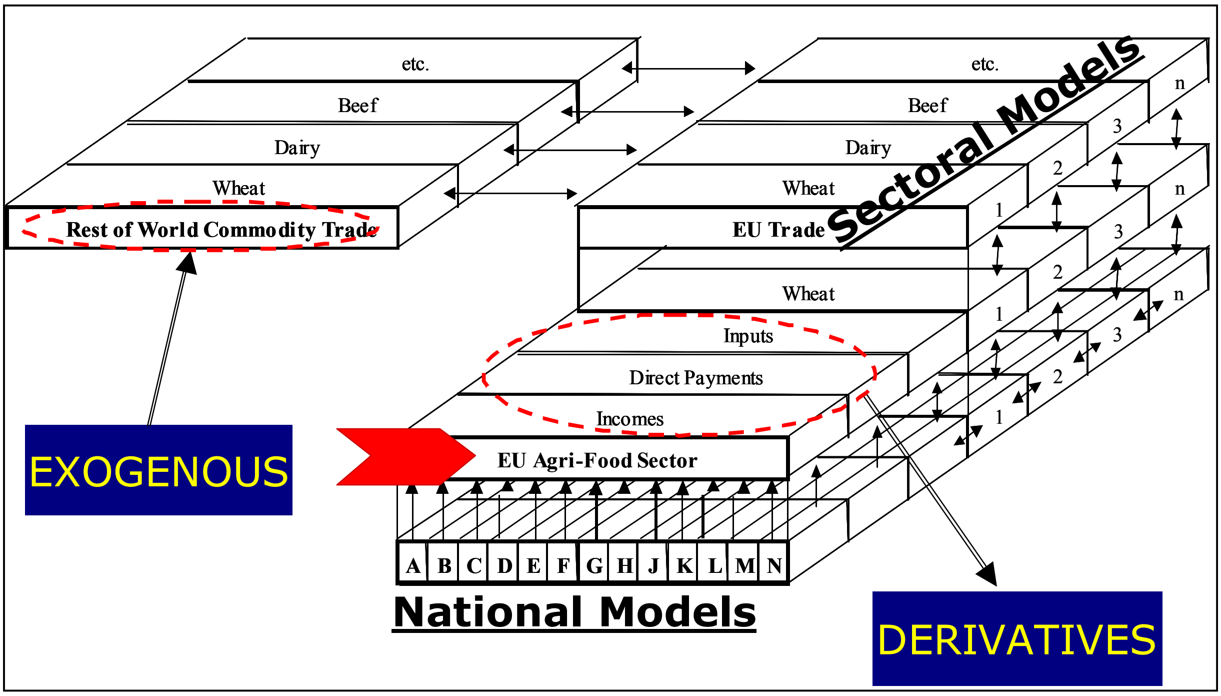
- Grains (Cereals): soft and durum wheat, barley and maize;
- Oilseeds: rapeseed, soybeans and sunflower seed (seed, oil and meal use);
- Livestock: cattle-beef, pig, broiler, other poultry and sheep
- Dairy-milk products: cheese, butter, whole milk powder and skim milk powder

Finally, by combined EU model we refer to the aggregation of 9 country models, that is Italy, Belgium (including Luxembourg), Finland, France, Germany, Greece, Netherlands, Spain, UK, covering about 85% of the value of EU-15 agricultural output. None of the currently missing countries (Austria, Denmark, Ireland, Portugal, Sweden) is a "major" agricultural producer, so their exclusion should not imply relevant biases in the generated projections.

2.2. The Italian case: main characters

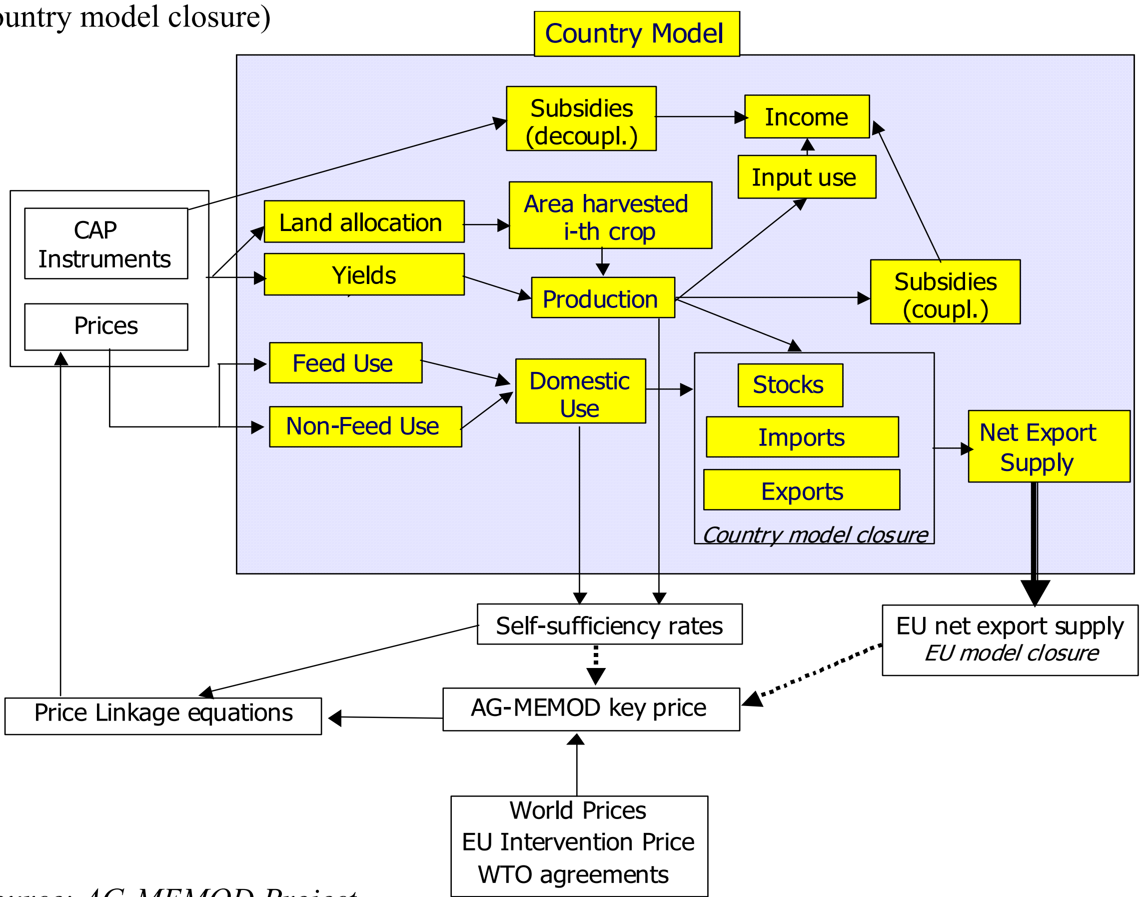
Italy is traditionally considered the second agricultural producer country in the EU, following France. In particular, looking at the sectoral value added, Italian agriculture accounts for more than 15% of the EU value added, more or less as Germany and a little more than Spain. Nevertheless, the Italian agri-food sector shows some quite specific character in terms of output composition. In particular, in the formation of the value of agricultural output the role of specific Mediterranean crops (for instance, durum wheat, wine grapes, olives, citrus, other fruits, etc.) is very high in Italy and, more generally, in Mediterranean countries. This specificity of the Italian agri-food sector may be appreciated by looking at the Italian share within EU for the different agricultural commodities (table 1). Italy accounts for just 12% of the value of animal productions within the EU, and for 18% for the value of crops. However, within these general categories we can observe great variations. Italy covers about 55% of durum wheat production, 25% for all fruits and, among these, more than 30% for both wine grapes and olives.

Figure 1 – AG-MEMOD modelling strategy for the EU agri-food sector



Source: AG-MEMOD Project

Figure 2 – Integration and closure of the any (crop) commodity country and EU model within AG-MEMOD (dot lines identify exogenous effects on price formation, i.e. not linked to country model closure)



Source: AG-MEMOD Project

Table 2 shows that in the last decade, since the 1992 McSharry Reform, the soft wheat cultivated area has dramatically decreased by about 42%, while it remained almost constant for fruits and vegetables. On the contrary, it increased for durum wheat (about +10%), also because its support remained higher than other cereals and oilseeds due to the supplementary *per ha* payments. Actually, durum wheat is the commodity on which the higher shock is expected upon the introduction of the LA CAP Reform, as its harvested area remained artificially high with respect to the declining tendency observed in other cereals. For this main reason, it has been largely emphasized as the most critical sector in analysing the impact of the CAP reform in Italy and will be dealt with in detail in next sections.

A major point with respect to the Italian agricultural specialization is that its structural characters do not allow, at least in many geographical contexts and in many commodities, to be competitive with the other major agricultural producers in the EU and, even more, in the world. In the last decades the diffusion of many crops and animal products in the Italian agriculture can be only explained by the high support provided by the CAP, whereas labour as well as land productivity often remained lower than the EU average (Esposti and Lobianco, 2004). As soon as the CAP, as well as any other national agricultural policy, aims to re-orient agriculture towards market competition, Italian farms show substantial problems in being competitive in many sectors to which the CAP has previously oriented considerable resources, especially in those commodities where price competition remains the key factor of success.

Figures 3-5 display in detail the production, consumption and net export patterns since 1980 of selected major crop commodities included in the Italian AG-MEMOD model. These figures suggest quite interesting interpretation about how the CAP, together with many other external changes, strongly affected land allocation and production decisions in the last two decades. Furthermore, they are helpful in the interpretation of policy scenarios, disentangling long-term existing patterns from changes induced by the LA Reform.

Major changes have been observed in the last 20 years in the cereals sector, especially for soft wheat. As already mentioned, Italian agriculture experienced a quite rapid and intense reduction of soft wheat cultivated area. This determined a strong decline in production (-40%) while consumption remained almost constant over time. It also implied a negative effect on the soft wheat trade balance; it was already significantly negative in early eighties and became three times larger in late nineties. On the contrary, in durum wheat production a relevant increase was observed until mid-nineties with a consequent increase of the positive trade balance, which was after that counterbalanced by a reduction in production growth rate and a more intense consumption growth. Another major change observed in the Italian crops sector during the last 20 years and strongly related to the CAP support, is the rapid rise of oilseeds cultivated area. For soybean (but also sunflower and rape seed), production was almost negligible in the early eighties and then became quickly a major component in land allocation in Italy, thus becoming the first EU producer of soybean and one of the major country producer of sunflower seeds. Nevertheless, it must be noticed, on the one hand, that this intense growth stopped and partially inverted, in the nineties. On the other hand, Italy remained significantly not self-sufficient for all these oilseeds, as they are of great relevance for the livestock and dairy sectors feed use. It is also evident, however, that the rise in these crops cultivated area only partially depended on an higher level of internal consumption or in some tendency to substitute imports with domestic product. The major force driving this increase and, after that, its successive fall or stagnation, seems to have been the strong support granted by the CAP that made these productions compete with cereals in land allocation.

In fact, as mentioned, a relevant part of the Italian agricultural output is not covered by the EU and Italian AG-MEMOD model here considered, and this has to be carefully taken into account in the evaluation of results. Table 3 shows that the GOLD commodities cover just 40%-45% of the value of agricultural output in Italy and this share remains quite stable over the nineties. The other commodities included in the Italian model but excluded from the EU combined model here considered (that is, AG-MEMOD-non GOLD group), represent just 15% of output value, thus their exclusion from the country models combination should not generate a large distortion in the model results. On the contrary, a major limitation to the interpretation and suitability of results comes from the exclusion of relevant part of output, more than 40%, that is the Extra-AG-MEMOD commodities group. These are excluded from any country model, and from the EU combined one consequently, mainly due to the particular complexity of their markets, therefore to major difficulties encountered in defining a consistent and realistic enough commodity market model template (major examples of this kind of problems are wine production, greenhouses production, especially flowers and vegetables, etc.).

Table 1 – Share of Italian agriculture on EU-15 value of output, various products (1993-2003)

	1993	1996	1999	2002	2003
Crops	19%	18%	19%	18%	18%
Cereals	14%	13%	14%	14%	13%
Durum Wheat	65%	58%	55%	52%	NA
Industrial crops	10%	9%	10%	9%	8%
Forage plants	13%	11%	12%	12%	11%
Fruits	30%	26%	27%	27%	25%
Olive oil	44%	38%	40%	32%	34%
Wine	27%	27%	28%	28%	31%
Vegetables	16%	17%	16%	15%	16%
Animal products	12%	12%	12%	12%	13%
Milk	10%	11%	11%	12%	12%
Cattle	11%	12%	13%	13%	14%
Poultry	18%	17%	15%	16%	17%

Source: EUROSTAT

Table 2 – Cultivated area of main groups of crops in Italian agriculture, 1992-2003 (thousands of Ha)

	1992	1995	1998	2001	2003
Cereals	4225	4225	4068	4113	4127
Soft Wheat	988	859	698	625	577
Durum Wheat	1530	1623	1629	1664	1689
Vegetables	501	408	364	459	457
Fruits (incl. olives+wine	2871	2738	2697	2720	2661

Source: ISTAT

Table 3 – Coverage of the Italian AG-MEMOD model by commodity groups as % on the national agricultural output value

Commodity group	1992	1995	1998	2001
GOLD group	41.67%	44.52%	42.18%	43.20%
AG-MEMOD-non GOLD	15.79%	16.03%	15.35%	14.86%
Extra AG-MEMOD group	42.54%	39.45%	42.47%	41.94%
TOTAL	100%	100%	100%	100%

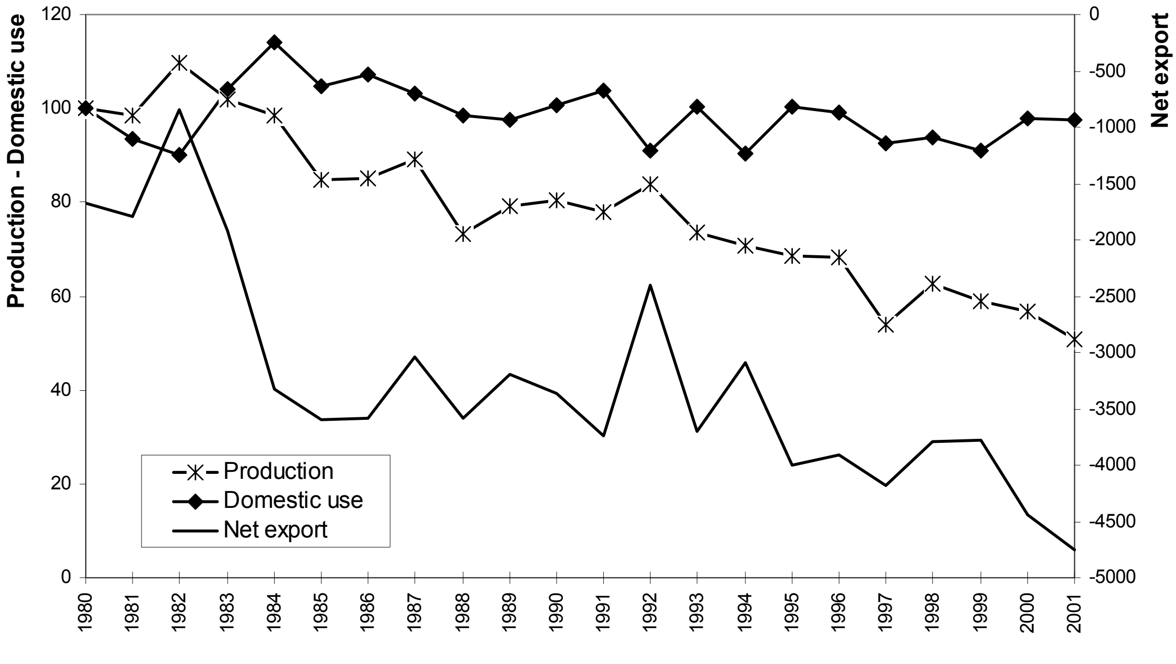
Source: AG-MEMOD Project

Table 4 - EU agricultural spending by country recipient, 2001-2003

COUNTRY	2003		2002		2001	
	millions €	%	millions €	%	millions €	%
France	10464	23.6%	9782	22.5%	9230	22.2%
Germany	5877	13.2%	6813	15.7%	5862	14.1%
Italy	5393	12.2%	5695	13.1%	5344	12.9%
Spain	6485	14.6%	5960	13.7%	6185	14.9%
Other EU countries	16159	36.4%	15270	35.0%	14912	35.9%
EU-15	44378	100%	43520	100%	41533	100%

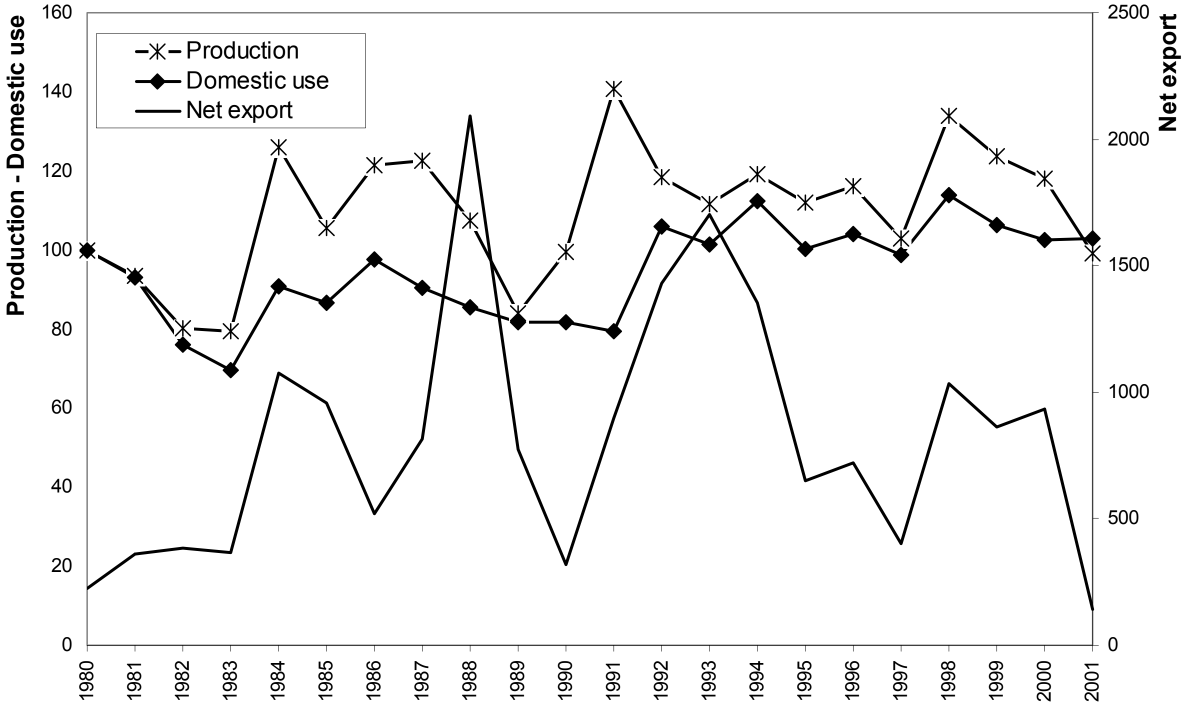
Source: European Commission; Data includes rural development payments from EAGGF, Guarantee Section

Figure 3 – Soft wheat: production and consumption (domestic use) index (1980 = 100) and net export (in thousands of tonnes), 1980-2001



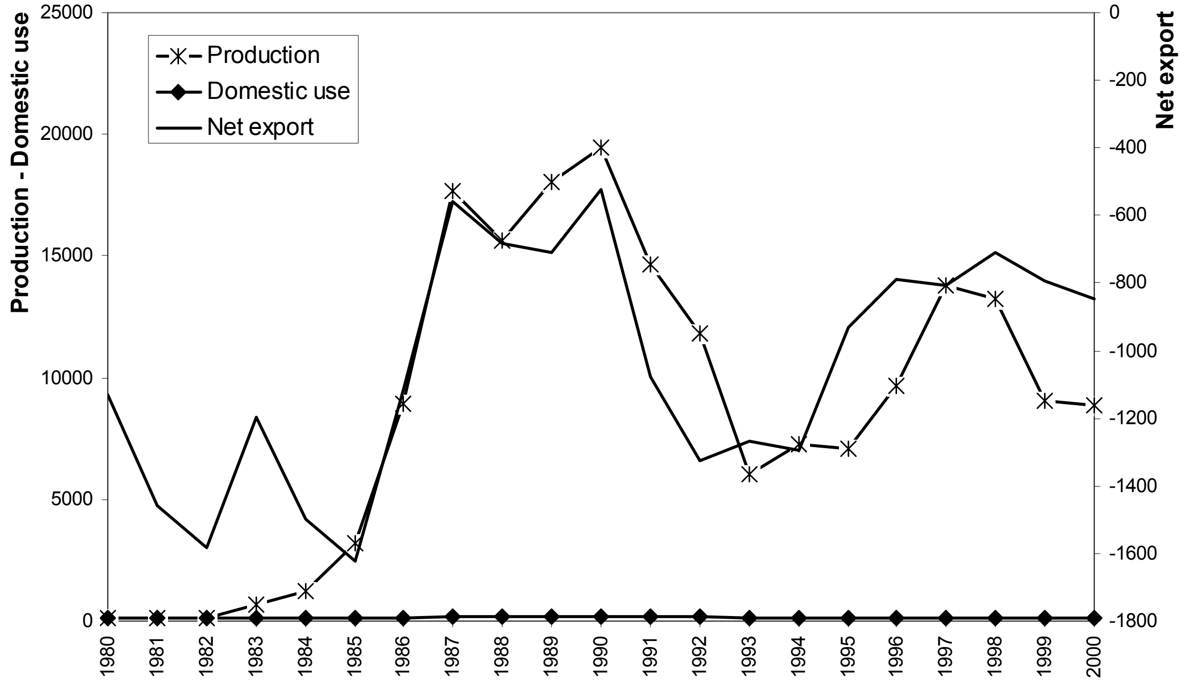
Source: EUROSTAT and PSD database

Figure 4 - Durum wheat: production and consumption (domestic use) index (1980 = 100) and net export (in thousands of tonnes), 1980-2001



Source: EUROSTAT and PSD database

Figure 5 - Soybean: production and consumption (domestic use) index (1980 = 100) and net export (in thousands of tonnes), 1980-2000



Source: EUROSTAT and PSD database

The output composition of Italian agriculture has major relevance in policy analysis, also because it affects the full amount of payments received by the sector from the CAP measures. Table 4 reports the distribution of the EU CAP expenditure by recipient country in the last three years (2001-2003) before the reform. It emerges that Italy receives less payments than what could be expected on the base of its share on the EU agricultural value added. In fact, Germany and Spain receive more money than Italy, though their sectoral value added is lower or equal to the Italian one. Moreover, the gap between France and Italy (payments in France are almost double in 2003) is much larger than the difference in terms of output value. This distortion is mainly caused by the specific composition of output, since in Italy a relevant part of the agricultural output is generated by non-supported, or less supported, products. In general terms, this reinforces the idea that the overall impact of the CAP reform in the Italian case might take different directions and intensity, compared to other EU countries.

In this general context, the focus on the durum wheat case is easily explained. Firstly, as described, it is the major, if not the only, Mediterranean character within the EU-15 AG-MEMOD model. Secondly, durum wheat is a key crop in Italy and one of the most specific production in the Mediterranean regions. Not only Italy accounts for more than 50% of durum wheat cultivated area in the EU-15; durum wheat also covers almost 50% of cereals cultivated area in Italy, and it is highly concentrated (about 75% of cultivated area) in the Southern regions. Finally, durum wheat has been largely supported by the CAP until the 2003 CAP; thus, the full decoupling of the durum wheat supplementary payment (still 313€/ha in 2004) raised several objections about the future of this crop, particularly in Southern Italy (AgriSole, 2004), as respective yields and prices often make it not competitive with other crops (for instance, soft wheat).

2.3. Structure of the commodity market sub-models

Any commodity model is formed by a set of either behavioural equations and identities. The behavioural equations allow estimating and projecting the key endogenous variables in the respective market; the identities represent the market closure conditions. As example, the Annex reports the list of behavioural equations estimated for any specific commodity in the crops sector, the consequent set of model equations in implicit form, and the estimates for a limited number of equations, where durum wheat variables appear as depended variables.[4] These equations can be grouped in three sets according to their theoretical justification: supply side, demand side, price and stock formation. Identities concern in most cases the international trade balance (imports or exports), rarely stock formation (beginning or ending stocks). Finally, a further set of equations is estimated to reconstruct the major components of the EAA (see Esposti and Lobianco, 2004, for more details). Here, we just discuss the general characters of the crops model mainly to emphasize the inclusion of those variables representing cross-commodity and cross-countries relations, as well as of the relevant policy instruments.[5]

The basic assumption in the crop sub-models is that land allocation is a three-steps decision process driven by prices, CAP payments and yields. Producers first settle on the total land allocated to cereals (grains) and oilseeds groups. Then, in a second stage, this total area

[4] An exhaustive presentation of the complete econometric model with the explicit functional specifications of the estimated equations can be found in Berloni *et al.* (2002) and Esposti and Lobianco (2004).

[5] Here, we skip the description of the livestock part of the Italian model (including four sub-models: cattle and beef meat, pig and pig meat, sheep and lamb meat, poultry meat, the latter divided in broiler and other poultry) and of the dairy model. These are quite complex models. However, the focus, here, is on crops and in particular on durum wheat, since for them much higher impacts are expected. Anyway, all details also on these parts of the Italian AG-MEMOD model, as well as on the respective results can be found in Esposti and Lobianco, 2004.

is allocated to each crop within these main groupings where wheat is considered as a single aggregate crop. Finally, in the third stage, the total wheat area is allocated between soft and durum wheat. This allocation behaviour is driven by the expected returns associated to any group and specific crop. This expected return depends on the current and lagged real prices and on the current direct (coupled) payments. Supply is finally obtained by adding an yield equation for any crop commodity; here, yield depends on the amount of cultivated land (taking into account possible diminishing returns), on the trend yield (taking into account exogenous technological progress), and on market prices.

On the demand side, for both cereals and oilseeds the model admits two different uses: the food use and the animal feed use. These two demand components are modelled separately. The food use demand is specified, when needed, within a demand system and depends on the population level, on the national *per capita* GDP, on own commodity market lagged and/or current price and on lagged and/or current prices of all possible complements and substitutes. The distinctive feature of the feed use demand equations is the inclusion, besides prices, of feed demand indices expressing feed-using agricultural activities, namely meat and milk production. For oilseeds, the demand side is more complex since it explicitly models the crushing demand depending on the lagged prices of crushing products (oils for food use and meals for feed use) and of the original seeds. Therefore, for any oilseeds three different prices and markets are specified, that is seed, oil and meal.

For any modelled commodity, besides supply and demand side equations, a third group of equations is estimated to complete the supply and demand balance at the country level. So, equations modelling ending stock, export or import levels are included and estimated depending on current year prices, production and domestic use, and the level of the beginning stocks (that is, lagged ending stocks). However, as mentioned, to make all these estimated (endogenous) variables satisfy year-by-year the country supply and use identity, for any market there exists one endogenous variable that closes the model and thus is obtained by the supply and use identity. Generally these non-estimated closure (residual) variables are imports. Among crops, we use exports as closing variable only for durum wheat, as Italy is currently a net exporter of this commodity.

The building of any commodity model is completed by an equation making the commodity price endogenous, that is an equation describing how market price is formed. In a closed economy, the mentioned supply and use identity condition would be sufficient for an endogenous determination of equilibrium market prices matching internal supply and demand. Yet, our model does not represent a closed economy since other Member States and, of course, the rest of the World, have important impacts on the country markets. To allow for such impacts we use price linkage equations to account for the relations among Members States markets, and between European Union and the rest of the World. Therefore, in the usual case where Italy is not the key-market, the price formation equations include as regressor the respective key-market price and, when needed, the lagged key-price, the Italian and key-market self-sufficiency rates, the EU market intervention price. The exceptional case is durum wheat, where Italy itself is the key-market.[6] Then the price formation equation links the durum wheat Italian price, which is also the EU key-price, directly to the durum wheat world market price.

In this form, the AG-MEMOD Italian model includes all the relevant CAP variables and contains, for all the modelled commodities, the most relevant cross-commodity linkages. Moreover, it is connected through price formation equations to all other countries commodity markets. Thus, the Italian model can be combined with AG-MEMOD models of other EU

6 The Italian durum wheat price is used as leading price also in the WEMAC (World Econometric Modelling of Arable Crops) approach (Benjamin *et al*. 2003).

countries and solved for the entire combined EU market; solving this aggregate model gives the equilibrium result for the entire EU for a given set of exogenous variables (Chantreuil and Levert, 2003).

2.4. Model estimation: some notes

The parameters of the behavioural equations outlined above, are estimated using annual data for the period 1979-2000. Longer data series could be available for several equations. Nevertheless, this opportunity is not exploited to not introduce further structural breaks in the model that could be hardly identified, thus increasing the risk of erroneous projections.

These annual data are obtained mostly from EUROSTAT's, namely New-Cronos and AgrIS databases. The EUROSTAT standard is always adopted in the definition of the model variables. For those variables for which EUROSTAT data are not available or not practical, other reliable sources are considered, such as FAO and OECD databases or national/government sources of official agricultural data (INEA, ISMEA, etc.). The projections of exogenous variables for years 2003-2010 come from FAPRI projections and, for policy and macro variables, from the appropriate EU Commission documents.

For any equation, the appropriate specification is selected in order to obtain results fitting well with prior economic assumptions and expected behaviours and with acceptable statistical goodness of fit. When possible, flexible theory-consistent specifications are adopted to not impose *ex-ante* restrictions especially on preferences and technology. As a consequence, either linear or log-linear specifications are used. On the original specification, some simple empirical adjustments are introduced by adding trends and dummies, which can assume different economic meaning according to the equation. The trend is usually aimed to allow for structural tendencies that are not taken into account by the other regressors; for example, a trend term included in the yield equations is mainly aimed to proxy technological progress. Time dummies are introduced mainly in those equations where relevant changes in the Common Agricultural Policy could have generated structural breaks. Very often, we introduce a time dummy for 1993 to admit a structural break in the dependent variables induced by the MacSharry Reform.

For some equations, the parameters estimation is obtained using Ordinary Least Squares (OLS). In many cases, however, this estimator could generate biased results. As mentioned, linkages may exist among several equations either because the error terms may be correlated across different equations or because the dependent variable of one equation also appears as explanatory variable in other equations, that is simultaneity across equations occurs. In particular, when a demand system is specified, we adopt a Seemingly Unrelated Regression (SUR) estimation using the iterated Zellner procedure, to take into account cross-correlation of the error terms. Simultaneity is then admitted, on the crops supply side, between commodity yield and land allocation equations and, in price formation, between price linkage equations, stocks formation and exports (imports) equations. When simultaneously is assumed, the system of equations is estimated through a 3SLS (Three Stage Least Squares) estimator.[7]

[7] The estimation of all behavioural equations is run with the software TSP 4.5. In fact, the whole Italian AG-MEMOD model includes 176 estimated equations. A complete description of variables definition, data sources, equations specification, estimation techniques, parameter and elasticity estimates and inference can be found in Berloni *et al*. (2002). However, information about the estimated equations concerning the EAA calculations, as described in Esposti and Lobianco (2004) and Tabeau and van Leeuwen (2003), are available at the website http://www.agmodels.org/italy/. All this material is also available upon request.

3. CAP scenarios and the case of durum wheat

This and next section present projections of the model endogenous variables up to 2010. Since most variable are updated to 2002, projections generally refer to the 2003-2010 period, though policy impacts are mainly displayed by comparing 2010 projections among scenarios.

3.1. Baseline scenario

This section describes the exogenous variables projections under the baseline scenario. A relevant part of these projections are indeed common to the baseline and the alternative (LA) scenarios. In fact, the underlying macroeconomic variables and the world market prices projections are the same across the two scenarios. Moreover, both scenarios do not make assumptions about the outcome of the WTO Doha Development Round thus the existing Uruguay Round Agreement on Agriculture (URAA) is assumed to prevail in both cases for the whole projection period. Nor do they incorporate the accession of new members on the 1st of May 2004. Therefore, the only difference between the two scenarios concerns the projections of CAP measures. The baseline scenario incorporates the Agenda 2000 reform of the CAP and assumes a no-change regime until 2010; the assumptions about the CAP as agreed under 'Agenda 2000' are outlined in Binfield *et al.* (2003a, 2003b and 2003c).

As mentioned, world market prices are assumed exogenous in the AG-MEMOD model for all commodities; their projections come from FAPRI 2003 *World Situation and Outlook 2003* (FAPRI, 2003a), which includes a review of the background to these projections (see also Esposti and Lobianco, 2004, for details). It should be reminded that the AG-MEMOD model is linked to the FAPRI-Missouri EU GOLD model and allows for the incorporation of the impact of global supply and demand developments on EU agricultural markets (FAPRI, 2003a; Hanrahan, 2001). In contrast, projections of prices on EU key-markets under both the baseline and LA scenarios are endogenously generated by solving the EU combined model.

A critical aspect in generating the simulation results under AG-MEMOD framework is related to the role of commodity key-prices, since they are the driving-forces behind this multi-commodity and multi-country equilibrium modelling. Here, we try two alternative specifications of the only Italian key-price, that is durum wheat price, to be interpreted as "limit cases" of all possible intermediate specifications of price formation (see Annex for details about the equation alternative specifications). In both cases, price is driven by the world market price, assumed fully exogenous. However, in one case (Vers. 1 or Baseline 1/B1), the EU net export of durum wheat does not affect price formation which is also affected by a slightly negative time trend. In the other case (Vers. 2 or Baseline 2/B2), the negative time trend is excluded while the lagged EU net export (approximating the EU self-sufficiency rate) is included among regressors of the durum wheat price formation equation, thus shifting price upwards.

This change in key-price equation specification provides interesting information about the role of price formation in the AG-MEMOD approach. On the one hand, it may introduce a major effect even when no CAP reform is assumed (both specifications are baselines); figure 6 displays the projections of the world market price together with the two mentioned baselines of the durum wheat price showing a significant different pattern over the projection period. On the other hand, while the CAP reform does not affect the durum wheat key-price at all in Vers. 1, since it is just driven by its lagged values and the world market price, in Vers. 2 the CAP reform may cause a significant increase in durum wheat price; in fact, it takes into account that the reform causes a reduction in the overall EU durum wheat production thus lowering its net exports (self-sufficiency), eventually generating an upward pressure on price.

3.2. Alternative scenarios

The policy reform introduced and examined under the alternative scenarios are those CAP measures contained in the Final Presidency Compromise Document of the Council of the European Union, on 26 June 2003, also called Luxembourg Agreement (thus, LA) (Council of the European Union, 2003). Under the Luxembourg Agreement and the negotiations that followed, a very wide range of possible implementation scenarios can be envisaged. What is examined here, however, is the most extreme implementation scenario allowed under the Luxembourg Agreement, i.e. all direct payments (with the exclusion of supplementary payments for durum wheat) under Agenda 2000 are fully decoupled at the earliest possible date. Member State choices vis-à-vis the implementation of the Luxembourg Agreement may actually deviate significantly from the maximum decoupling scenario analysed here. However, the present analysis serves primarily to illustrate the effects of the chosen scenario and the analytical capacity of the AG-MEMOD model. Anyway, an analysis of the impact of the actual Luxembourg Agreement implementation choices made by any Member States is possible with the AG-MEMOD model, as such political choices have been formally defined. In fact, this possibility is exploited here for the durum wheat production in Italy. [8]

The LA essentially modifies the CAP as it applies to cereals, oilseeds, livestock and dairy sub-sectors. From January 2005, cereals and oilseeds arable aid payments are decoupled from production. In durum wheat, the supplementary premium is gradually reduced by about 15% from 2004/05 to 2006/07. According to the national choices, it may be fully or only partially (60%) decoupled, with the additional introduction of a durum wheat quality premium (40€/ha) for traditional production areas (art. 72-74 of COM(EU) No 1782/2003). In the beef sector the suckler cow, special beef, and slaughter premium is decoupled from production. In the sheep sector the ewe premium is fully decoupled. In the dairy sector a reduction in the butter intervention price of 10% will take place in addition to the intervention price reductions agreed to under Agenda 2000. The dairy compensation premiums agreed under Agenda 2000 are further augmented. These compensation payments are fully coupled to production until 2006 and decoupled from then onwards. The milk quota is to continue until 2014/15 under the LA.

From the above description, it follows that for any commodity the impact of the LA will be observed starting from year 2005, and the impact results will be here displayed accordingly. Due to their intrinsic complexity, in the present analysis no attempt is made to incorporate cross-compliance, modulation or other specific elements of the Luxembourg Agreement.

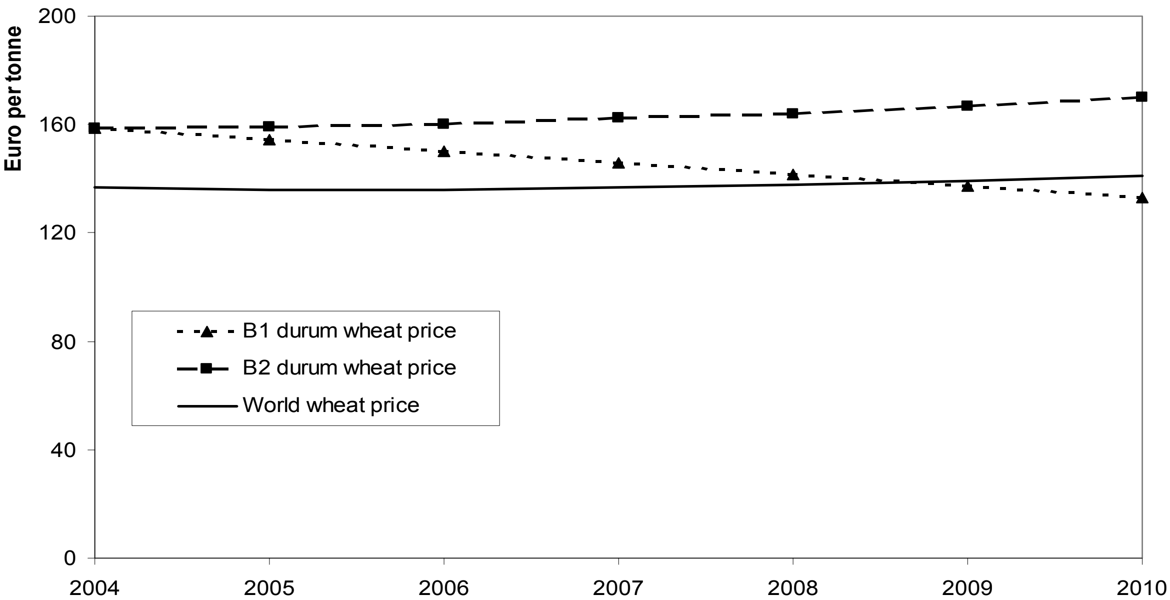
To enter the LA in the country commodity models, the Single Farm Payment (SFP) is therefore applied in all countries from 2005 with the maximum amount of decoupling agreed at the Luxembourg Council. Unlike previous policy instruments, the Single Farm Payment is not driven by levels of various farming activities, though the land would have to be maintained in 'good agricultural condition'. Thus, the LA affects the commodity models by changing the expected gross returns, through reduction in intervention price, when it applies, and through reduction of direct payments or premiums. However, the analysis of farmer response has shown that these payments are still likely to be somewhat supportive of farming

[8] A fully detailed description of the CAP revision under the LA, as well as of all possible implementation options, is reported in Binfield *et al.* (2003c). The official document concerning the CAP reform is COM(EU) No 1782/2003, especially concerning full decoupling and single farm payments, whose detailed rules for the implementation are described in COM(EC) No 795/2004. Finally rules for the implementation of cross-compliance, modulation and the integrated administration and control system are defined in COM(EC) No 796/2004.

activity (Dewebre *et al*., 2001; Westhoff and Binfield, 2003; Binfield *et al*., 2003b); in other words they may still have a residual supply inducing effects. So, although decoupling is assumed to be full, we assume farmers still associate part of the decoupled payment to the original production; as residual supply inducing effect we thus alternatively assume that 30% or 10% of the SFP actually remains associate to the original commodity, as it were a direct payment (see Westhoff and Binfield, 2003, and Binfield *et al*., 2003b, for more details on the theoretical motivation of this assumption). The comparison between 30% and 10% residual effect shows how it plays, as wanted, a sort of incentive to maintain higher production levels.

As mentioned, is a major interest here to perform a more detailed analysis of the durum wheat case with respect to the CAP reform implementation. The CAP reform has paid specific attention and reserved specific measures to this commodity. We already mentioned the decoupling of the supplementary payment and the introduction of a quality premium *ex* art. 72; in addition, Italy decided to apply in 2005 the optional specific-quality premium *ex* art.69, thus adding a further coupled payment for durum wheat currently estimated at 50€/ha. With specific reference to durum wheat, the LA scenarios are thus distinguished in three groups.[9] Scenario 1 assumes that the durum wheat supplementary payment is fully decoupled and quality premiums *ex* art. 69 and 72 (40€/ha+50€/ha) are paid; this scenario is the closest to the actual and current implementation in Italy of the CAP reform. Scenario 2 assumes that the supplementary payment remains fully coupled but quality premiums are skipped. Scenario 3 assumes that the supplementary payment is only partially decoupled (60%) and quality premiums are activated. Any of these contains four scenarios generated by the alternative specifications of the durum wheat price formation according to the mentioned hypotheses (Vers. 1 and 2) and by assuming alternatively 30% or 10% residual supply inducing effect of the decoupled payment. Table 5 summarizes the whole set of scenarios here adopted.

Figure 6 – Wheat price projections: alternative baseline durum wheat price projections (B1 vs. B2) and wheat world market price



Source: Our elaboration on Italian AG-MEMOD model

9 These scenarios do not necessarily correspond to real possible options admitted by the reform. Nevertheless, they represent extreme cases that well stress the whole range of possible impacts of the reform itself.

Table 5 – Description of the whole set of adopted CAP scenarios (DW = durum wheat)

	Decoupling of arable aid payments	Residual supply inducing effect	DW supp. payment decoupling	DW price	DW quality premium *ex* art. 72-74	DW quality premium *ex* art. 69
BASELINE						
B1	NO	NO	NO	Vers. 1	NO	NO
B2	NO	NO	NO	Vers. 2	NO	NO
LA SCENARIO 1						
S1_1_a	Full	30%	YES	Vers. 1	YES	YES
S1_1_b	Full	10%	YES	Vers. 1	YES	YES
S1_2_a	Full	30%	YES	Vers. 2	YES	YES
S1_2_b	Full	10%	YES	Vers. 2	YES	YES
LA SCENARIO 2						
S2_1_a	Full	30%	NO	Vers. 1	NO	NO
S2_1_b	Full	10%	NO	Vers. 1	NO	NO
S2_2_a	Full	30%	NO	Vers. 2	NO	NO
S2_2_b	Full	10%	NO	Vers. 2	NO	NO
LA SCENARIO 3						
S3_1_a	Full	30%	60%	Vers. 1	YES	YES
S3_1_b	Full	10%	60%	Vers. 1	YES	YES
S3_2_a	Full	30%	60%	Vers. 2	YES	YES
S3_2_b	Full	10%	60%	Vers. 2	YES	YES

4. Results

A selection of the main findings concerning the impact of the LA scenarios is provided in this section and they refer the to last year of projection, that is 2010. Complete projections are partially reported in Esposti and Lobianco (2004) and can be provided upon request. Due to space limit, the model results here described only refer to the crop sector and with major emphasis on durum wheat, either because the rest of the model (particularly, livestock and dairy models) are only marginally affected by the reform, at least in Italy (Esposti and Lobianco, 2004), and because the perspectives of the durum wheat sector has soon become in Italy the most relevant and debated issue upon the application of the new CAP regime (Agrisole, 2004).

4.1. Crop sector

Table 6 reports the major results emerging from simulating the impact of mentioned CAP scenarios on very aggregate variables concerning the crop commodities under study, that is cereals (grains) and oilseeds. Major interest is on the supply side, that is on land allocation and on yields and, consequently, on overall production. This latter effect on total production may eventually generate significant changes in the sectoral trade balance, that is net export.

However, before analysing the main effects on the supply side, it is interesting also to understand how prices behave since they only transmit on the demand side the impacts of the reform. As mentioned, prices in the AG-MEMOD model are driven by the EU key-prices, which are in turn somehow linked to world market prices. So, here major interest is on understanding the behaviour of the only Italian key-price, that is durum wheat price. In this respect, a clear evidence emerges by comparing the two alternative specifications of the baseline scenario (B1 vs. B2) since they only differ by how price formation is modelled, the CAP measures being fixed at the Agenda 2000 regime in both cases. B2 derives the durum wheat price not only from the exogenous world market value but also by a proxy of the EU self-sufficiency rate for durum wheat. Since both baseline projections indicate an higher growth of EU demand than supply for durum wheat, the durum wheat price in B2 is significantly higher than in B1 (see figure 6). Due to higher price, B2 shows a significantly higher harvested area and production for cereals (+17% for both with respect to B1) and this also strongly reflects on net export, that are indeed higher in B2 by about 40%. The impact of these differences in durum wheat price between B2 and B1, on the contrary, is null on oilseeds production. These effects of price are fully confirmed in sign, as expected, in any comparison between analogous alternative scenarios, where price formation is the only difference (that is comparison between S*_1_* and S*_2_* scenarios). However, in magnitude we observe quite small difference in terms of CAP Reform impact between the baselines; in other words, though price formation specification strongly matters in how baseline behaves, the CAP impact is essentially the same regardless the baseline.

Beyond these price effects, the variation observed between the alternative scenarios and the respective baselines and across alternative scenarios can be fully attributed to the CAP reform and implementation. As expected, the reform causes a significant reduction of cereals harvested area ranging between 11% and 23% (so in any case higher than 10%), and a corresponding reduction in production (between 10% and 23%) and, more intensely, in net export (between 24% and 72%). On the contrary, the impact on oilseeds is by large much smaller: the reduction in harvested area does not vary very much across scenarios and amounts to about 0,5%, as well as the corresponding reduction in production, while net export reduction is limited to 2%-3%.

It is interesting to compare the S*_*_a with the S*_*_b counterparts, as the differences between them depends on how intense supply residual inducing effect of full decoupling is assumed. The observed differences go in the expected direction: a lower residual effect (10%) implies a greater reduction in harvested area (thus, also in production and net export) in both cereals and oilseeds. However, again, the difference is much larger for cereals, since it amounts to about 2-3% in both harvested area and production with respect to the baseline, while it is just 0,15% and 0,10%, respectively, in oilseeds.

Further differences across alternative scenarios are, as mentioned, only due to the different implementation of the reform with respect to the specific durum wheat measures (S1_*_* with respect to S2*_* and S3_*_* counterparts). In aggregate terms, these difference are not particularly relevant, in the case of oilseeds (they are actually null), while become particularly important for cereals, thus confirming how durum wheat matters in the Italian crop sector. Comparing the full coupling (S2_*_*) with the full decoupling with quality premiums (S1_*_*) options concerning the durum wheat supplementary payment, the difference (with respect to the baseline) in terms of harvested area and production ranges between 6% and 7%. Partial decoupling with quality premiums (S3_*_*) provides, as expected, in-between results. This evidence confirms that the implementation of the durum wheat specific measures of the CAP reform may actually be, in the Italian case, one of the most crucial issue in the application of the reform itself. Then, a more detailed insight into these effects on durum wheat is provided in next section.

Table 6 – The impact of the CAP reform: 2010 % variation with respect to the respective baseline scenario (B1 or B2) in the crops sectors

	Harvested area: cereals	Harvested area: oilseeds	Production: cereals	Production: oilseeds	Net export: cereals	Net export: oilseeds
BASELINE						
B2 wrt B1	17.35	0.00	17.31	0.00	41.56	0.00
LA SCENARIO 1						
S1_1_a	-20.00	-0.47	-19.75	-0.38	-38.23	-2.35
S1_1_b	-23.21	-0.60	-22.83	-0.49	-44.19	-3.02
S1_2_a	-17.04	-0.47	-16.04	-0.38	-62.30	-2.35
S1_2_b	-19.78	-0.60	-18.55	-0.49	-72.08	-3.02
LA SCENARIO 2						
S2_1_a	-13.30	-0.47	-12.59	-0.38	-24.38	-2.35
S2_1_b	-16.51	-0.60	-15.62	-0.49	-30.25	-3.02
S2_2_a	-11.33	-0.47	-10.26	-0.38	-39.86	-2.35
S2_2_b	-14.07	-0.60	-12.73	-0.49	-49.48	-3.02
LA SCENARIO 3						
S3_1_a	-16.08	-0.47	-15.55	-0.38	-30.10	-2.35
S3_1_b	-19.29	-0.60	-18.60	-0.49	-36.01	-3.02
S3_2_a	-13.70	-0.47	-12.64	-0.38	-49.12	-2.35
S3_2_b	-16.44	-0.60	-15.14	-0.49	-58.81	-3.02

Source: Our elaboration on Italian AG-MEMOD model

4.2. Evidence for durum wheat

Table 7 reports in details the impact of the reform on the durum wheat sector. It firstly makes explicit how the different specification of the price formation across the baseline (B1 and B2) strongly affects the results, as price is much higher when the EU self-sufficiency is included in price formation mechanism (see figure 6). This generates several expected effects. On the one hand, demand decreases significantly (by 16%) passing from B1 to B2 while production increases, though this effect is much less relevant. In fact, higher price induces more harvested area (23%), which, however, implies a reduction of yields (12%), thus partially offsetting the former effect. The combination of lower demand and an higher supply eventually generates a reduction in import (3%) and a significant increase of export (+32%), thus a strong increase in durum wheat net export.

Again, however, our major interest is on the effect of the reform on durum wheat production in Italy, despite the significantly different possible behaviour of the respective price. First of all, since all alternative scenario is compared in table 7 (as in table 6) with the respective baseline (that is with the same specification of the price formation) and since the durum wheat price (as any key-price) is only driven by exogenous variables, for no scenario there is any variation in demand with respect to the baseline, and all the effects of the CAP reform are observed on the supply side.

Table 7 – The impact of the CAP reform: 2010 % variation with respect to the respective baseline scenario (B1 or B2) in durum wheat (DW)

	DW Harvested area	DW Yield	DW demand	DW Import	DW export
BASELINE					
B2 wrt B1	23.60	-12.16	-15.84	-3.09	32.07
LA SCENARIO 1					
S1_1_a	-22.94	13.62	0.00	1.70	-17.69
S1_1_b	-26.09	15.75	0.00	1.98	-20.55
S1_2_a	-18.56	15.51	0.00	0.91	-6.93
S1_2_b	-21.11	17.94	0.00	1.07	-8.14
LA SCENARIO 2					
S2_1_a	-13.83	8.90	0.00	0.84	-8.76
S2_1_b	-16.98	11.03	0.00	1.07	-11.13
S2_2_a	-11.19	10.13	0.00	0.34	-2.56
S2_2_b	-13.74	12.56	0.00	0.45	-3.40
LA SCENARIO 3					
S3_1_a	-17.61	10.86	0.00	1.19	-12.32
S3_1_b	-20.77	12.99	0.00	1.43	-14.90
S3_2_a	-14.25	12.37	0.00	0.56	-4.26
S3_2_b	-16.80	14.79	0.00	0.69	-5.26

Source: Our elaboration on Italian AG-MEMOD model

Secondly, on the supply side, the effect of decoupling is normally a little larger for durum wheat with respect to the other cereals. Harvested area reduction ranges between 11% and 26%; this strong effect is only partially counterbalanced by yields increase, ranging between 9% and 16%, thus letting the reduction of production at a still significant level. Since demand is not affected by decoupling, this reduction on the supply side can be fully observed in trade balance: a slight increase in import (lower than 2%) but, above all, a significant decline in export (between 3% and 20%), whose large variations are mainly determined, as expected, by the different specifications of the price formation equation.

Within this large impact, the effect of a different specification of the supply inducing effect (30% vs. 10%) is, as before, quite limited since the harvested area shows a greater reduction in latter case by about 3% with respect to the baseline. Even in this case, the impact on land allocation is partially offset by a corresponding increase in yields, such that the overall implication of this residual effect in terms of production and import-export is almost negligible. Again, on the contrary, more remarkable is the variation induced by how the specific measures for durum wheat are implemented. *Ceteris paribus*, the difference between full decoupling (with quality premiums) and full coupling of the supplementary payment ranges between 7% and 10% in harvested area, whereas it is 4%-5% for yields, obviously moving in the opposite direction with respect to harvest area. Thus full decoupling of supplementary payments may generate up to a 9% larger reduction of durum wheat export with respect to the baseline. The intermediate scenario (full decoupling with quality premiums) confirms how modulating the decoupling scheme of the supplementary payment may significantly attenuate the strong impact the CAP reform generates on the Italian durum wheat supply.

4.3. The Economic Accounts for Agriculture (EAA)

This section summarises the implications for the aggregate value of agricultural output, inputs use and income in Italy under the baseline and CAP reform scenarios.[10] The measured aggregate output derived from the commodity models can be used to estimate the expenditure for inputs, including the compensation of the employees; then, the overall agricultural self-employment income can be calculated as operating surplus. The main elements of the Economic Accounts for Agriculture (EAA), the links between the AG-MEMOD model variables and these elements, and the modelling methodology used to derive those EAA components not directly linked to the AG-MEMOD model, have been taken from Tabeau and van Leeuwen (2003). The calculations of all the EAA components concerning the Italian model, together with the estimated equations to compute them and the complete set of their 2003-2010 projections, are described and reported in Esposti and Lobianco (2004).

Here, we report the computed impact of the CAP reform, according to the mentioned alternative scenarios, on the major components of the EAA in Italy (table 8). In particular, the final outcome in terms of value of agricultural production and of agricultural income is the most critical point in the evaluation of the CAP reform, since it implies a substantial shift in the way support is delivered but it is also aimed to not affect significantly the farmers' income. According the our simulations, this outcome seems quite realistic. First of all, once more, the comparison between the two baselines shows how price formation specification matters; here, however, the impact is relatively small, since an higher durum wheat price actually implies about 2% increase in the value of output, Gross Value Added and self-employment income, and a 3% increase in input use (intermediate consumption) and total subsidies.[11]

Variations take the excepted sign and show limited magnitude also comparing alternative LA scenarios with the baseline. In all cases, the CAP reform causes a slight reduction in the value of agricultural output, ranging between 0,6% and 1,1%, and a more intense (but still small) reduction in input use, ranging between 1,9% and 3,4%. In addition, the change in support regime also normally generates a slight increase in overall subsidies, up to 8,5%, though according to the some scenarios (those implying full decoupling of the durum wheat supplementary payment), subsidies may even be declining by about 1,3%. Also the use of hired labour, therefore expenditure for wages and salaries, is proportionally reduced by about 1% without major differences among the scenarios. Eventually, these effects on the value of production and input use offset in the calculation of Gross value Added and, above all, of agricultural (i.e., self-employment) income. This latter crucial variable is expected to remain almost unchanged with respect to the baseline, since in most scenarios it should increase up to 1,8%, but in few cases (related to full decoupling in durum wheat supplementary payment) it may also decline by 0,2%.[12]

[10] We do not draw conclusions from the aggregate results in terms of specific farm level effects, as these impacts (as well as farm specific aspects of the reform, such as modulation) would require a detailed farm level modelling and can not be achieved within commodity market models as the AG-MEMOD approach.

[11] The EAA distinguish the total subsidies to agriculture in two components, namely 'subsidies on products' and 'subsidies on production'. Here we aggregate these two components in one amount of 'Total subsidies'.

[12] Here, agricultural income is meant in nominal terms; thus, a constant nominal income actually implies a slowly reducing income in real terms (Esposti and Lobianco, 2004).

Since the overall impacts on EAA are quite small, relevant differences among the alternative scenarios can be hardly detected. The degree of the residual supply inducing effect has really a negligible effect (no more than a 0,1% difference), whereas the decoupling of the durum wheat supplementary payment, with coupled quality premiums, remains particularly meaningful. Though in absolute terms the difference among S1_*_*, S2_*_* and S3_*_* scenarios is small (lower than 2%), it makes the difference just in terms of the overall effect of the reform on the Italian agricultural income. With fully coupled supplementary payment, income increases by 1,3-1,8%; with fully decoupled payment and quality premiums it can also decline up to 0,2%, whereas the intermediate solution (partial decoupling with quality premiums) generates about 1% increase.

This result may also demonstrate how durum wheat can play a key-role in the way the reform is viewed, and accepted, in the Italian agriculture context. Not only it is the major annual crop harvested in Italy, particularly in Southern Italian region; it also involves specific CAP measures whose application may be modulated at the national level thus affecting the overall impact of the reform in a marginal but somehow decisive way.

Table 8 – The impact of the CAP reform: 2010 % variation with respect to the respective baseline scenario (B1 or B2) in major EAA components

	Agricultural output at market prices	Intermediate consumption	Total subsidies	Gross value added (incl. subsidies)	Wages & Salaries	Self-employment Income
BASELINE						
B2 wrt B1	1.95	2.89	3.03	1.59	2.13	2.21
LA SCENARIO 1						
S1_1_a	-0.97	-2.90	8.59	1.26	-1.06	1.75
S1_1_b	-1.12	-3.37	8.55	1.26	-1.22	1.76
S1_2_a	-0.98	-2.82	6.60	0.94	-1.07	1.30
S1_2_b	-1.14	-3.28	6.57	0.94	-1.24	1.30
LA SCENARIO 2						
S2_1_a	-0.62	-1.95	0.43	0.10	-0.68	0.14
S2_1_b	-0.77	-2.42	0.32	0.10	-0.85	0.13
S2_2_a	-0.62	-1.89	-1.18	-0.15	-0.68	-0.20
S2_2_b	-0.77	-2.35	-1.29	-0.15	-0.84	-0.21
LA SCENARIO 3						
S3_1_a	-0.77	-2.34	5.67	0.85	-0.84	1.18
S3_1_b	-0.92	-2.82	5.59	0.85	-1.00	1.18
S3_2_a	-0.77	-2.28	3.92	0.58	-0.84	0.81
S3_2_b	-0.92	-2.74	3.85	0.58	-1.01	0.80

Source: Our elaboration on Italian AG-MEMOD model

5. Some final remarks: comparison with other approaches and models

Figure 7 summarizes the impact on selected variables of the alternative policy scenarios with respect to the respective baseline. For any group of scenarios (1, 2 and 3) relating to coupling-decoupling device of the durum wheat supplementary payment, the maximum impact is reported. It clearly emerges that the impact on durum wheat area is expected to be quite large, although significantly attenuated by yield increase thus generating a limited impact on production (< 10%). Nevertheless, the effect on trade is particularly relevant: a slight increase of import (<2%) and, above all, a large decline of durum wheat export (>10%). The role of national choices in attenuating these effect is also remarkable; for instance, partial decoupling would reduce the negative impact on durum wheat area and export by about 5%.[13] This is also evident when the total (i.e., aggregated over the whole agricultural sector) impact on output and income is considered. Though the aggregate effect is small, it still differs according to the alternative implementation of the durum wheat specific measures; in particular, it affects the total amount of subsidies delivered to the Italian agriculture, thus confirming how relevant durum wheat is also in this respect.[14]

In the evaluation of the model projections summarized above, one major issue concerns their robustness and reliability. In this respect, it can be useful to compare the most important results with evidence emerging from other studies and approaches about the impact of the CAP reform on EU and Italian agriculture (table 9).[15] Results obtained within the AG-MEMOD model can be compared to the projections presented by the Commission using a similar approach, thus also similar to the FAPRI approach and results (European Commission, 2003; FAPRI, 2003b). However, the EC simulation does not emphasize the country specific effects of the reform, which are, on the contrary, of major interest here. At the EU-15 level, the impact of the reform as reported by the Commission indicates a 0,9% and 1% decline of cereals and oilseeds cultivated area, respectively. More specifically, a 5,5% decline in durum wheat area is expected. In AG-MEMOD (Esposti and Lobianco, 2004), the EU projected decline is 2% for cereals and 6% for oilseeds, thus implying a more intense impact of the reform especially in these latter crops.

Another interesting comparison can be attempted with the OECD report (OECD, 2004) about the impact of the 2003 CAP reform. The OECD analysis is carried with both the PEM approach and the AGLINK model. Despite the methodological differences among the two, both refer to the EU-15 as one aggregate bloc, thus missing the relevant distributional effect of the reform across member states. Most results generated by two approaches are quite similar. At the EU aggregated level, the PEM suggests a 2,5% reduction in cereals harvested area and a 2,8% reduction for oilseeds. The AGLINK results report different evidence according to the decoupling scheme, but no major differences emerge with maximum or minimum decoupling, at least for cereals. About 0,5% reduction in cultivated area for wheat and coarse grains is reported, while for oilseeds this reduction is only observed with minimum decoupling, but it is negligible. It is also important to notice that also in the AGLINK model the decoupling of payments is entered by assuming some residual effect on production as a sort of *ad valorem* equivalent with respect to the fully coupled support case (see also Dewbre *et al*., 2001 and van Tongeren *et al*., 2001).

Other interesting studies concern the CAPMAT approach suggesting an 8% reduction of wheat area at the EU-15 level, the CAPSIM study indicating a 25% reduction of durum wheat area (only -1% for soft wheat) at EU level, and the INEA study with cereals production

[13] Other scenarios (i.e., national choices) on art.69 could be tested in future research since it may largely vary from just 40€/ha (no art.69 payments) up to 220€/ha (as the regulation admits up to 180€/ha *ex* art.69).

[14] It must be noticed that the current AG-MEMOD model does not include any budgetary ceiling for the decoupled payments, although it is actually imposed by the CAP reform. Thus, the introduction of this budgetary constraint in the model, and its consequent feedback on projections, could represent a relevant future improvement of the approach.

[15] All mentioned studies rely on partial equilibrium models but some of them are synthetic models not estimated models as AGMEMOD (see van Tongeren *et al*., 2001, for a detailed review).

falling by 30% in several countries, Italy included. All these studies are reviewed in details in ESPON (2004); they represent interesting references even because suggest similar impacts of the reform, though major divergence emerge just in the expected reduction of the wheat area, with particular uncertainty on durum wheat. However, even these studies usually focus on the EU as a whole, therefore they can be hardly compared to the Italian results here reported. A little more detailed is the WEMAC model, that includes an EU aggregate with also some country details about the major EU agricultural countries (Italy included)[16] and makes also more explicit the relation between the EU and world markets, [17] but only concerns cereals and oilseeds. Also in this case, however, the expected impact of decoupling is limited, with a 2,6% and 6,8% reduction in soft wheat and durum wheat harvested area (Benjamin *et al.*, 2003).

However, what will really happen to wheat area and, above all, to durum wheat cultivation is a major concern in Italy and should be more expressely evaluated within country-specific models. In October 2004 the AIS (Italian Association of Seed Producers) estimated a reduction of durum wheat production ranging between 20% and 30% which is not far from results here presented (AgriSole, 2004). Moreover, using a Positive Mathematic Programming (PMP) approach, Arfini (2004) has recently calculated the possible impact of the reform on Italian land allocation. His results are not so different to what obtained in our AG-MEMOD projections. According to different decoupling devices (partial vs. full decoupling), he obtains a reduction of cereals cultivated area ranging between 9% and 13%. Also for oilseeds the results are not particularly different. Though his results suggest a +1% increase in oilseeds harvested area, both approaches essentially signal that the CAP reform is not expected to affect oilseeds land allocation very much. The effects of the reform on the aggregate EAA figures are similar. Arfini suggests a 4% decline in the value of crops output compared to about -1% generated by the AG-MEMOD model. In fact, this little higher decline in the value of output also explains his higher expected reduction of inputs use for crops, -6% vs. –4%.

Nevertheless, one missing key-issue remains also in the country-specific AG-MEMOD projections concerns the different impact of the reform across Italian regions. This is of particular relevance since some mostly affected commodities (and durum wheat in particular) are concentrated in different parts of the country; durum wheat is actually limited to the Southern and Central part of the country. Using a specific EU regional modelling approach (CAPRI approach), Britz (2004) have emphasized that the reduction of durum wheat cultivated area for some Southern Italian region may be even larger than 30%. Other regional studies confirm how the geographical bias of the CAP reform may be critical in Italy (IReR, 2004), although according to other studies (ESPON, 2004) this should not generate great effects on income at the Italian regional level.

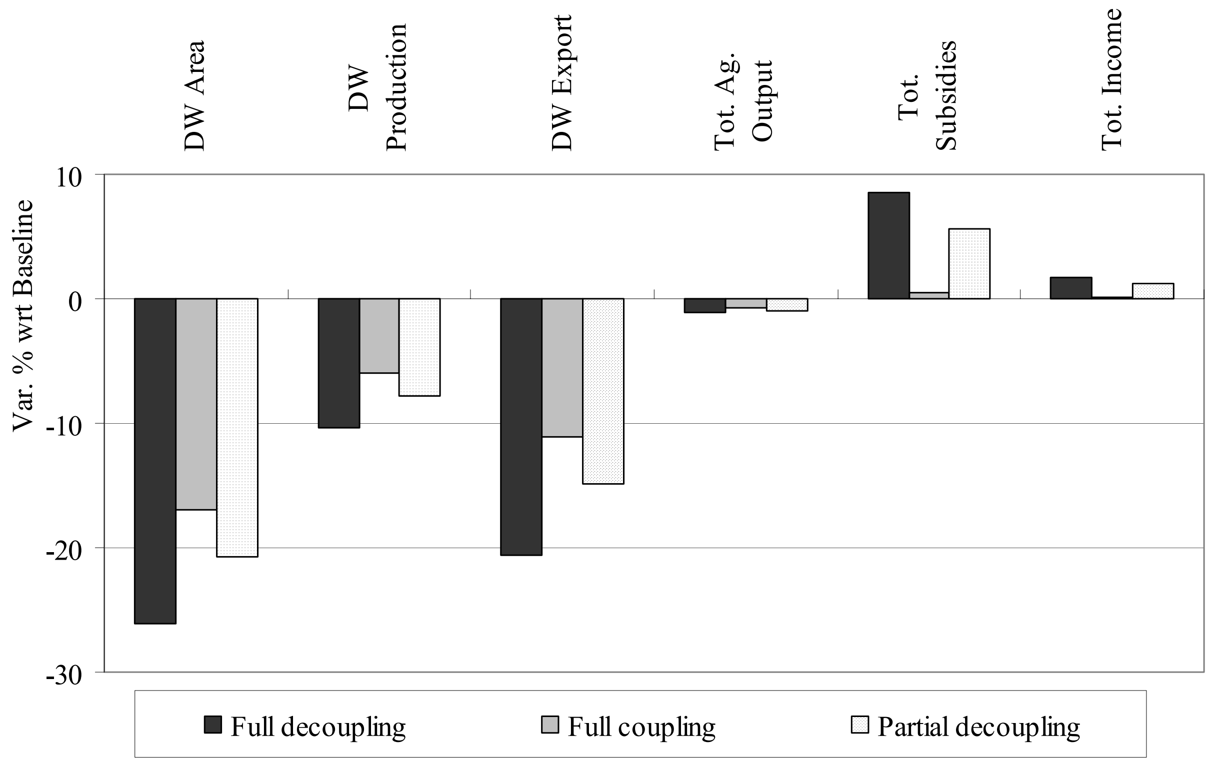
Therefore, results here obtained do confirm most general indications about the impact of the 2003 CAP reform emerging from other studies and shed more light on the country-specific consequences. Income is expected not to change very much, area allocation will be affected to an higher extent but will mainly involve cereals, and durum wheat in particular, rather than oilseeds. At a more disaggregated level, however, these effects might indeed be amplified. In Italy, the impact on cereals and durum wheat is expected to be strong and this

[16] Unfortunately specific results for Italy of the WEMAC model have been not published. Also the FAPRI-GOLD model (Binfield *et al.*, 2003b) specifically models Italy. As for WEMAC, however, this country disaggregation is introduced just to better generate EU aggregate results; so country results are not provided. In addition, the FAPRI-GOLD model for Italy is a synthetic model not an econometric one.

[17] It must be noticed that in both AGLINK and WEMAC models, world prices are endogenous since the EU aggregates affect price formation at the world market level. This does not hold in the AG-MEMOD approach, although, as mentioned, it may be integrated within the FAPRI World Modelling System, thus making world price formation indeed endogenous.

makes particularly crucial the way the specific measures for durum wheat are implemented within the CAP reform. The strong specialisation on durum wheat of several Italian regions may thus justify the concerns emerged in this respect about the biased territorial effects of the reform. This critical aspect can not fully tackled within the approach presented in this paper and should deserve further attention in future research.

Figure 7 – Maximum effect of alternative decoupling devices of the durum wheat supplementary payment with respect to the respective baseline (% variation)



Source: Our elaboration on Italian AG-MEMOD model

Table 9 – CAP reform impacts on cereals and wheat harvested area according to different partial equilibrium models

	Cereals	Wheat	Durum Wheat
EU-15 Aggregate			
AGMEMOD (EU-9)	-2%	-2%	-
EU COM	-0,9%	-1,5%	-5,5%
FAPRI (2003b)	-1,1% / -0,9%	-1,5% / -1,2%	-4,9% /-4,4%
OECD (PEM/AGLINK)	-2,5% / - 0,5%	- 0,5%	-
WEMAC	-	- 2,6% (soft wheat)	- 6,8%
Italy			
AGMEMOD	- 23% / - 11%	- 25% / - 11%	- 26% / - 11%

Source: Our elaboration on various sources (see references in the main text)

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ANNEX: Structure of the Italian AG-MEMOD model (cereals and oilseeds)

Table A.1 – List of behavioural equations of crop sub-models

Equations	*Total Grains Total oilseeds*	*Soft wheat Durum wheat Barley Maize*	*Rapeseed Sunflower seed Soybean*	*Rape oil Sun oil Soy oil*	*Rape meal Sun meal Soy meal*
Area harvested	X	X (only durum wheat)			
Share on total area		X (soft+durum wheat)	X		
Yield		X	X		
Production				X	X
Food *per capita* demand		X			
Food *per capita* demand (share)				X	
Feed demand		X			X
Crush demand			X		
Stocks		X	X	X	X
Imports		X (only durum wheat)			
Exports		X (excl.durum wheat)	X	X	X
Price formation		X	X		

The general (implicit) form of these equations is described as follows:

Supply side

We assume that land allocation is a three-steps decision process. Producers first determine the total land allocated to cereals or grains (*g*) and to oilseeds (*o*). Secondly, this total area is allocated to any of the n,m crops belonging to the two groups respectively, where wheat is a single aggregate. Thirdly, total wheat area is allocated between soft and durum wheat.

In the first decision step, the total harvested area at year t for grains ($ah_{g,t}$) and oilseeds ($ah_{o,t}$) is determined as follows:

(1a) $ah_{g,t} = f\left(er_{g,t}, er_{o,t}, ah_{o,t}, v_t\right)$

(1b) $ah_{o,t} = f\left(er_{g,t}, er_{o,t}, ah_{g,t}, v_t\right)$

where $er_{g,t}$ and $er_{o,t}$ are the expected *per* ha returns for cereals and oilseeds, respectively, and v_t is a vector of exogenous variables which can have an impact on the harvested area (namely, the set aside rate and a linear trend). The expected returns for the two commodity groups are calculated as weighted sum of the expected returns $er_{i,t}$ of any of the i-th crop belonging to the group plus the *per ha* compensation or payment ($C_{g,t}$ or $C_{o,t}$):

(2a) $er_{g,t} \equiv \sum_i \alpha_i \cdot er_{i,t} + C_{g,t} \;, \quad where \sum_i \alpha_i = 1, \qquad \forall\, i = 1,......,n$

(2b) $er_{o,t} \equiv \sum_i \alpha_i \cdot er_{i,t} + C_{o,t} \;, \quad where \sum_i \alpha_i = 1, \qquad \forall\, i = 1,......,m$

where α_i is the lagged share on total group area. The expected return $er_{i,t}$ is the three-years weighted sum of the trend return (that is, the product of the trend yield $ty_{i,t}$ by the market price $p_{i,t}$, where the trend yield is estimated by regressing the observed yield on a deterministic trend):

(3) $er_{i,t} \equiv \sum_{L=2}^{0} \beta_{t-L} \cdot ty_{i,t-L} \cdot p_{i,t-L} \;, \quad where \sum_L \beta_{t-L} = 1$

where β_{t-L} is 0.5, 0.3 and 0.2 for L = 0, 1 and 2 respectively.

The second decision step involves the allocation of land among the n,m crops of the grains-oilseeds group, respectively. This allocation is modelled as share equation as follows:

(4) $sh_{i,t} = f\left(er_{g,t} / er_{i,t}, v_t\right)$ or $f\left(er_{o,t} / er_{i,t}, v_t\right)$

where $sh_{i,t}$ is the i-th crop share on total group area, and v_t again includes the set aside rate and a linear trend. It follows that land allocated to any i-th crop is derived as an identity:

(5) $ah_{i,t} \equiv sh_{i,t} \cdot ah_{g,t}$ or $ah_{i,t} \equiv sh_{i,t} \cdot ah_{o,t}$

In equations (4) and (5) wheat is considered as a single aggregate. Therefore, a durum wheat (DW) area equation is estimated:

(6a) $ah_{DW,t} = f\left(er_{DW,t}, er_{g,t}, er_{o,t}, v_t\right)$

to allow for the calculation of the consequent soft wheat (SF) area as:

(6b) $ah_{SW,t} \equiv ah_{Wheat,t} - ah_{DW,t}$

The supply side of the model is completed by the yield equation, which is written, for any i-th cereals crop, as follows:

(7) $y_{i,t} = f\left(ty_{i,t}, ah_{i,t}, p_{i,t-1}, (ah_{g,t} + ah_{o,t})\right)$

whereas for any oilseeds crop is:

(8) $y_{i,t} = f\left(ty_{i,t}, ah_{i,t}\right)$

Therefore, the *per hectare* yield $y_{i,t}$ depends on the calculated trend yield, the harvested area and, for cereals, on lagged own price and on the total area allocated to grains and oilseeds. Total production (*qp*)for any i-th crop can be derived by multiplying estimated yield and area.

Demand side

On the demand side, *per capita* food (non-feed), crush and feed demand is modelled using the following general functional forms:

- Food (non-feed) use (cereals)

(9) $qd_{nfeed,i,t} = f(p_{i,t}, v_t)$

where $qd_{nfeed,i,t}$ and $p_{i,t}$ are the *per capita* food demand and price for i-th commodity, respectively, and v_t is a vector of other variables (*per capita* GDP, lagged feed demand, other prices)

- Feed demand (grains and oilseeds meals)

(10) $qd_{feed,i,t} = f(p_{i,t}, p_{m,t}, \gamma_{i,t})$

where $qd_{feed,i,t}$ is the *per capita* feed demand for i-th commodity, $p_{i,t}$ and $p_{m,t}$ are the own and other feed prices, and $\gamma_{i,t}$ is a feed demand index.

- Crush demand (oilseeds)

(11) $cr_{i,t} = f(cm_{i,t}, cr_{i,t-1})$

The *per capita* crush demand of i-th oilseed depends on a crushing margin $cm_{i,t}$ relating the own (oils and meals) price with the price of the original seeds.

- Oils demand (seeds oils)

(12) $qd_{tot,i,t} = f(p_{i,t}, p_{m,t}, gdp_t)$

Seeds oil demand is calculated as *share* of the total *per capita* oils-fats expenditure in a demand system that includes the three vegetable oils and butter; gdp_t indicates the *per capita* GDP, $p_{i,t}$ and $p_{m,t}$ are the own and other oil prices. Multiplying the estimated share by the expenditure we obtains the respective oil demand.

Finally, total demand (food+feed) can be derived for any commodity multiplying by population and summing the above components.

Trade, stocks and price formation

In any commodity model, for modelling imports, exports and stock level equations we use the following general functional forms:

(13) $im_{i,t} = f(qp_{i,t}, qd_{tot,i,t}, st_{i,t}, st_{i,t-1}, v_t)$

(14) $ex_{i,t} = f(qp_{i,t}, qd_{tot,i,t}, im_{i,t}, st_{i,t}, st_{i,t-1}, p_{i,t})$

(15) $st_{i,t} = f(qp_{i,t}, st_{i,t-1}, p_{i,t}, pol_{i,t})$

where $im_{i,t}$, $ex_{i,t}$ and $st_{i,t}$ are imports, exports and ending stocks respectively for the i-th commodity, while $p_{i,t}$, $qp_{i,t}$ and $qd_{tot,i,t}$ are price, production and the total demand, respectively; $Pol_{i,t}$ is a vector of possibly relevant policy variables (mainly, intervention prices), while v_t may include other variables as time trend, dummy and production losses. It must be also reminded that for any commodity, one the three equations above is not estimated but calculated from the domestic supply and demand identity, thus playing as the model closing (market clearing) variable.

When the Italian market is not the EU key-market, the i-th commodity price $p_{i,t}$ in Italy is estimated through the price linkage equation:

(16) $p_{i,t} = f(p_{key,i,t}, v_{i,t})$

where $p_{key,i,}t$ is the EU key-price and $v_{i,t}$ is a vector of variables which could have an impact on the Italian price (mainly, the Italian self sufficiency rate and the key-market self sufficiency rate). For oilseeds the world price is directly used in the price formation equation since no EU key-price exists for these products.

For durum wheat, the Italian price is considered the key-price. In this case, the equation describing the price formation is written as:

(17) $p_{DW,t} \equiv p_{key,DW,t} = f(p_{world,DW,t} v_{DW})$

where $p_{world,DW,t}$ is the durum wheat world price, and v_{DW} is a vector of variables which could affect the durum wheat Italian price. In particular, as further explanatory variables we admit the durum wheat price at time (t-1), the EU durum wheat net export at time (t-1), as a proxy of the EU self-sufficiency rate, and a time trend. In fact, as mentioned, two different alternative specifications of equation (17) are used in running the model: with the lagged price and time trend and without the EU durum wheat net export as regressor (Vers. 1), without the lagged price and time trend and with the EU net export (Vers. 2).

Selected (durum wheat) equation estimates

Here, we just report the estimates for a limited number of equations, where durum wheat variables appear as depended variables.[18] Standard error are reported in parenthesis below the parameters point estimate. Yield and area equations are estimated simultaneously, as well as price formation, import and stocks equations, using an 3SLS estimator. The other equations are estimated with an OLS estimator.

- DURUM WHEAT AREA HARVESTED

DWAHAIT = 1096,02 + 0,0006*DWEGRIT + 0,0003*G3EGRIT + 0,0001*O3EGRIT –11,50*GRSARE5 + 6,69* TREND
(806,48) (0,0003) (0,0004) (0,0002) (5,36) (16,79)
R^2 = 0,533

- DURUM WHEAT TREND YIELD

DWYHTIT = -84,13 + 0,0435*TREND
(17,50) (0,0088)
R^2 = 0,4219

- DURUM WHEAT YIELD

DWYHAIT = 4,91 + 1,11*DWYHTIT + 0,0001* DWPFRIT(-1) – 0,0014*(G3AHAIT+O3AHAIT) + 0,0008*DWAHAIT
(2,60) (0,952) (0,0001) (0,0006) (0,0012)
–0,4600*DUMMY
(0,2368)
R^2 = 0,484

- DURUM WHEAT FEED DEMAND[19]

DWUFEIT = 509,39 – 0,297*WHFINIT – 0,0003*DWPFRIT - 0,0001*SWPFRIT
(429,99) (0,327) (0,0001) (0,0002)
R^2 = 0,259

- DURUM WHEAT NON FEED PER-CAPITA DEMAND

DWUFCIT = – 25,38 + 0,0002*SWPFRIT – 0,0001*DWPFRIT + 0,0514*RGDPCIT + 9,19*DUMMY
(36,59) (0,0001) (0,0001) (0,0280) (2,22)
R^2 = 0,718

- DURUM WHEAT ENDING STOCKS

DWCCTIT = 9777,49 + 0,4289*DWCCTIT(-1) + 0,2686*DWSPRIT – 0,0091*DWPFRIT – 306,49*TREND
(5129,23) (0,1534) (0,1295) (0,0043) (132,03)
R^2 = 0,679

- DURUM WHEAT LOSS

DWLSDIT = –10,12 + 0,9741*(DWSPRIT-DWSPRIT(-1))
(15,06) (0,0416)
R^2 = 0,987

[18] The specification and estimation of all the other model equations are reported in Berloni *et al.* (2002).
[19] Although feed demand is almost negligible for durum wheat, it is still included to maintain consistency with the other crop productions.

- DURUM WHEAT IMPORT

DWSMTIT = 0,0773*(DWUDCIT+DWCCTIT+DWLSDIT-DWSPRIT-DWCCTIT(-1)) + 60,38*TREND
(0,1737) (6,96)
$R^2 = 0,291$

- DURUM WHEAT PRICE FORMATION EQUATION

Vers. 1
DWPFRIT = 15064,10 + 35,33*DWPMDIT + 0,6591*DWPFRIT(-1) – 348,52*TREND
(9479,94) (18,17) (0,1399) (119,34)
$R^2 = 0,703$

Vers. 2
DWPFRIT= 28844,6 + 106,91*DWPMDIT – 2,99*DWUXNE5(-1) – 21937,40*DUMMY
(3627,67) (7,09) (0,7651) (2099,66)
$R^2 = 0,586$

- CLOSING VARIABLE (Identity): DURUM WHEAT EXPORT

DWUXTIT= DWSPRIT+DWCCTIT(-1)+DWSMTIT-DWUDCIT-DWCCTIT-DWLSDIT

Legend:

DUMMY	Dummy variable (=1 from 1993)
DWAHAIT	Durum wheat area harvested
DWCCTIT	Durum wheat ending stocks
DWCCTIT(-1)	Durum wheat beginning stocks
DWEGRIT	Durum wheat expected real gross returns
DWLSDIT	Durum wheat loss
DWPFRIT	Durum wheat real price
DWPMDIT	Durum wheat world real price (converted in national currency)
DWSMTIT	Durum wheat imports
DWSPRIT	Durum wheat production
DWUDCIT	Durum wheat total demand
DWUFCIT	Durum wheat non feed *per capita* demand
DWUFEIT	Durum wheat *per capita* demand
DWUXNE5	Durum wheat EU net exports
DWUXTIT	Durum wheat exports
DWYHAIT	Durum wheat yield
DWYHTIT	Durum wheat trend yield
G3AHAIT	3-grains total area (wheat as a single aggregate)
G3EGRIT	3-grain expected real gross returns
GRSARE5	Cereal set-aside rate
O3AHAIT	3-oilseeds total area
O3EGRIT	3-oilseed expected real gross returns
RGDPCIT	Real *per capita* GDP
SWPFRIT	Soft wheat real price
TREND	Time trend
WHFINIT	Wheat feed demand index

Note: (-1) indicates the variable at time (t-1)

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