Assessing the impacts of the 2003 CAP Mid Term Review:
How sensitive are they to the assumed production responsiveness to Agenda 2000 direct payments ?

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Abstract:

The EU adopts once again in June 2003 a new reform of its farm policy with a new step toward the decoupling of farm income support instruments. Available impact studies find that this reform will reduce production incentives, substantially for beef and to a lesser extent for arable crops. All these studies assume that the Agenda 2000 arable crop direct payments are already mostly decoupled while beef premiums are much more linked to production. Our main objective in this paper is to test the robustness of these results to this questionable modelling on Agenda 2000 direct payments. Our analysis reveals that the negative impacts of the CAP MTR on both the arable crop and beef productions is robust to the modeling of Agenda 2000 direct payments. On the other hand, our analysis shows that the decoupling effects may be higher on the arable crop markets than on the beef markets. Policy implications of these results are finally derived.

Keywords: Common Agricultural Policy, Decoupling, Computable General Equilibrium, European Union.

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Introduction

In June 2003 the European Council agreed on a new reform of its Common Agricultural Policy (CAP). This reform, decided in the context of a Mid Term Review (MTR) of the Agenda 2000 CAP reform of 1999, contains five main elements, namely i) the reduction of market price support, ii) the introduction of mandatory cross-compliance rules, iii) the strengthening of rural development by the modulation of direct payments, iv) a new mechanism to reduce direct payments in case of budget pressure, and v) the decoupling of direct support by the creation of a Single Farm Payment (SFP). This SFP will replace most of the present direct payments and will not be tied to current production of any commodity. Moreover agricultural production is no longer required to receive the benefits of the payment. On the other hand, farmers will be subjected to cross-compliance conditions, in particular the obligation to keep their land in good agricultural and environmental conditions.

Many economic analyses have been performed to measure the market and welfare impacts of this last reform. By and large, these analyses mostly focus on the effects of the redesign of direct support instruments. Table 1 below reports some results from seven available studies conducted at the EU15 level. We exclude from this table those studies which consider MTR proposals or report national/regional results only. In a general way, these results all go in the same direction. Arable crop productions decrease mainly through a reduction of land allocated to these activities ; yields per hectare marginally increases. Milk production is virtually unchanged due to binding milk quotas. Non ruminant production are only indirectly affected by the reform and thus the impacts are very limited. Finally beef production also contracts, despite increases of fodder and pasture areas. This reduction mainly results from the development of more extensive production techniques. Another empirical regularity across all studies is the higher effects observed on the beef market compared to those obtained on the arable crop markets. On the average (last column of table 1), the wheat production will decrease by 1.8% compared to 3.2% for the beef production, despite greater increases of the domestic price for the latter (5.5% compared to 1.6%).

[Insert Table 1]

If the general direction of effects is quite similar across studies, the magnitude of these effects widely diverges. For instance, the reduction of wheat production ranges from nearly nothing (5 studies) to as much as 6% (2 studies). The reduction of beef production is more evenly spread in the bracket zero - 7%. These differences are not unexpected because underlying models rely on various specifications. But it is highly critical to understand them because policy implications of these results may be dramatically far apart. If one believes that this CAP MTR and its SFP does not really change production, then he might question the very likely classification of the SFP in the green box at the World Trade Organization (WTO). More generally these results might raise some doubts about the relevance of the distinction between the blue and green boxes. On the other hand, if one believes that this reform effectively reduces production incentives, then the European Union (EU) may be in a better position in the current WTO multilateral negotiations.

Some studies have already engaged some sensitivity analysis in order to test the robustness of these impacts and understand these differences. Balkhausen et al. (2005) examine the sensitivity of impacts to elasticity parameters using the ESIM model. As expected, they find strong influences of these parameters on some impacts, the most significant one being the effect of the land mobility parameters on arable crop areas. If they assume a huge mobility of land, arable crop areas (and production) decrease by as much as 18%, compared to 7% in their

central case.[1] They do not report the symmetric case with low mobility of land but it is very likely that they will obtain more limited decreases of these areas. The OECD (2004) focuses on the assumed production effects of the new SFP instrument. All models, be they econometric or synthetic, must adopt some assumptions regarding the effects of the SFP on production. In the standard version of the Aglink model, the production effects of the SFP are assumed to be 6% of the impact of market price support for arable crop and beef productions[2]. The sensitivity analysis applies parameters of 0.02 and 0.10 for the SFP instead of the initial 0.06. On the maximum decoupling scenario, they find that the impacts are rather sensitive to this parameter. The reduction of soft wheat area varies between 1% and 0.3% (0.5% in the central case) and the reduction of beef production between 1% and 0.1% (0.6% in the central case). In relative terms, these differences appear to be substantial (reaching as much as 100%) but in absolute terms they are finally very modest (less than 0.5%).

These two sensitivity analyses, that we are aware of, help to partly understand the differences between published figures on the impacts of the CAP MTR. In any case do they reverse the general messages of all studies: the CAP MTR and its decoupling with the SFP will lead to a more extensive beef (and milk) production to the detriment of the level of arable crop activities ; impacts on the beef markets are larger than those on arable crop markets.

The main objective of this paper is to test whether these results are robust to the specifications of Agenda 2000 CAP direct payments. These results are derived from models which generally assume that Agenda 2000 arable crop direct payments were already partially decoupled and Agenda 2000 beef direct payments are much more coupled to the production. However some statistics and studies raise some doubts about the decoupled nature of Agenda 2000 arable crop direct payments. Moreover Agenda 2000 beef premiums were granted to farmers but subject to many eligibility rules which reduce their degree of coupling. Hence an examination of the sensitivity of CAP MTR impacts on the modeling of Agenda 2000 direct payments is legitimate. In that respect, we use a detailed Computable General Equilibrium (CGE) model focused on the EU15 agriculture and food sectors, which allows to consider various modeling of direct payments.

This paper is organized as follows. In the first section, we provide a review and discussion of the modeling of Agenda 2000 direct payments in simulation models. We divide this section in two separate sub sections, one devoted to the arable crop direct payments and the other to the beef direct payments. In the second section, we present our modeling framework. We obviously focus on the representation of Agenda 2000 direct payments. Section three is devoted to the definitions of the baseline and simulations of the CAP MTR. Section four offers some methodological and political conclusions and suggests directions of research.

1. The modeling of Agenda 2000 direct payments: Review and discussion

Many models are currently operational to simulate the effects of the CAP instruments in general, of its direct payments in particular. It is beyond the scope of this paper to review all these models.[3] We voluntary limit our

[1] Note that Balkhausen et al. use a modified version of the ESIM model (with new product and country coverage) and that the impacts of the CAP reform in the central case greatly differ from those derived by the European Commission using an older version of this model (results reported in table 1).

[2] The 6% assumption comes from the PEM model defined on arable crops only (Dewbre et al., 2001). By definition, this figure does not take into account that the eligible area to the SFP is fixed and is not restricted to arable crops.

discussion to the models, mentioned in table 1, which have been employed in order to assess the legal CAP MTR. As far as possible, our discussion is based on elements given in the publications supporting these results because different versions of same models may lead to different results (see footnote 1 on the ESIM model).

1.1. The modeling of Agenda 2000 arable crop direct payments.

The production impacts of any input subsidy depends, among other things, on the production technology of the targeted sector as well as the functioning of the input market. It is thus helpful to mention these specifications developed in simulation models, in conjunction to the modeling of direct payments.

With the exception of the GTAP CGE model, all models (which are of Partial Equilibrium (PE) nature) specify the production technology of arable crop sectors as the product of a yield function and an area function. Let's start with these PE models. Yields per hectare are generally assumed to be independent of direct payments. Appendix 1 shows analytically the theoretical restrictions imposed by such specifications, independently of any assumptions on the functioning of land market. In these PE models, Agenda 2000 arable crop direct payments only enter area allocation functions (like prices) weighted by a coupling factor.

This factor, which varies between 0 and 1, is sometimes referred as a highly synthetic representation of all known theoretical effects of direct payments (risk related effects, dynamic effects, …) but which are not explicitly specified in the models because they are extremely difficult to capture (see, for instance, Chantreuil et al., 2005). A value of zero implies that Agenda 2000 direct payments have no effects on area allocations and more generally no effects at all, because yields are independent of direct payments. To the contrary, a value of one implies that the effects of these direct payments are similar to those of prices of arable crops, corrected by appropriate yields.

Last row of table 1 reports the coupling factors used in available studies. It is worthy to remark that the only PE study which obtains significant decrease of cereal production assumes a high coupling factor and the opposite for the other PE studies. This tends to suggest that these coupling factors have substantial bearings on impacts and hence it is useful to argue the choice of a particular (or a range of) coupling factor. Nevertheless, this does not provide formal evidence and, as mentioned before, the modeling of policy instruments alone does not determine their impacts, this also depends on the modeling assumptions of the input markets (mainly land in the present case).

In the context of PE models, where all primary factor markets are not explicitly represented, the zero value seems to us a very extreme option because it does not recognize that producers must cultivate their land in order to receive the direct payments. Of course they are allowed with the Agenda 2000 to set aside part of their land but not their full farm, so that they must keep producing (at least partially). In fact this zero value makes implicitly the assumption that direct payments are fully capitalized in land rents.

At the other hand of the spectrum, the one value implies that producers must engage in production in order to receive payments, that these payments influence the factor allocation across activities. As stated earlier, this influence depends on the factor mobility as well as relative payments across activities. For instance, if all activities receive the same per unit direct payment and the factor is perfectly mobile, then direct payments have finally no production impacts. This ends up like the zero value. As far as we understand the CAPRI results, the

[3] The interested reader may refer to papers written by INEA researchers (www.inea.it).

reduction of cereal production is mainly governed by a harmonization of direct payments across all activities while direct support is fully capitalized in land values (information extracted from the dual values of land).

To our knowledge, only the OECD does justify the 0.14 coupling factor by relying on the PEM model. This figure suggests quite limited production impacts of Agenda 2000 arable crop direct payments and that there are highly capitalized on land rents. Unfortunately, this figure is obtained with a PEM model which does not take into account that the total land eligible to Agenda 2000 arable crop direct payments is limited, nor the set aside requirements, nor the existence of other policy instruments of the CAP. Now it is clear that the impact of one instrument depends on its interactions with other instruments. This coupling factor is, as recognized by the OECD, flimsy but justified.

In CGE models in general, in GTAP in particular, production technologies and costs are explicitly represented. Production technologies are represented by more or less flexible functional forms, mainly depending on the distinction of products (inputs and outputs) and factors. If substitution possibilities between land and other inputs are assumed to be zero, then this implies that yields per hectare are only indirectly dependent of prices and this is finally very similar to previous PE specifications. If, one the other hand, land can easily substitute with other factors (labor, chemicals, …), then yield effects may be huge. In the precise application of GTAP to the CAP MTR, this information on production technologies and yield effects is not available. Agenda 2000 arable crop direct payments are represented by a direct land subsidy and accordingly this suggest that these payments are fully capitalized in land rents. Again, as far as we understand the GTAP results, the reduction of cereal production is mainly explained by a harmonization of direct payments across all activities.

In addition to the specific issues raised so far, our main concern with all these studies is that they assume, more or less explicitly, that Agenda 2000 arable crop direct payments are nearly fully capitalized in land values. While this may be correct in the long run with land markets working perfectly, we believe that this may be not the case when the full effects of CAP MTR will realize. This opinion is based on the following grounds. Recent statistics from Eurostat show that rents for agricultural land are still much lower than per hectare direct payments. Table 2 reports these statistics for France, Germany and the United Kingdom. It appears that rents represent between one third to two third of per hectare direct payments. According to these figures, the full capitalization assumption is irrelevant for recent years for those Member States and one might not exclude that this is the same thing at the end of the present decade. As far as we understand them, all models already assume that Agenda 2000 direct payments are nowadays fully capitalized in land rents/values and logically they do not consider partial capitalization in the future.[4] Of course not all land are rented but figures from farm accounting data (in particular the Farm Accounting Data Network) also suggest that, on own land use farms, Agenda 2000 arable crop direct payments are not fully capitalized in land.

[Insert Table 2]

Our opinion is also based on studies which try to evaluate the degree of capitalization of direct payments into lands. To our knowledge, there are no published studies applied to the EU agriculture. We are only aware of a French unpublished study (Meze, 2003) which does not find that 1992 CAP arable crop direct payments did

[4] In a longer working paper, Jensen and Frandsen (2003) implicitly recognize that there might be some issues by assuming full capitalisation into land of direct payments when they suggest to improve their cost structures, especially the factor cost shares in the land using sectors.

capitalize in land rents. On the other hand, there are many published studies on the capitalization of direct payments in the USA. In particular Roberts et al. (2003) and subsequently Kirwan (2004) find that the marginal degree of capitalization of US direct payments into land lies around 0.3-0.4 in 1997. Without providing formal evidence for the EU case, these studies tends to challenge the full capitalization usually assumed in simulation models.

If one is willing to accept the idea that CAP arable direct payments might not be fully capitalized in land rents/values, then it remains to explain why and to suggest where the non-capitalized part indeed goes. The reasons we put forward here are that there might exist some rigidities/imperfections on agricultural factor markets and that capitalization takes time. CAP arable crop direct payments were initially introduced as compensatory payments for price decreases in order to support farm revenues. It might be the case that farmers perceive these new direct payments as a reward for their labor and thus resist to fully transmit these payments to landowners. This assumption makes sense given the strong opposition of farmers in some EU member states with the CAP MTR and its SFP because this new instrument further breaks the link between support and production (farmers are no longer required to produce in order to receive the direct support). In addition, land leasing arrangements heavily depends on Member States but it is not uncommon to see very long contracts, with small possibilities to renegotiate it. This may explain a slow capitalization of direct payments in land values. Finally, there exist some national regulation laws on farm land uses which also prevent full arbitrage and thus full capitalization. According to these arguments, it is not unlikely that the non capitalization part may be perceived as a labor/capital subsidy by farmers and that it prevents major labor outflows from agriculture after the 1992 and 1999 CAP reforms.

In the empirical part of our paper, we will consider this capitalization issue and the possibility that part of Agenda 2000 arable crop direct payments is perceived as a labor/capital subsidy. We will able to do that because we make use of a detailed CGE model where production costs, including labor and land costs, are fully documented.

1.2. The modeling of Agenda 2000 beef direct payments.

In a general way, the modeling of the beef sector/policy is less well documented than other sectors. One must recognize that this sector is very complex and it is understandable that modelers have taken different routes (if not shortcut) to represent it. With the Agenda 2000 CAP reform, there are three main beef direct payments in terms of budgetary expenditures (table 3). Below we present them and simultaneously how they are represented in simulation models.

[Insert Table 3]

i) The Scukler Cow Premium

This first one in terms of expenditure (more than 2 billion €) is the Suckler Cow Premium (SCP) introduced in 1980 whose level reaches 200 € per animal from 2002 onwards. This premium is granted to every farmer who owns these animals (hence coupled to the animals). However total SCP claims are subject to individual quotas and are also conditional on a maximum stocking density (1.8) of subsidized animals per forage hectare. Moreover, from 2002 onwards, farmers must allocated at least 15% and up to 40% of their SCP individual quotas to heifers. Before 2002, there were allowed a maximum of 20%. From available statistics (second part of

table 3), it appears that EU15 suckler cow herds always overcome EU15 SCP quotas, by nearly one million suckler cows or 9% of the quotas. If we add the requirements to allocate at least 15% of these premiums to heifers, it appears that the number of suckler cows non eligible to SCP reaches around 2.6 millions. In other words, nearly 22% of suckler cows are not subsidized. This figure is far from negligible and raises some specific issues in terms of modeling.

As far as we understand them, suckler cow herds are generally explicitly included in PE models and are expressed using dynamic functions with beef prices and premiums as explanatory variables. We report in the bottom of table 1 their baseline levels. It appears that the suckler cow herd is always projected to overcome SCP quotas. In order to take into account these quotas, it seems that these studies reduce unit SCP or specify again coupling factors between 0 and 1. By this manner, they implicit assume that producers take into account an average SCP for all their animals. This assumption may be reasonable but others as well. In particular, given the huge number of suckler cows not receiving SCP, one might assume that last suckler cows are simply determined by the standard price marginal cost equalization condition. In such cases, SCP may have indeed very limited production effects and simply gives some rents to quota holders. These two interpretations are both plausible and in fact depends on the true production costs. Unfortunately they are generally absent from PE models.

As far as the GTAP CGE model is concerned, production costs are by definition explicit but with the GTAP sectoral coverage, the suckler cow herd is not explicitly represented. Instead the bovine cattle sector is assumed to produce bovine cattle using mainly feed ingredients, labor, land and capital. The latter is very heterogeneous and theoretically includes the suckler cow herd. Accordingly the SCP is modeled as a capital subsidy. How mobile across activities are the services of capital is the crux of the matter but is not documented.

ii) The Special Beef Premium

The second premium in terms of expenditures is the Special Beef Premium (SBP) scheme which was first introduced in 1987. Main characteristics of this premium are that it is paid to adult male animals only (hence coupled to these animals) but again subject to two major restrictions. One is the same maximum stocking density rule (1.8) and the second is that claims within a member state are subject to national ceilings. This is a significant difference with the SCP where quotas are individuals. If SBP claims exceed the ceiling in any year, then all claims by individual producers are scaled back accordingly (the unit SBP is reduced). From available statistics, it appears that in recent years claims are roughly equal to production and are always higher than ceilings (by nearly 2 million heads or 20% overshooting). Again this raises some specific issues in terms of modeling.

It seems that all models explicitly consider the SBP and adopts, like the SCP, an average subsidy approach to the production of male animals when modeled, to the production of bovine cattle otherwise. This assumption makes sense because, to date, farmers effectively receive ex post an average SBP. Again other assumptions may be relevant because the previous one implicitly supposes that farmers are able to correctly anticipate the true production level at their member state level. It seems to us not unreasonable to formulate other SBP expectations. For instance, when deciding to produce male animals, farmers may expect that their historic production level will benefit from the full SBP and do not really expect SBP for additional males. In this case, over quota male animals are simply determined by the price-marginal cost equalization condition.

iii) The slaughter premium

The third premium is the slaughter premium introduced with the Agenda 2000 CAP reform. In fact there are two slaughter premiums, one for bovine cattle and one for calf. Like the SBP, claims within a member state are subject to national ceilings and any breach of these ceilings will result in a scaling back of claims in the member state concerned. To date, these ceilings have not been overcome and all models represent it as a perfectly coupled subsidy to bovine production (to the two kinds of animals when distinguished).

iv) Other beef premiums

In addition to the three beef premiums mentioned so far, there exists many others whose application differs by Member States. Two of them provides subsequent support. The first one is the extensification premium. Basically, an additional premium payment is made on top of the SCP and SBP if the real stocking density on a holding is within certain set limits. These limits are allowed to vary by Member States. This extensification premium is notified in the green box measure at the WTO while all other beef premiums are in the blue box. Many modeling of this premium are possible, leading to rather extreme conclusions. One possibility may be to consider it as a coupled subsidy which is in addition to the SCP and SBP. One another possibility is to assume no effects because it is notified as belonging to the green box. One additional view consists in assuming that this subsidy is in fact a land subsidy which may reduce beef production. In fact some farm simulation models find that the removal of this extensification subsidy leads to an intensification of cattle production (Lherm et al., 2004). The second one is the so-called national envelopes. Each member state has the possibility to grant fixed additional payments on top of all other beef premiums or to make permanent pasture area payments. Accordingly many modeling of this last beef premium are again possible. Unfortunately we have not been able to find any information on the modeling of these two other beef premiums.

Our main concern with the modeling of the three main beef premiums (eventually the others when information will be available) is that usually they are assumed to operate at the margin: last production units are determined by a condition stating that marginal costs equal price plus a (possibly weighted) subsidy. Eligibility rules for these direct payments are only implicitly taken into account while we underline above that they may have significant impacts on their coupling degree. Again our detailed CGE model, where production costs are explicitly acknowledged, allows us to better incorporate these specific rules and hence to test the robustness of the CAP MTR impacts to the modeling of the intricate Agenda 2000 CAP direct payments.

2. Modeling framework

We first give general characteristics of our modeling framework and then give full details of the modeling of Agenda 2000 direct payments for arable crop and bovine activities.

2.1. General Characteristics

Our model is a static, single-country, multi-sector GE model of the EU15 economy. It is neo-classical, assuming perfect competition in all markets and specifying constant returns to scale technologies. Investment is savings driven and balance of payment equilibrium is ensured by financial flows. Two exchange zones are considered, the first one being represented by the 10 new Member States that joined the EU on May 2004 and the second

being the Rest of the World (RoW). The EU is potentially a large country in the world market for agricultural and food products in the sense that trade flows affect other regions' export prices through a series of export demand and import supply functions.

In addition to the modeling of the CAP instruments (see below), this model is original on the three following aspects. The first original feature of the model is the disaggregation of the EU economy into activities and commodities. The model identifies 75 products and all major economic agents operating on the food chain: agri-industrial sectors, agricultural sectors, food processing industries, food retailers, traders, as well as domestic consumers. This huge distinction allows to capture major backward and forward linkages across sectors. For instance, the model distinguishes organic fertilizers which are produced by animal activities and used by crop activities. Unlike most CGE models which are based on the GTAP database, it relies on original data and a Social Accounting Matrix calibrated for the year 1995. Main sources of this SAM are Eurostat database (SPEL, COMEXT, COSA, …) and FEOGA/WTO notifications for policy variables.

The second original feature of our model is the specification of price and income elasticities. The model uses globally regular-flexible functional forms for the specification of production technologies and consumers' preferences. The flexible form developed by Perroni and Rutherford (1995), i.e. the Lower Triangular Leontief Nonseparable N Stage Constant Elasticity of Substitution, is used. This form combines the notion of latent separability and a nested CES structure. This approach allows introducing any regular matrix of price and income elasticities. In order to calibrate the parameters of these regular-flexible functional form, published econometric estimates of price and income elasticities were used.

The third original feature of the model is the modeling of primary factor markets. The model distinguishes three production factors, land, labor and capital, which are in fixed supply. We assume imperfect mobility of labor and capital across sectors (through a CET function). Imperfect mobility of land between agricultural sectors is also represented by nested CET functions and our mobility structure was derived from the French agricultural supply model (Matthieu et Ramanantsoa, 1995). It subsequently appears that this is very similar to the ones presently developed in the GTAP model. In order to represent the multiproduct nature of agricultural firms and to avoid allocating labor and capital to each farm enterprise, a revenue function is used. We thus assume that farm capital, labor and overhead expenses are first combined as a composite service (hereafter labeled labor/capital bundle), which is then combined to land and intermediate inputs allocated to each farm enterprise (coefficients on the inputs allocated to each enterprise come Eurostat's SPEL database). This representation of the agricultural technology draws on Peterson et al (1994).

2.2. Modeling of the arable crop sector and poliy

The arable crop Common Market Organisation (CMO) directly concerns the following sectors of our model: three cereal activities (soft wheat, barley and corn), three oilseeds (rapeseed, sunflower and soya), one protein crop (field peas), and finally one "aggregated" fodder crop on arable land which includes silage maize. All these sectors have the same mono-product technological structure ; they only differ in terms of data. As a consequence, we focus our presentation on the soft wheat sector.

Table 4a) presents the initial data (year 1995) used to calibrate the technological and political parameters of this sector. Data on physical characteristics, receipts and expenditures all come from Eurostat sources (mainly SPEL

database). The main issue is to allocate the remaining value added to primary factors of production. As stated earlier, we do not separate labor and capital for each farm enterprise but rather assume that they use a bundle of labor and capital. Thus, for the soft wheat sector, we only need to split the value added into two components, i.e. rents for the land and the labor/capital bundle.

It is at this stage that the issue of direct payment capitalization does appear. If these data represent an equilibrium (in fact a maintained assumption in CGE models), the land rent must not be lower than the land direct payment. Let's assume for a while that we fully allocate direct payments to land (full capitalization assumption). In that case, the unit land rent must be at least equal to 318€/ha which is much higher than those observed. One additional issue with this assumption is that the remaining labor/capital rent may be low. This issue is not very significant for soft wheat because the market price of this cereal was high in 1995. On the other hand, it is highly problematic for oilseeds (not shown in table 4a) where this remaining labor/capital rent is negative (for instance, in the case of rapeseed, the SPEL database reports a negative value (-42€/ha) for the value added without direct payments). Nonetheless all simulation models assume more or less explicitly this full capitalization of direct payments into land. We depart from this assumption for the calibration of our model and assumes instead a 30% capitalization. In the same time, we assume that the land unit rent equals observed land rents (roughly 170€/ha). Initial values for the labor/capital bundle are calibrated as residuals.

The 30% figure is derived from Roberts et al. (2003) in the case of the US. We easily recognize that it is highly heroic to assume the same percentage in the EU and thus one may ask a sensitivity analysis to this initial figure. We prefer to test different values of this degree of capitalization when building our baseline because it is not very useful to examine the sensitivity of CAP MTR impacts for 1995.

The impacts of any input subsidy also depends on the production technology of the subsidized sector. Table 4b) reports the initial price elasticities of hicksian input derived demands for the soft wheat production. In order to determine these elasticities, we conduct a literature review and adopt substitution elasticities from Gohin et al. (2003) and from Jensen et al. (2002). We obviously apply our cost shares to these substitution elasticities and implement the result matrix using a latent separability approach (see above). As stated earlier, many simulation models assume that yields per hectare are fixed. In our case, they are endogenous and depends on all prices, including land prices. It appears for example that, at the initial point, soft wheat yields per hectare increase by 0.09% when land prices increase by 1%, all other prices and soft wheat production remaining constant. This results from a substitution with all other inputs (fertilisers, pesticides and the labor/capital bundle).

[Insert Tables 4]

We finally mention here that our model also includes other policy instruments of the arable crop CMO. In particular, trade measures include export subsidies, tariff quotas, in-quota tariffs, out-of-quota tariffs, ad valorem and specific tariffs, and the tariffs from the safeguard clause. The modeling of these price support instruments basically follows other CGE approaches (see for instance Folmer *et al*., 1995; Bach *et al*., 2000; van Meijl and van Tongeren, 2002). On the other hand, we depart from CGE representations of the set aside requirements which generally capture them with a factor neutral supply shock. We specify a new derived demand in the land market which is determined as a fraction (the set aside rate) of land derived demands of all arable crop activities.

2.3. Modeling of the bovine cattle sector and policy

The EU beef CMO is very complex, with different premiums on bovine animals. Fortunately we have been able to define most of them using again the SPEL database. Our model details the following cattle activities: Dairy cows, Suckler cows, Beef calf, Calf rearing, Heifers and Bulls and Steers. They are all multi-product activities (producing bovine cattle, organic fertilizers, eventually milk, calfs, …) where we generally assume fixed relationships between the different outputs. One particular exception is the heifer activity where heifers may enter the dairy cow herd or the suckler cow herd or may be slaughtered. We model this arbitrage with a CET function and calibrate it in order to target a bovine cattle supply price elasticity. All these activities use feed ingredients (both concentrated and fodders), a labor/capital bundle as well as animals. Again all these activities are modeled in the same way and we now focus on the suckler cow activity.

The suckler cow activity offers four type of products (bovine cattle, calves, suckler cows and organic fertilizers) using feed ingredients, labor/capital, other inputs (veterinary) and the initial suckler cow herd. We assume some substitution possibilities between feed ingredients (Mahé and Munk, 1987) and again use a latent separability approach. All other inputs (including the suckler cow herd) are used in fixed proportions.

Regarding the beef premiums, this activity was only eligible to the SCP and the extensification premium in the year 1995. We model both as a subsidy to the use of suckler cow herd at the initial point. In this initial year, the suckler cow herd is lower than the quota and thus we assume a fully coupled input subsidy. However it is important to allow our model to endogenously define some non-subsidized suckler cows. In that respect we implement a complementary approach which can be explained as follows. The program of the representative producer of the suckler cow activity is given by:

$$\underset{SC1,SC2}{Max} \quad P.(SC1+SC2)-(PSC-SCP).SC1-PSC.SC2-C(SC1+SC2;W)$$
$$s/t \qquad SC1 \le QSCP$$

where $SC1$ stands for subsidized suckler cows, $SC2$ non subsidized or over quotas suckler cows, P an appropriately weighted output price, PSC the market price of suckler cows, SCP the unit SCP, $C(\ )$ the cost function which includes all input costs except the cost of acquiring suckler cows and which depends on prices of inputs W , $QSCP$ the quota level. In the initial situation, $SC2$ is null but it may become positive in the baseline depending on the evolutions of output prices and costs. First order conditions of this program are:

$$P-(PSC-SCP)-Cm(SC1+SC2;W)-\lambda \le 0 \quad \perp \quad SC1 \ge 0$$
$$P-PSC-Cm(SC1+SC2;W) \le 0 \quad \perp \quad SC2 \ge 0$$
$$SC1-QSCP \le 0 \quad \perp \quad \lambda \ge 0$$

where λ is the dual value attached to the quota constraint. These conditions, implemented in our model, imply that if non subsidized suckler cows are positive, then the SCP simply gives a rent to SCP quota owner. On the other hand, if the suckler cow herd is lower than the quota, then the SCP is fully coupled to the input use and to production. Current modeling of the SCP does not take into account of the SCP quota in this manner but only implicitly by reducing the unit SCP. They implicitly assume that the suckler cow herd is determined by the following condition:

$$P - (PSC - ASCP) - Cm(SC;W) = 0$$

where $ASCP$ is the average unit SCP. This condition implicitly states that all suckler cows are subsidized and obviously removing (or reducing) the SCP will necessarily have some production effects. In the simulation below, we will contemplate the two specifications where the second may be viewed a special case of the former with an infinite SCP quota level.

Basically we develop the same modeling for the bull and steer activity and the SBP and again will explore in the simulation section the two alternative specifications. As far as the slaughter premium is concerned, it has been introduced with the Agenda 2000 and necessarily is null in our initial database. When defining the baseline, we will assume that this subsidy is coupled to the production of bovine cattle. Like the two other premiums, there are some ceilings. They are much more difficult to implement in our modeling framework because many activities benefit from this new premium. We only check after simulations whether aggregate quota levels are overcome or not. Finally given the lack of details regarding the extensification premium and the national envelopes, we assume that they supplement the SCP and SBP using 1995 percentages. Again our model includes the price support instruments. We just underline here that they are defined both at the animal and meat levels.

3. Experiment design and results

3.1. Definitions

Our main objective in this paper is to examine the sensitivity of CAP MTR impacts to the modeling of Agenda 2000 direct payments. The modeling of these payments are one element which allows to define our baseline. So our sensitivity analysis requires the building of different baselines. We will consider in this paper two baselines which nevertheless share some common assumptions on the evolution of non policy exogenous variables and non direct payments policy variables.

In both cases, our assumptions are designed with the intent of representing the EU economy in 2008. The most crucial ones in the context of this paper are the followings. We always assume that the marginal productivity of all inputs of arable crop activities increases by 1.5% per year. This implies for instance that, all other things being equal, yields per hectare increase by 1.5% per year. We also assume a 1.5% increase of milk cow yields and the marginal productivity of all feed ingredients in all animal activities increase by 1% annually. On the macro-economic side, the euro is assumed to stabilize around 1.05 against the US dollar. As far as changes in dietary patterns are concerned, we assume a 2% annual decline in beef consumption, compensated by a 1% increase of white meat consumption. As regard world market conditions, we rely on FAPRI 2004 projections of world market prices in order to scale the intercept parameters of our export demand and import supply functions. It must be clear at this stage that the baseline levels of yields per hectare, domestic and world prices, productions and demands, …, depends on all these exogenous factors.

Last important exogenous variables for the definition of the baselines are agricultural policy parameters. We implement the Agenda 2000 CAP reform while maintaining international trade rules (for instance possibilities of export subsidies). This implies in particular that cereal interventions decrease by 15%, that the set aside rate is fixed at 10% and that unitary arable crop direct payments are increased by 16.7% in case of cereals (from 54 to

63€/ton of reference yields) and decreased by 33% in case of oilseeds (from 94 to 63€/ton of reference yields). On the dairy markets, we implement a 2.4% increase of milk quotas, a 15% reduction of the intervention prices of butter and skimmed milk powder, the introduction of a coupled dairy payment of 35.5€/ton of milk. On the beef markets, we implement a 20% reduction of the beef intervention price, an increase of the SCP from 145 to 200€ per suckler cow, an increase of the SBP from 109€ to 210€ per animal, the introduction of a 80€ per adult bovine cattle slaughtered and 50€ in case of calf. Finally, we assume that the extensification premium and the national envelopes will translate in a top up of the SCP by 110€ per suckler cow.

We now explicit the differences between the two baselines. In the first one, we adopt a standard approach for the modeling of the Agenda 2000 direct payments where we assume firstly that the arable crop direct payments will be fully capitalized in land values at the 2008 horizon (the 30% become 100%), secondly that beef premiums are not constrained by individual or aggregate ceilings. Hereafter we will call it the standard modeling which tends to represent current modeling of Agenda 2000 direct payments. In the second one, hereafter labeled an alternative modeling, we assume firstly that the arable crop direct payments are partly capitalized in land (50%) and secondly that beef premiums are granted to a reduced number of animals (10824 thousands suckler cows in case of the SCP, 8453 thousands male animals in case of the SBP).

At this stage several comments are in order. The 50% figure assumed in the alternative modeling may be highly debated and we try now to motivate this choice. Our purpose in this paper is to test the sensitivity of CAP MTR to the modeling of Agenda 2000 direct payments. Our opinion is that a particular sensitivity analysis is useful when one considers significant differences between different options. This suggests a quite low degree of capitalization. On the other hand, the sensitivity analysis must still be relevant in the sense that the varying parameters must still be consistent with other modeling assumptions. We explain before that the capitalization of arable crop direct payments into land may take time for a variety of reasons ; hence the baseline value can not be lower than the initial value (30%). The 50% figure seems to us a tradeoff between these two arguments. The alternative modeling of the beef premiums may be also highly debated. For instance, the quotas on premiums may be introduced in many different manners, with the possibility of a cross-subsidy between in-quota and out-of quota animals. Again our objective is to test in a rather radical but still plausible way the modeling of these beef premiums and it seems to us that the two modeling alternatives are a priori attractive.

Up to now, we only present the assumptions which define our baselines. It remains to describe the CAP MTR scenarios. Like many other CAP MTR analysis, we will focus on the measures of market price support and the decoupling and will ignore the issues regarding mandatory cross-compliance, modulation and financial disciplines. We always assume a 10% decrease of the butter intervention prices. Regarding decoupling, we face one significant issue with our EU15 model because the CAP MTR allows Member States to maintain part of their Agenda 2000 direct payments. Choices differ by Member States and consequently the EU15 levels of remaining Agenda 2000 direct payment are endogenous. In our simulations, we assume that Agenda 2000 arable crop direct payments are reduced by 90%, that the slaughter premium on adult animals by 80%, the SCP by 50% and the SBP by 90%. Furthermore we assume that the new SFP has no market effects, a highly questionable but common assumption. We apply these percentage reductions equally in our two baselines.

3.2. Results

By nature all CGE results are interrelated but in order to simplify the analysis we will focus first on the impacts on arable crop markets and activities and then turn on those on the beef markets and activities. Table 5a) reports our results on the soft wheat market and activity using the standard approach while table 5b) reports the same results with the alternative modeling of Agenda 2000 direct payments. In both cases, the implementation of the CAP MTR induces a decrease of soft wheat production, by 1.6% with the standard specification, by as much as 7.3% with the alternative one. Our standard result is rather similar to the average of available results (1.8% reduction, cf. Table 1). By contrast our alternative result is quite stronger than the largest available result (6.0% with the GTAP model). These results suggest that the modeling of Agenda 2000 direct payments has a significant influence on the CAP MTR impact on soft wheat production.

In fact it appears in our analysis that the soft wheat area decreases by similar percentages following the CAP MTR (by 9% and 7.4% respectively). In both cases, soft wheat land rent decreases significantly due to the strong reduction of arable crop direct payments. In fact arable land shifts from the cereals and oilseeds activities to the sugar beet activity and the fodder crop on arable land activity (again due to a leveling of unitary direct payment across activities) This acreage reduction is significantly compensated by an increase of yields in our standard approach (8.1%), which is an original result of our analysis and may be explained as follows. In this standard modeling of Agenda 2000 direct payments, we assume full capitalization of arable crop direct payments into land in the baseline. The net price of land for the soft wheat activity is very low and farmers have no incentives to intensify in this baseline. When the CAP MTR is implemented, this net price increases because the absolute reduction of land rent is lower than the absolute reduction of unit direct payment (due to the reallocation of land). Hence we observe an intensification with respect to land in the soft wheat activity because we allow some substitution between land and other inputs. This is apparent for example in the marginal effects of the CAP MTR on the use of pesticides or fertilizers.

By contrast the CAP MTR leads to very marginal yield effects (0.1%) when we adopt the alternative modeling of Agenda 2000 direct payments. This may be explained as follows. The net price of land for the soft wheat activity also increases in that case but the net price of the labor/capital bundle does so simultaneously because we strongly reduce that part of Agenda 2000 direct payments which was perceived as a labor/capital subsidy. These two effects compensate each other. All inputs mainly decrease through a contraction effect (for instance, the use of pesticides decreases by 6.9%).

All results mentioned so far are equilibrium results which capture many impacts. In particular, when the domestic production significantly decreases following the CAP MTR “decoupling”, this puts some pressure on domestic prices and/or on trade. As expected, with the standard approach, the market impacts are quite limited ; for instance, the domestic and world prices increase by 0.3%. They are much pronounced with the alternative approach: these prices increases by 6% (6€/ton) and EU exports decreases by 22.9% (4.5 MT).

[Insert Tables 5]

Let’s turn to the impacts on beef markets and sectors (Tables 6a and 6b). Again, with our standard modeling of Agenda 2000 direct payments, our simulated impact of the CAP MTR on beef production (3.6% reduction) nearly equals the average of available estimated impacts (3.2%). More generally most of our standard results are

in line with average ones: our baseline level of the suckler cow herd is 12974 thousands cows (compared to 12433) and our reduction of this herd following the CAP MTR is 7.4% (compared to 7.7%). The main exception is the price effect where we obtain larger figures (10% increase compared to 5.5%) because we assume more inelastic demand functions. Like all other studies, we obtain a more extensive bovine production. Green fodder areas increase by 6.7% (not reported in table 6a), mostly on arable land.

Once we depart from this standard approach where all animals are subsidized, impacts are much more different. One must first note that the baseline suckler cow herd is now much lower (11361 thousands cows) and out-of-quota suckler cows represent 4.7% of the total herd. In that case, the SCP only gives some rent to the owner of the SCP quotas. In the economic account, these rents are included in other costs. This is the same case for the SBP (not reported in Table 6b). On the other hand, total claims of the slaughter premium are lower than the aggregate ceilings. This last subsidy is then coupled to the production of both adult bovine animals and calves. When we implement the CAP MTR on this alternative baseline, notably the reductions of all these premiums, we find a small decrease of beef production (1.2%). This reduction mainly results from the decrease of the slaughter premium while the reductions of both the SCP and the SBP have no market effects. We still obtain a more extensive bovine production because green fodder areas still increase but this shift is much lower than previously. As expected, this lower production impact goes with smaller market effects. For instance, beef price increases by 3.2% compared to 10% with the standard approach.

[Insert Tables 6]

Concluding comments

The EU adopts once again in June 2003 a new reform of its farm policy with a new step toward the decoupling of farm income support instruments. Available impact studies find that this reform will reduce production incentives, substantially for beef and to a lesser extent for arable crops. All these studies assume that the Agenda 2000 arable crop direct payments are already mostly decoupled while beef premiums are much more linked to production. Our main objective in this paper is to test the robustness of these results to this questionable modelling on Agenda 2000 direct payments. In particular we hypothesize that Agenda 2000 arable crop direct payments may not be fully capitalised in land values ; instead they still support farm labor and capital. We also allow the possibility that some bovine animals are not subsidised, a fact observed for many years now. This sensitivity analysis is performed using a detailed CGE model for the EU15 economy which allows a precise representation of CAP instruments.

Our analysis reveals that the negative impacts of the CAP MTR on the arable crop and beef productions is robust to the modeling of Agenda 2000 direct payments. Also robust is the positive impact of this reform on the extensification of the beef production. On the other hand, our analysis shows that decoupling effects may be higher on the arable crop markets than in the beef markets. With the alternative modeling of Agenda 2000 direct payments, the CAP MTR induces a 7.3% reduction of soft wheat production (and a 6.0% price increase) and “only” a 1.2% reduction of beef production (and a 3.2% price increase). Our analysis also shows that the arable crop production may become more intensive because the net land prices go up for these activities.

From a political point of view, these results may have some serious implications. Firstly, they suggest that it is highly critical to correctly represent all policy instruments when assessing a policy. Depending on the way one models the beef premiums ceilings, the CAP may appear mostly decoupled or highly coupled to this production. In a more prospective view, this suggests that one must take care of all cross compliance rules when measuring the consequences of the new single farm payment. More generally, one must carefully consider all eligibility rules of green box measures and certainly not focus only on their positive production impacts through wealth or dynamic effects. Secondly, if one is ready to accept that Agenda 2000 arable crop direct payments are not fully capitalised in land values, this suggests that the CAP MTR effectively makes a progress towards decoupling for these activities: EU farmers are no longer required to produce in order to receive the SFP, to the contrary of Agenda 2000 direct payments. It seems to us that this is much less evident in the case of the USA (mainly due to the history of the USA farm policy and the expectations of farmers of the possibility to update their base acreages). On the other hand, the fact that the EU allows each Member State to maintain part of Agenda 2000 direct payments softens this shift towards decoupling and thus the EU may still concentrate some criticisms of developing countries.

From an academic point of view, our analysis clearly relies on some modelling assumptions which warrant further investigations (for instance how to model the SFP). Our results suggest that understanding the functioning of land markets (and more generally farm labor and capital markets) in the EU must be a top priority. Equally important is to reconsider the econometric estimations of production elasticities because they directly determine the market impacts of farm income support instruments.

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Table 1: Selected published impacts of the CAP MTR on EU15 markets (in percentages from the baseline) and modeling assumptions

Model	CAPRI a)	GOLD b)	FAPRI c)	ESIM d)	AGLINK e)	GTAP f)	AGMEMOD g)	Average
Years of comparison	2009	Average 2010-2014	2010	2010	2008	2013	2010	
Cereal production	-5.7	Na	Na	-0.6	Na	-6.0	Na	
Wheat production	-4.3	Na	-0.3	-0.2	-0.5	-6.0	na	-1.8**
Wheat area	-4.6	-1.1	-0.3	-0.9	-0.5	na	-0.1	
Wheat yields	0.3	na	0	0.7	0.0	na	na	
Wheat price	6.9	2.0	0.6	0.1	-0.1	na	0.2	1.6
Beef production	-4.4	-2.2	-1.9	-1.9	-0.1~-0.6	-7.1	-4.5	-3.2***
Suckler cow herd	-9.5	-10.8	-8.2	-6.8	na~-3.2	na	na	-7.7***
Milk cow herd	-0.4	na	-0.1	1.0	na~-0.9	na	na	
Beef prices	7.8	5.8	4.5	6.0	0.5~2.7	na	6.0	5.5***
Pork production	-0.2	0.3	0.2	0.5	0.1	0	-0.1	
Poultry production	0.4	0.3	0.4	0.6	0.0	0	-0.1	
Milk production	0.1	0	0	0.1	0.1	-0.7	0.0	
Milk price	1.1	-1.8	-0.4	-8.8	-2.6	na	na	
<u>Modeling assumptions:</u>								
Coupling factor of Agenda 2000 arable crop premiums*	*1*	0.5	*0*	na	0.14	*NR*	na	
Coupling factor of Agenda 2000 beef premiums*	*1*	>0.5	na	na	Na	*NR*	na	
Baseline suckler cow herd (000 heads)	13979	12120	12895	11758	11414	Na	Na	12433***

Na: non available, NR: Non relevant

* : Figures in italics reflect our understanding of the underling modeling framework as described in the mentioned papers.

**: For the GOLD and AGMEMOD based results, we assume that production effects are equal to area effects.

***: For the AGLINK based results, we use minimum decoupling figures.

a) from http://www.agp.uni-bonn.de/agpo/rsrch/dynaspat/xml/scenario.xml#TOP
b) From Binfield et al. (2005).
c) From Fabiosa et al. (2005).
d) From European Commission (2003).
e) From OECD (2004). Wheat does not include durum wheat. The OECD performs two simulations, one with full decoupling and one with minimum decoupling. Results between the two options differ significantly only for beef. We thus provide for these variables the extremes.
f) From Jensen and Frandsen (2004). We report results from the partial decoupling simulation.
g) From Chantreuil et al. (2005).

Table 2. Land rents and Agenda 2000 arable crop direct payments (€/ha)

	Land rents	Per hectare direct payments (a)
France	131	370
Germany	251(b)	340
United Kingdom	200 (c)	354

Source: Eurostat, Agriculture in the European Union, Statistical and economic information, various years.

(a): figures obtained by dividing total Agenda 2000 arable crop direct payments by effectively eligible areas.
(b): figure for new rents.
(c): figure for England.

Table 3. Beef direct payments and production in the EU15

	2000	2001	2002	2003
Budget expenditures (M€)				
Suckler cow premium	1776	1977	2157	2225
Special beef premium	1530	1788	1967	1945
Slaughter premium	494	1184	1710	1718
Extensification premium	913	891	1018	989
Additional payments	148	322	483	483
Production and quota levels (000 heads)				
Suckler cow quota	10824	10824	10824	10824
Suckler cow herd	12150	11860	11770	11730
Delivered premiums	9864	10242	10281	na
Adult slaughter premium quota	na	23494	23494	23494
Adult slaughtering	na	18220	19075	na
Calf slaughter premium quota	na	5984	5984	5984
Calf slaughtering	na	2578	3084	na
Male adult premium quota	9378	8453	8453	8453
Delivered premiums	10837	10550	10689	na
Male adult slaughtering	10192	10442	10353	10164

Source: **www.ofival.fr** and European Commission, FEOGA expenditures

Table 4. Calibration of the soft wheat sector.

a) Initial data

Physical characteristics	
Production	80080 MT
Area	13358 Mha
Yields	6 MT/ha
Receipts	
Market	10557 M€
Direct payment	4248 M€
Expenditures	
Seeds	723 M€
Fertilizers	2242 M€
Pesticides	1239 M€
"Value added"	10601 M€
Value added and direct payment decomposition	
Land rents	2293
Land direct payment	1274
Labor/capital rent	8308
Labor/capital direct payment	2974

b) Initial Hicksian demand price elasticities

	Land	Organic nitrogen	Organic phosphate	Organic potassium	Mineral nitrogen	Mineral phosphate	Mineral potassium	Pesticides	Labor/ Capital
Land	-0.090	0.004	0.003	0.002	0.008	0.003	0.002	0.013	0.054
Organic nitrogen	0.010	-0.739	0.045	0.036	0.421	0.042	0.028	0.101	0.054
Organic phosphate	0.010	0.064	-0.560	0.036	0.126	0.140	0.028	0.101	0.054
Organic potassium	0.010	0.064	0.045	-0.766	0.421	0.042	0.028	0.101	0.054
Mineral nitrogen	0.010	0.213	0.045	0.121	-0.614	0.042	0.028	0.101	0.054
Mineral phosphate	0.010	0.064	0.151	0.036	0.126	-0.571	0.028	0.101	0.054
Mineral potassium	0.010	0.064	0.045	0.036	0.126	0.042	-0.479	0.101	0.054
Pesticides	0.010	0.034	0.024	0.019	0.067	0.022	0.015	-0.247	0.054
Labor/Capital	0.010	0.004	0.003	0.002	0.008	0.003	0.002	0.013	-0.046

Table 5 a). Impacts on soft wheat market and activity with the STANDARD modeling of Agenda 2000 direct payments

Market		**Technology**		**Econ account**	
Production	80080 95049 (18.7%) 93505 (-1.6%)	Production	80080 95049 (18.7%) 93505 (-1.6%)	Market receipts	10557 10322 (-2.2%) 10186 (-1.3%)
Imports	1150 828 (-28.0%) 825 (-0.3%)	Area	13358 15934 (19.3%) 14503 (-9.0%)	Land subsidy	1274 5876 (361.2%) 535 (-90.9%)
Consumption	70995 80460 (13.3%) 79180 (-1.6%)	Yield per ha	6.0 6.0 (-0.5%) 6.4 (8.1%)	Labor/capital subsidy	2974 0 (-100%) 0 (--)
Exports	10339 15223 (46.4%) 14977 (-1.6%)	Pesticides	1239 1118 (-9.8%) 11108 (-0.9%)	Costs of inputs	4204 4345 (3.3%) 4374 (0.7%)
Domestic prices	131 108 (-17.6%) 108 (0.3%)	Mineral nitrogen	829 714 (-13.8%) 720 (0.9%)	Land rent	2293 6051 (163.9%) 819 (-86.5%)
World prices	113 108 (-4.5%) 108 (0.3%)	Labor/capital bundle	8308 7712 (-7.2%) 7606 (-1.4%)	Labor/capital rent	8308 5802 (-30.2%) 5527 (-4.7%)

Table 5 b). Impacts on soft wheat market and activity with the ALTERNATIVE modeling of Agenda 2000 direct payments

Market		**Technology**		**Econ account**	
Production	80080 100876 (26.0%) 93490 (-7.3%)	Production	80080 100876 (26.0%) 93490 (-7.3%)	Market receipts	10557 10340 (-2.1%) 10159 (-1.8%)
Imports	1150 778 (-32.4%) 822 (5.7%)	Area	13358 15456 (15.7%) 14316 (-7.4%)	Land subsidy	1274 2850 (123.7%) 264 (-90.7%)
Consumption	70995 81794 (15.2%) 78969 (-3.5%)	Yield per ha	6.0 6.5 (8.9%) 6.5 (0.1%)	Labor/capital subsidy	2974 2450 (-17.6%) 226 (-90.8%)
Exports	10339 19679 (89.2%) 15175 (-22.9%)	Pesticides	1239 1193 (-3.7%) 1111 (-6.9%)	Costs of inputs	4204 4768 (13.4%) 4416 (-7.4%)
Domestic prices	131 102 (-22.2%) 108 (6.0%)	Mineral nitrogen	829 798 (-3.7%) 732 (-8.3%)	Land rent	2293 3177 (38.5%) 577 (-81.8%)
World prices	113 102 (-9.9%) 108 (6.0%)	Labor/capital bundle	8308 8259 (-0.6%) 7613 (-7.8%)	Labor/capital rent	8308 7694 (-7.4%) 5696 (-26.5%)

For all variables, first figures correspond to 1995 initial point, the second to the baseline (in parentheses the difference with the initial point) and the third to the CAP MTR simulation (in parentheses the difference with the baseline)

Table 6 a). Impacts on beef market and suckler cow activity with the STANDARD modeling of Agenda 2000 direct payments

Market		**Technology**		**Econ account**	
Production	7300 6704 (-8.2%) 6463 (-3.6%)	Suckler cow herd	10912 12794 (17.2%) 11846 (-7.4%)	Market receipts	12556 16108 (28.3%) 15935 (-1.1%)
Imports	177 160 (-9.4%) 166 (3.2%)	Fodder on arable land	544 743 (36.5%) 781 (5.2%)	SCP	1975 3636 (129.8%) 1683 (-53.7%)
Consumption	6738 6809 (1.1%) 6578 (-3.4%)	Fodder on non arable land	1211 1292 (6.7%) 1196 (-7.5%)	Slaughter premium	0 190 35 (-81.5%)
Exports	707 0 (-100%) 0 (--)	Labor/capital bundle	4318 5063 (17.2%) 4687 (-7.4%)	Fodder costs	1755 2296 (30.8%) 1721 (-25.1%)
Domestic prices	3500 3126 (-10.7%) 3437 (10.0%)			Other input costs	8458 10707 (26.6%) 10313 (-3.7%)
World prices	1393 1915 (37.4%) 1915 (0.0%)			Labor/capital rent	4318 6931 (60.5%) 5632 (-18.7%)

Table 6 b). Impacts on beef market and suckler cow activity with the ALTERNATIVE modeling of Agenda 2000 direct payments

Market		**Technology**		**Econ account**	
Production	7300 6398 (-12.4%) 6320 (-1.2%)	In quota suckler cow	10912 10824 (-0.8%) 10824 (0.0%)	Market receipts	12556 17127 (36.4%) 16452 (-3.9%)
Imports	177 167 (-5.4%) 169 (1.1%)	Out of quota suckler cow	-- 537 291 (-45.8%)	SCP	1975 3076 (94.4%) 1538 (-50.0%)
Consumption	6738 6516 (-3.3%) 6442 (-1.1%)	Suckler cow herd	10912 11361 (4.1%) 11115 (-2.2%)	Slaughter premium	0 160 32 (-80.0%)
Exports	707 0 (-100%) 0 (--)	Fodder on arable land	544 746 (37.1%) 753 (1.0%)	Fodder costs	1755 1769 (0.8%) 1587 (-10.3%)
Domestic prices	3500 3544 (1.3%) 3656 (3.2%)	Fodder on non arable land	1211 1119 (-7.6%) 1113 (-0.5%)	Other input costs	8458 13688 (61.8%) 11748 (-14.2%)
World prices	1393 1915 (37.4%) 1915 (0.0%)	Labor/capital bundle	4318 4496 (4.1%) 4397 (-2.2%)	Labor/capital rent	4318 4906 (13.6%) 4700 (-4.2%)

For all variables, first figure corresponds to 1995 initial point, the second to the baseline (in parentheses the difference with the initial point) and the third to the CAP MTR simulation (in parentheses the difference with the baseline)

Appendix 1. Theoretical implications of yield functions independent of direct payments.

Yields per hectare are often specified in PE models as functions of own producer price and a trend capturing the impact of technical change. The impacts of area direct payments on production then only occur through the land allocation and they do not appear in yield functions. To elicit the economic implications of these specifications, consider the case of a mono-product firm employing three inputs, including land.[5] Production is denoted by y, uses of input one and two by x_1 and x_2 respectively, and the amount of land by l. Producer prices related to these variables are respectively denoted by p, w_1, w_2 and w_l. These producer prices equal market prices corrected by eventual taxes/subsidies (for instance, output subsidies, input taxes, area direct payments, …). We assume that all these prices are taken as given for the producer. Technological constraints faced by this firm are represented by a production function satisfying usual theoretical requirements (positive, non decreasing in input quantities, twice continuously differentiable and concave). As usual in the production theory, this firm chooses the levels of inputs and output in order to maximise its profit. The maximisation program of the firm is then:

$$\begin{aligned} \Pi(p, w_1, w_2, w_l) = & \max_{y, x_1, x_2, l} py - w_1 x_1 - w_2 x_2 - w_l l \\ s/t \qquad & y = f(x_1, x_2, l) \end{aligned} \tag{A.1}$$

First order conditions of this program for an interior solution are:

$$\begin{cases} pf_{x_1} - w_1 = 0 \\ pf_{x_2} - w_2 = 0 \\ pf_l - w_l = 0 \end{cases} \tag{A.2}$$

The total differentiation of the first order conditions and the production function leads to the following system:

$$\begin{cases} pf_{x_1x_1}dx_1 + pf_{x_1x_2}dx_2 + pf_{x_1l}dl = dw_1 - f_{x_1}dp \\ pf_{x_2x_1}dx_1 + pf_{x_2x_2}dx_2 + pf_{x_2l}dl = dw_2 - f_{x_2}dp \\ pf_{lx_1}dx_1 + pf_{lx_2}dx_2 + pf_{ll}dl = dw_l - f_l dp \\ f_{x_1}dx_1 + f_{x_2}dx_2 + f_l dl - dy = 0 \end{cases} \tag{A.3}$$

Solving the system (A.3), we obtain the comparative static of input and output optimal quantities[6]:

$$\begin{aligned} dx_1 = \frac{1}{D}\Big(& \left(f_{x_2x_2}f_{ll} - f_{x_2l}^2\right)dw_1 + \left(f_{x_2l}f_{x_1l} - f_{x_1x_2}f_{ll}\right)dw_2 + \left(f_{x_1x_2}f_{x_2l} - f_{x_1l}f_{x_2x_2}\right)dw_l \\ & + \left(f_{x_1}f_{x_2l}^2 - f_{x_1}f_{x_2x_2}f_{ll} + f_{x_2}f_{x_1x_2}f_{ll} - f_{x_2}f_{x_1l}f_{x_2l} + f_l f_{x_1l}f_{x_2x_2} - f_l f_{x_1x_2}f_{x_2l}\right)dp \Big) \end{aligned} \tag{A.4}$$

$$\begin{aligned} dx_2 = \frac{1}{D}\Big(& \left(f_{x_2l}f_{x_1l} - f_{x_1x_2}f_{ll}\right)dw_1 + \left(f_{x_1x_1}f_{ll} - f_{x_1l}^2\right)dw_2 + \left(f_{x_1x_2}f_{x_1l} - f_{x_2l}f_{x_1x_1}\right)dw_l \\ & + \left(f_{x_1}f_{x_1x_2}f_{ll} - f_{x_1}f_{x_1l}f_{x_2l} + f_{x_2}f_{x_1l}^2 - f_{x_2}f_{x_1x_1}f_{ll} + f_l f_{x_2l}f_{x_1x_1} - f_l f_{x_1x_2}f_{x_1l}\right)dp \Big) \end{aligned} \tag{A.5}$$

[5] The three input case is general enough for our purposes. Extension to the multi-input case is straightforward. On the other hand, extension to a multi-output framework is more complex but does not alter the conclusions derived from our simplified framework.

[6] To simplify the notations, we normalise the output price to unity.

$$dl = \frac{1}{D}\begin{pmatrix} \left(f_{x_1x_2} f_{x_2l} - f_{x_1l} f_{x_2x_2}\right)dw_1 + \left(f_{x_1x_2} f_{x_1l} - f_{x_2l} f_{x_1x_1}\right)dw_2 + \left(f_{x_1x_1} f_{x_2x_2} - f_{x_1x_2}^2\right)dw_l \\ + \left(f_{x_1} f_{x_1l} f_{x_2x_2} - f_{x_1} f_{x_1x_2} f_{x_2l} + f_{x_2} f_{x_2l} f_{x_1x_1} - f_{x_2} f_{x_1x_2} f_{x_1l} + f_l f_{x_1x_2}^2 - f_l f_{x_1x_1} f_{x_2x_2}\right)dp \end{pmatrix} \quad \text{(A.6)}$$

$$dy = \frac{1}{D}\begin{pmatrix} \left(f_{x_1}\left(f_{x_2x_2} f_{ll} - f_{x_2l}^2\right) + f_{x_2}\left(f_{x_2l} f_{x_1l} - f_{x_1x_2} f_{ll}\right) + f_l\left(f_{x_1x_2} f_{x_2l} - f_{x_1l} f_{x_2x_2}\right)\right)dw_1 \\ + \left(f_{x_1}\left(f_{x_2l} f_{x_1l} - f_{x_1x_2} f_{ll}\right) + f_{x_2}\left(f_{x_1x_1} f_{ll} - f_{x_1l}^2\right) + f_l\left(f_{x_1x_2} f_{x_1l} - f_{x_2l} f_{x_1x_1}\right)\right)dw_2 \\ + \left(f_{x_1}\left(f_{x_1x_2} f_{x_2l} - f_{x_1l} f_{x_2x_2}\right) + f_{x_2}\left(f_{x_1x_2} f_{x_1l} - f_{x_2l} f_{x_1x_1}\right) + f_l\left(f_{x_1x_1} f_{x_2x_2} - f_{x_1x_2}^2\right)\right)dw_l \\ + \begin{pmatrix} f_{x_1}^2\left(f_{x_2l}^2 - f_{x_2x_2} f_{ll}\right) + f_{x_2}^2\left(f_{x_1l}^2 - f_{x_1x_1} f_{ll}\right) + f_l^2\left(f_{x_1x_2}^2 - f_{x_1x_1} f_{x_2x_2}\right) \\ + 2 f_{x_1} f_{x_2}\left(f_{x_1x_2} f_{ll} - f_{x_1l} f_{x_2l}\right) + 2 f_{x_1} f_l\left(f_{x_1l} f_{x_2x_2} - f_{x_1x_2} f_{x_2l}\right) \\ + 2 f_{x_2} f_l\left(f_{x_2l} f_{x_1x_1} - f_{x_1x_2} f_{x_1l}\right) \end{pmatrix} dp \end{pmatrix} \quad \text{(A.7)}$$

with $D = f_{x_1x_1} f_{x_2x_2} f_{ll} - f_{x_1x_1} f_{x_2l}^2 - f_{x_2x_2} f_{x_1l}^2 - f_{ll} f_{x_1x_2}^2 + 2 f_{x_1x_2} f_{x_1l} f_{x_2l}$

This denominator is negative due to the concavity of the production function. One can easily check that input derived demand and output supply functions are homogenous of degree zero with respect to input and output producer prices. The supply function is non decreasing in output producer prices. Finally, input derived demands are non increasing in their own producer prices. In particular, land derived demand is non increasing with the producer price of land and by extension is non decreasing with the area direct payment.

In that simplified framework, yield labelled r is given by the ratio of output supply and land derived demand, so that its comparative static is given by:

$$dr = \frac{1}{Dl}\begin{pmatrix} \left(f_l - \frac{y}{l}\right)\begin{pmatrix} \left(f_{x_1x_2} f_{x_2l} - f_{x_1l} f_{x_2x_2}\right)dw_1 + \left(f_{x_1x_2} f_{x_1l} - f_{x_2l} f_{x_1x_1}\right)dw_2 + \left(f_{x_1x_1} f_{x_2x_2} - f_{x_1x_2}^2\right)dw_l \\ + \left(f_{x_1} f_{x_1l} f_{x_2x_2} - f_{x_1} f_{x_1x_2} f_{x_2l} + f_{x_2} f_{x_2l} f_{x_1x_1} - f_{x_2} f_{x_1x_2} f_{x_1l} + f_l f_{x_1x_2}^2 - f_l f_{x_1x_1} f_{x_2x_2}\right)dp \end{pmatrix} \\ + f_{x_1}\begin{pmatrix} \left(f_{x_2x_2} f_{ll} - f_{x_2l}^2\right)dw_1 + \left(f_{x_2l} f_{x_1l} - f_{x_1x_2} f_{ll}\right)dw_2 + \left(f_{x_1x_2} f_{x_2l} - f_{x_1l} f_{x_2x_2}\right)dw_l \\ + \left(f_{x_1} f_{x_2l}^2 - f_{x_1} f_{x_2x_2} f_{ll} + f_{x_2} f_{x_1x_2} f_{ll} - f_{x_2} f_{x_1l} f_{x_2l} + f_l f_{x_1l} f_{x_2x_2} - f_l f_{x_1x_2} f_{x_2l}\right)dp \end{pmatrix} \\ + f_{x_2}\begin{pmatrix} \left(f_{x_2l} f_{x_1l} - f_{x_1x_2} f_{ll}\right)dw_1 + \left(f_{x_1x_1} f_{ll} - f_{x_1l}^2\right)dw_2 + \left(f_{x_1x_2} f_{x_1l} - f_{x_2l} f_{x_1x_1}\right)dw_l \\ + \left(f_{x_1} f_{x_1x_2} f_{ll} - f_{x_1} f_{x_1l} f_{x_2l} + f_{x_2} f_{x_1l}^2 - f_{x_2} f_{x_1x_1} f_{ll} + f_l f_{x_2l} f_{x_1x_1} - f_l f_{x_1x_2} f_{x_1l}\right)dp \end{pmatrix} \end{pmatrix} \quad \text{(A.8)}$$

Despite the restrictions on the production function, it is not possible to determine unambiguously the impacts of each producer price on yield. For instance, let consider the output producer price effect to explain this ambiguity. An increase of this price would lead to an increase of production and simultaneously of land use if we assume that land is a normal factor. The total impact on yield depends of the relative strength of these two effects. If land derived demand is more output price responsive than other input derived demands, then it is likely that yield is decreasing in output producer price. Equation (A.8) also shows that yield depends on the land producer price, which includes the area direct payment. The expression of this effect is given by:

$$\frac{dr}{dw_l} = \frac{1}{Dl}\left(\left(f_l - \frac{y}{l}\right)\left(f_{x_1x_1}f_{x_2x_2} - f_{x_1x_2}^2\right) + f_{x_1}\left(f_{x_1x_2}f_{x_2l} - f_{x_1l}f_{x_2x_2}\right) + f_{x_2}\left(f_{x_1x_2}f_{x_1l} - f_{x_2l}f_{x_1x_1}\right)\right)$$
$$= \frac{1}{Dl}\left(\left(f_l - \frac{y}{l}\right)\frac{dl}{dw_l} + f_{x_1}\left(f_{x_1x_2}f_{x_2l} - f_{x_1l}f_{x_2x_2}\right) + f_{x_2}\left(f_{x_1x_2}f_{x_1l} - f_{x_2l}f_{x_1x_1}\right)\right) \quad \text{(A.9)}$$

Equation (A.9) shows that assuming that area direct payments do not influence yield requires the nullity of the right hand side. It definitely occurs if there are no substitution between land and other input ($f_{x_1l} = 0, f_{x_2l} = 0$) and if the marginal productivity of land is constant and equal to the average productivity ($f_l = \frac{y}{l}$, or equivalently, $f_{ll} = 0$). These assumptions contradict previous empirical findings of these technological relationships (for instance, see Hertel et al., 1996). Moreover, we must note that, with such restrictions on the production technology, the denominator D is null and the system can only be resolved in terms of dx_1, dx_2, dy.

To sum-up, specifications used by PE models that assume no direct payments effects in yield functions implicitly impose strong restrictions on the production technology: no substitution between land and other inputs and constant marginal productivity of land. With these specifications, the potential impacts of area direct payments are not fully taken into account.