A General Equilibrium Analysis of the Mid Term Review of the CAP on Italian Agriculture

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ISMEA

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1. Introduction

This paper investigates the impact of the mid term review of the Common Agricultural Policy (CAP) on Italian agriculture using a general equilibrium approach which determines the impact on the value and volume of the production for every economic sector, factor demand, market price; factor prices; and levels of well-being of agricultural, rural and urban households. The model refers to a walrasian economy where all markets are competitive, firms produce goods with the objective to maximize profits, families demand goods so as to maximize their welfare and production factors are remunerated at their marginal productivity.

The implementation of the CAP instruments and the introduction of price rigidities, both of goods and production factors, breaks apart this ideal environment. The paper first describe the main features of the model of the Italian economy by comparing it with existing agricultural models. The subsequent section describes the policy scenarios delineated by the Mid-term review of the CAP and presents the results of the simulations along with some discussion of policy implications.

2. An abridged comparison of AGE agricultural models

This section compares our Italian model developed for ISMEA, the Italian Research Institute for Agricultural Markets, with the French model MEGAAF (*Modèle of équilibre général de agricultures et de sourone français*) which is a well established general equilibrium model of the agricultural sector (De Muro e Salvatici 2001). The comparison is undertaken on the basis of a) the sector level of disaggregation, b) the specification of the supply and demand side of the economy, c) the institutional component. The ISMEA model includes 28 sectors. The aggregation of the agricultural sectors reproduces the aggregation of the Common Market Organizations (OCM) and reports the relevant agro-industrial sectors. The other sectors of the economy have been aggregated on the basis of the linkages with the primary sector. The aggregation of services reflects the aggregation reported in the ISMEA 1995 input/output table of Italian agriculture. The sectoral detail is as follows:

- 11 sectors for the primary block: [*(1) CEREALS, (2) VEGETABLES, (3)INDUSTRIAL CROPS, (4) VITICULTURE, (5) OLIVES, (6) FRUIT, (7) FLORICOLTURE, (8) MILK, (9) LIVESTOCK, (10) OTHER LIVESTOCK, (11) FISHING*];
- 8 sectors for the agricultural-and-food industry [*(12) FRESH MEATS, (13) MILK PRODUCTS, (14) BREAD, PASTA AND CEREAL TRANSFORMATION; (15) FRUIT AND VEGETABLES; (16) OIL AND FATS; (17) FEED; (18)OTHER FOOD INDUSTRIES;. (19) BEVERAGES*];
- 7 sectors for the non-agricultural-and-food industry [*(20) FUEL AND LUBRIFICANTS; (21) ENERGY; (22) WATER; (23) FERTILIZERS; (24) PESTICIDES; (25) OTHER CHEMICAL AND PHARMACEUTICAL PRODUCTS; (26)OTHER INDUSTRIES*];
- 2 sectors for services [*(27) TRANSPORTS AND COMMUNICATION, (28) OTHER SERVICES*].

Table 1 presents a description of these sectors.

Table 1 - Definition of the sectors

Primary sector		
1	*CEREALS*	Wheat, durum wheat, rice, corn and cereals, and other forage
2	*VEGETABLES*	Potatoes, tomatoes, other vegetables and legumes (beans, peas, garlic, cabbages, mushrooms...)
3	*INDUSTRIAL CROPS*	Sugar beet, soy bean, other industrial crops (hemp, linen, cotton, peanuts, sesame, other oil seeds), crude tobaccos
4	*VITICOLTURE*	Grapes
5	*OLIVE*	Olives
6	*FRUIT*	Citruses, fresh and dry fruit
7	*FLORICOLTURE*	Floricolture and other cultivations products (flowers and seeds, spices, sugar cane, coffee, seagrass and other vegetables)
8	*LIVESTOCK-MILK*	Milk
9	*LIVESTOCK-BEEF*	Livestock beef
10	*OTHER LIVESTOCK*	Trees, goat, pork, chicken, rabbits
11	*FISHING*	Fishing, sea products

agro-food sector		
12	*BEEF*	Fresh and stored beef
13	*MILK PRODUCTS*	Milk and milk products
14	*BREAD PASTA AND TRASF. CEREALS*	Cereal products, bread products and sweets, pasta products
15	*ORTO-FRUIT*	Conservation and transformation of fruit and vegetables
16	*OIL AND FATS*	Olive oil, seeds, oil and fats
17	*FEED*	Feed tobaccoes
18	*OTHER AGRO-FOOD IND*	Working of beets
19	*BEVERAGES*	Wine, other foods (alcoholic beverages, beer, non alcoholic beverages, tea, coffee...)

Other industries sector		
20	*FUEL AND LUBRIF*	Fuel and lubrificants
21	*ENERGY*	Electric power
22	*WATER*	Water
23	*FERTILIZERS*	Fertilizers
24	*PESTICIDES*	Pesticides
25	*OTHER CHEMICAL AND PHARMACEUTICAL PROD*	Other chemical and pharmaceutical products
26	*HEAVY INDUSTRY*	Maintenance, other industrial products, agricultural and industrial machinery, constructions and public works, other industrial productions (products of iron and steel, glass, motor vehicles, ships, aircrafts, spinning and webbing, footwear, furniture...)

Services sector		
27	*TRCOMUNCRINS*	Transports and communication, credit and insurance
28	*OTHER SERVICES*	Other services (business, hotels and public services, leisure and cultural services, general services of P.A., public and private health services…)

As a term of comparison, the MEGAAF Model describes the French economy distinguishing 22 productive activities originating 30 products. The agricultural sector is described by 9 primary sectors supplying 14 different goods. Agro-industry covers 6 activities supplying 11 food items.

The specification of demand and supply is standard. Both the ISMEA and the MEGAAF model describe technologies and preferences using constant elasticity of substitution (CES) type of functions. On the consumption side, the ISMEA model differently from MEGAAF model leisure explicitly within the household utility function. This structure exploit a feature of the ISMEA cross-section data base which reports a stylized time use survey.

The remaining term of comparison refers to the aggregation of the institutional component. Our model for ISMEA presents the characteristics and the consumption habits of the agricultural household types that have been derived from the cluster analysis of the ISMEA micro data. Our social accounting is further articulated into a rural class and three urban classes graduated in terms of income levels. This classification permits an accurate distributional analysis of the impact of agricultural policies upon policy relevant farm-household typologies. The household types are defined as follows:

Table 2.2 - Composition of the 11 household classe

AgriculturalFarm-households	*Not agricultural*	
	Rural	*Urban*
(i) farm-households with limited resources	*(viii) rural*	*(ix) high income*
(ii) farm-households retired		*(x) mid income*
(iii) residential farm-households		*(xi) low income*
(iv) professional farm-households with low work remuneration		
(v) professional farm-households with high work remuneration		
(vi) large farm-households		
(vii) very large farm-households		

Another differential aspect concerning the derivation of the behavioural parameters used in the AGE model is of interest. A relevant feature of the ISMEA model is that it uses behavioural parameters estimated from the same data set used for the construction of the ISMEA 1995 Input/Output Table. The fact that the model can econometrically estimate the parameters used in the behavioural functions effectively links the macro model to the micro level of the analysis. The construction of this micro-macro relationship exploits a feature of the micro data that was designed to specifically implement the micro-macro link using exact aggregation theory and to provide sound micro-foundations to the macro model. The ISMEA 1995 survey about the socio-economic conditions of Italian agriculture was designed on the basis of a household collective model of the farm-household aiming at anticipating the real demand for information necessary to estimate the technology of

domestic and farm production along with the consumption preferences of the household. The ISMEA approach encompasses 5 survey types in one: (a) Farm budget data, (b) Input/Output, (c) Time Use Budget, (d) Household Consumption Survey, (e) Household Income Survey.

3. The Mid Term Revision

The present work simulates the impacts of the policy scenarios delineated in the mid-term review of the CAP as approved at the end of June, 2003. The reform can be summarized in three main pillars:

1) modifications of the market policies through variations of the intervention prices and/or variations of the existing premiums or introduction of new premiums for some products;
2) decoupling of the premiums: decoupling introduces a single payment per farm starting from year 2005, whose amount equals the mean of the direct payments received by the farm during the years 2000-2002;
3) modulation and degressivity of the premiums: all direct payments given to farmers (the single decoupled payment and specific payments for drum wheat, protein crops, rice, fruits in shell, olive oil, tobacco) will be reduced in the period 2005-2012 in the proportion of 3% in 2005, 4% in 2006, and 5% from 2007 to 2012. Premiums below 5000 euros are exempted.

a. Scenario A

Our ex-ante situation refers to the premiums established by Agenda 2000 in its full implementation. This information has been constructed using a non-behavioral model that has been updated from the 1995 to the 2001 situation and incorporated in our Agenda 2000 situation as implemented in year 2001. This is the benchmark against which we evaluate the effects due to the introduction of the reform as described in the following scenarios.

b. Scenario B

This scenario considers changes in the market policies introduced with the Mid Term Review. The proposed policy instruments are variations in the levels of intervention prices and premiums. The effects are evaluated with respect to scenario A depicting the ex-ante situation of Agenda 2000. The variation of the intervention price for a certain good is introduced through a change in both the intervention price and the import price since we assume that the CAP significantly affects the European market. Because for every good a certain degree of gradualism in the modification of the premiums is anticipated, the scenario identifies a theoretical situation of full implementation of the reform of the market policies for all the goods involved. It follows that there is not a common reference year for scenario B. The prices of the products not touched by the reform are left unchanged. It is therefore an abstract scenario also because it consider only market interventions without accounting for either decoupling or degressivity schemes. In detail, the B scenario for each product assumes the following:

4) Cereals, oil seeds, hay and set-aside: the premium remains the same as in scenario A.

5) Durum wheat: the base premium remains the same as for scenario A; a reduction of the additional premium for the traditional areas from 344.5 euros/ha to 285 euros/ha and elimination of the premium for the normal areas contemplating a gradual reduction within the years 2004-2006; in the B scenario we consider the final year; introduction of an incentive for quality of 40 euros/ha in the traditional areas.
6) Protein crops: the base premium remains the same as for scenario A; introduction of an additional premium of 55.57 euros/ha.
7) Forage: introduction of a direct subsidy to farmers by sharing the national amount of 160 million euros; we assume a premium of 272.3 based on the distribution of farmers producing forage.
8) Rice:
    - Reduction of the intervention price by 50% from 2004.
    - A compensation corresponding to an increase of the premium from 52 euros/ton to 177 euros/ton from 2004; hence, a constant productivity of 6.04 tons/ha the premium is: 177 euros/ton x 6.04 tons/ha = 1069.08 euro/ha.
9) Milk:
    - reduction of the intervention price of cream powder milk by 15 % and butter by 25%;
    - introduction of a premium determined on the basis of the milk quota assigned to the farm.

For all the other products, we do not consider any change in prices and premiums.

The simulation is performed as follows:

1) determination of the level of the premiums received by each sector of the general equilibrium model. To do this, we first compute using the policies described in scenario B the level of premiums received by each farm of the ISMEA sample, then we report them to the universe;
2) for the change in the intervention price of butter, we consider both the change of the intervention price, which exerts a negligible impact on the “milk and derived products” sector, because the relative weight of the stocks of butter with respect to its level of production is small, and of import prices. We make the hypothesis of a 6.1% reduction for the whole sector, given by the weighted mean of the reduction of import prices for the various goods;
3) we do not consider the change in intervention price of cream powder milk because it is not produced in Italy;
4) For the intervention price of rice, we assume that it has no impact on the cereals sector. This is because the share of the stocks of rice is insignificant with respect to the total level of cereals production and because a change in the import price of rice would still have a negligible impact considering the small share of rice imports.

As done for scenario A, scenario B also models premiums as coupled to the level of production and/or the level of factors, such as land or livestock heads, used. The only exception regards the "milk" sector, where the premium received by each farm is computed from the own quota and is therefore independent from production levels and quantity of factors demanded. The First Order Conditions for the profit maximization relative to factor demands are:

$$\begin{cases} Pva_i \cdot VA_i = \alpha_{Xs_i} \cdot Pd_i \cdot Xs_i \cdot \left(1 - \tau_{p_i} + c_{p_i}\right) \\ FACTd_{i,f} = \left(\alpha_{VA_i}\right)^{\sigma_{VA_i}} \cdot \left(\frac{Pva_i}{w_f - c_{i,f}}\right)^{\sigma_{VA_i}} \cdot VA_i \end{cases}$$

where $c_{p,i}$ represents the payment (in percentage form) received by sector *i* for each unit of product, and $c_{i,f}$ represents the payment received by sector *i* for each factor unit *f* used. For those sectors for which payments are determined on the basis of production levels we assume that $c_{i,f} = 0$. It is important to note that an increase in production payments (c_{p_i}) in a given sector determines an increase in the demand of all factors used by that sector and consequently of its added value and production level. On the other hand, an increase in factor payments ($c_{i,f}$) determines an increase only in that factor demand. Scenario B incorporates:

- A change in premium (+43%) for the cereal sector, where the premium is partially coupled to the amount of hectares cropped;
- Introduction of a premium for the "milk" sector on the basis of the milk quota owned by the farm which is therefore decoupled from the milk quantity produced;
- A 6.1% reduction of the import price in the "milk and derived products" sector.

Results of Scenario B

The simulation results of Scenario B are reported in Table 1. Inspection of the table reveals a significant increase in cereals production (+10%). This effect also influences the production of related sectors such as "bread, pasta and transformed cereals" (+3%) and "feed" (+7%). Production decreases in the "vegetables", "industrial crops", "viticulture", "olive" and "fruit" sectors because of the negative impact on factors demand due to the evolution of factor prices especially the large increase in the land price. The changes in product prices, that is in the levels of equilibrium prices in the domestic market, depend on supply changes. The impact on consumption prices is small because the consumption price is the average between the domestic and import price. The impact on exports and imports levels and on consumer and producer prices are also reported in Table 1. Table 2 shows the impact on factors demand.

Table 1 - Scenario B

Impact on production, exports, imports and prices, for the 28 sectors (in % variation)

	Production	Exports	Imports	Consumer prices	Producer prices
CEREALS	9.72	21.54	-5.53	-8.43	-9.66
VEGETABLES	-6.72	-7.59	-1.80	3.44	3.61
INDUSTRIAL CROPS	-6.40	-10.29	1.25	2.59	5.15
VITICOLTURE	-2.48	-5.95	1.97	2.68	2.70
OLIVE	-2.87	-6.35	1.21	2.91	2.92
FRUIT	-4.71	-5.29	-1.44	2.15	2.34
FLORICOLTURE	-4.59	-6.59	0.47	1.14	3.05
MILK	1.79	2.48	-0.55	-1.43	-1.62
BEEF	3.84	6.81	-1.51	-3.22	-3.63
OTHER LIVESTOCK	3.99	6.08	-0.91	-2.62	-3.30
FISHING	-0.07	-0.01	-0.64	-0.31	-0.40
MEAT	1.37	1.60	-0.36	-1.04	-1.19
MILK AND MILK PRODUCTS	0.96	0.78	9.26	-1.60	-0.79
BREAD PASTA TRASF. CEREALS	2.85	3.13	0.00	-1.87	-1.93
ORTO-FRUIT	-1.11	-1.53	-0.35	0.28	0.37
OILS AND FATS	-1.65	-2.80	0.03	0.74	1.02
FEED	6.55	10.09	-1.28	-4.21	-5.08
OTHER FOOD INDUSTRIES	-1.24	-1.36	-0.85	0.24	0.28
BEVERAGES	-0.29	-0.51	-0.48	-0.14	-0.15
FUEL E LUBRIF.	-0.04	-0.11	-0.54	-0.29	-0.35
ELECTRIC POWER	0.01	-0.16	-0.45	-0.28	-0.32
WATER	0.40	-0.20		-0.31	-0.31
FERTILIZERS	-0.70	-0.16	-1.16	-0.32	-0.32
PESTICIDES	-0.95	-0.15	-1.73	-0.20	-0.33
OTHER CHEM. AND PHARM. PROD.	-0.09	-0.15	-0.55	-0.23	-0.33
OTHER INDUSTRIES	0.02	-0.09	-0.46	-0.29	-0.36
TRANS. - COMM. - CRED. - INS.	-0.05	-0.05	-0.59	-0.36	-0.38
OTHER SERVICES	-0.06	-0.06	-0.59	-0.36	-0.38

Table 2 - Scenario B

Impact on factor demand

	Dependent labour - %	Farm labour %	Capital %	Land %
CEREALS	1.62	2.93	1.51	20.86
VEGETABLES	-3.57	-2.32	-3.67	-9.39
INDUSTRIAL CROPS	-2.17	-0.90	-2.27	-10.70
VITICOLTURE	0.04	1.34	-0.06	-6.08
OLIVE	-0.20	1.09	-0.30	-6.23
FRUIT	-2.50	-1.24	-2.60	-8.40
FLORICOLTURE	-2.05	-0.78	-2.15	-8.04
MILK	-1.54	-0.26	-1.64	-7.93
BEEF	0.32	1.62	0.21	-5.82
OTHER LIVESTOCK	0.71	2.01	0.61	-5.63
FISHING	0.00		-0.10	
MEAT	0.63		0.53	
MILK AND MILK PRODUCTS	0.63		0.53	
BREAD PASTA TRASF. CEREALS	1.34		1.23	
ORTO-FRUIT	-0.28		-0.38	
OILS AND FATS	-0.18		-0.28	
FEED	1.62		1.51	
OTHER FOOD INDUSTRIES	-0.50		-0.60	
BEVERAGES	0.02		-0.08	
FUEL E LUBRIF.	0.07		-0.03	
ELECTRIC POWER	0.15		0.04	
WATER	0.56		0.45	
FERTILIZERS	-0.55		-0.66	
PESTICIDES	-0.81		-0.92	
OTHER CHEM. AND PHARM. PROD.	0.04		-0.06	
OTHER INDUSTRIES	0.13		0.02	
TRANSP. - COMM. - CRED. - INS.	0.04		-0.06	
OTHER SERVICES	0.03		-0.07	

The change in the levels of premiums and payments affects factor demands and, consequently, their prices. The increase in the payments in the "cereals" coupled to the land area allocated to cereal crops has a strong impact on the demand for land and therefore in its value (+7%). Relevant is also the decrease on farm wages (-2%).

Table 3 - Scenario B
Impact on the price of factors of production (in %)

Dependent labour	-0.48
Farm labour	-2.00
Capital	-0.35
Land	7.24
Milk	-2.31
Beef	-0.09
Other Livestock	0.23

Table 4 presents the impacts on the land allocation decision per each sector.

Table 4 - Scenario B
Percentage change in land allocation

	Benchmark	Simulation
CEREALS	97.58	97.65
VEGETABLES	99.05	99.06
INDUSTRIAL CROPS	96.88	96.97
VITICOLTURE	98.70	98.86
OLIVE	99.46	99.49
FRUIT	99.70	99.73
FLORICOLTURE	96.76	96.92
MILK	94.95	95.78
LIVESTOCK BEEF	96.55	96.71
OTHER LIVESTOCK	96.18	96.67

Changes in factors remuneration determines different impacts on the levels of available income, aggregate consumption, leisure, and welfare of the selected household types as described in the following table. In general, agricultural households gain from the changes in agricultural policies described in scenario B, while rural and urban households suffer negligible losses.

Table 5 - Scenario B

Impact on agricultural, rural and urban households (in %)

	Available income	Aggregate consumption	Leisure	Welfare
Limited resources	0.40	0.79	0.89	0.85
Retirement	0.32	0.64	0.82	0.77
Residential	0.40	0.75	0.91	0.81
Professional with low work remuneration	-0.01	0.37	0.51	0.41
Professional with high work remuneration	0.88	1.28	1.40	1.29
Large	0.29	0.65	0.81	0.68
Very large	0.22	0.55	0.74	0.62
Rural	-0.60	-0.25	-0.09	-0.17
High income	-0.57	-0.32	-0.06	-0.15
Mid income	-0.58	-0.32	-0.06	-0.17
Low income	-0.58	-0.32	-0.06	-0.19

c. Scenario C (decoupled, without degressivity)

In this scenario we simulate the impact of the implementation of the decoupled scheme without considering degressivity. The June 2003 decision gave to the member countries the opportunity to apply the decoupling mechanism only partially for selected products. Several sub-scenarios to compute the amount of the single payment are admissible:

- Sub-scenario C1:
  - mais, other cereals, oil seeds, hay, forage, legumes, set-aside, beef, sheep and goats, milk (starting from 2007): premiums are provided in a single payment as for scenario B;
  - durum wheat: in the single payment the quality premium of 40 euros is not included and remains coupled;
  - protein crops: in the single payment the additional premium of 55.57 euro/ha is not included and remains coupled;
  - rice: in the single payment there is only a portion: 102 euro/t x 6.04 t/ha = 616.08; the remaining 453 euros/ha remain coupled;
  - olive oil: the premium remains coupled though the Commission is oriented to turn them into a single decoupled payment.

- Sub-scenario C2 (partial decoupling) - computation of the single payment in the case Italy decided to maintain it coupled:
  - 25% of payments per hectare of cereals,
  - 50% of direct payments for sheep and goats,
  - 100% of premium for milking cow and 40% of slaughtering premium.

- Sub-scenario C3 (partial decoupling) - computation of the single payment in the case Italy decided to maintain it coupled:
  - 40% of supplementary payments per hectare of durum wheat,
  - 50% of direct payments for sheep and goats,
  - 75% of special premium for male livestock.

The introduction of the single decoupled premium determines a modification of the profit function which becomes:

$$Pd_i \cdot Xs_i \cdot \left(1 - \tau_{p_i} + c_{p_i}\right) + Cfix_i - \left[Pva_i \cdot VA_i + P\text{int}_i \cdot INTtot_i\right]$$

where $Cfix_i$ represents the single decoupled premium received by the *i*-th sector. Because this premium is not coupled neither to production nor to the level of factor use, the first order conditions for profit maximization remain the same. Consequently, the decoupled premium represents the extra-profit received by the sector, which is divided among households in proportion to the share of owned land.

Short comment of results: Sub-scenario C1

The results of the simulation can be compared with the simulation results related to scenario A. Buy so doing it is possible to analyze jointly the impacts stemming from the introduction of new premiums and the decoupling scheme. The fact that in the "cereals", "other industrial crops", "beef" and "other livestock" sectors the premium is no longer linked to production levels or factor uses causes a significant reallocation of resources across sectors. As it is reasonable to expect, the sectors which are greatly affected, in terms of reduction in production, are those where decoupling is applied because for these sectors it is no longer convenient to keep a high level of production. The direct effect stemming from decoupling is the significant reduction in the demand for land allocated to cereals. This fact determines a notable reduction in the price of land (-10%) and, consequently, an increase in the land demanded by other sectors. Redistribution of land, and in turn of the production levels of the agricultural sectors, is one of the more meaningful results induced by the reform. Table 1-C1 shows the results relative to the impact on production, on exports and imports, and prices for each sector of the model. The subsequent table shows the impact on factor demand.

Table 1 - Scenario C1

Impact on production, exports, imports and prices, for the 28 sectors
(in % variation with respect to the same results of scenario A)

	Production in quantity	Exports in quantity	Imports in quantity	Consumption prices	Production prices
CEREALS	-15.53	-29.90	10.09	16.80	19.80
VEGETABLES	10.59	12.35	2.08	-5.14	-5.37
INDUSTRIAL CROPS	-3.65	-5.96	1.51	1.74	3.44
VITICOLTURE	3.64	9.53	-3.51	-4.14	-4.16
OLIVE	3.38	10.18	-3.12	-4.43	-4.44
FRUIT	7.27	8.44	1.53	-3.40	-3.68
FLORICOLTURE	7.16	10.48	-1.07	-1.77	-4.57
MILK	-3.19	-5.34	1.13	2.72	3.09
BEEF	-6.81	-11.65	2.27	5.89	6.71
OTHER LIVESTOCK	-7.04	-10.73	1.31	4.82	6.16
FISHING	-0.01	0.15	0.31	0.18	0.23
MEAT	-2.41	-2.82	0.05	1.52	1.75
MILK AND MILK PRODUCTS	-1.39	-1.19	-0.12	0.77	0.91
BREAD PASTA TRASF. CEREALS	-5.21	-5.61	-0.74	3.15	3.24
ORTO-FRUIT	1.63	2.37	-0.04	-0.65	-0.86
OILS AND FATS	1.25	2.88	-0.67	-0.80	-1.11
FEED	-10.97	-16.37	1.96	7.89	9.68
OTHER FOOD INDUSTRIES	-0.65	-0.50	0.14	0.49	0.56
BEVERAGES	0.23	0.61	0.17	0.00	0.00
FUEL E LUBRIF.	0.05	0.21	0.33	0.17	0.20
ELECTRIC POWER	0.09	0.24	0.35	0.16	0.19
WATER	0.93	0.26		0.18	0.18
FERTILIZERS	0.65	0.24	0.91	0.18	0.18
PESTICIDES	1.17	0.24	1.81	0.11	0.19
OTHER CHEM. AND PHARM. PROD.	0.07	0.24	0.28	0.13	0.18
OTHER INDUSTRIES	0.13	0.18	0.42	0.17	0.21
TRANS. - COMM. - CRED. - INS.	0.04	0.22	0.29	0.19	0.20
OTHER SERVICES	0.04	0.17	0.35	0.21	0.22

Table 2 - Scenario C1

Impact on factor demand of the 28 sectors
(in % variation with respect to the results of scenario A)

	Dependent labour	Independent labour	Capital	Land
CEREALS	-2.66	-4.21	-2.68	-28.91
VEGETABLES	5.50	3.82	5.47	15.33
INDUSTRIAL CROPS	-1.17	-2.75	-1.20	-5.68
VITICOLTURE	-0.04	-1.64	-0.07	9.44
OLIVE	-0.51	-2.10	-0.53	8.78
FRUIT	3.85	2.19	3.82	13.55
FLORICOLTURE	3.31	1.66	3.28	13.12
MILK	3.28	1.63	3.26	13.95
BEEF	-0.45	-2.04	-0.48	9.01
OTHER LIVESTOCK	-1.05	-2.63	-1.08	8.73
FISHING	0.01		-0.02	
MEAT	-0.91		-0.94	
MILK AND MILK PRODUCTS	-0.70		-0.73	
BREAD PASTA TRASF. CEREALS	-2.34		-2.36	
ORTO-FRUIT	0.55		0.52	
OILS AND FATS	-0.08		-0.11	
FEED	-2.55		-2.58	
OTHER FOOD INDUSTRIES	-0.31		-0.33	
BEVERAGES	0.02		0.00	
FUEL E LUBRIF.	0.04		0.01	
ELECTRIC POWER	0.07		0.04	
WATER	0.90		0.87	
FERTILIZERS	0.63		0.60	
PESTICIDES	1.15		1.12	
OTHER CHEM. AND PHARM. PROD.	0.04		0.02	
OTHER INDUSTRIES	0.14		0.11	
TRANSP. - COMM. - CRED. - INS.	0.03		0.01	
OTHER SERVICES	0.05		0.02	

In addition to the reduction of the value of land, it is interesting to note that the reduction of the value of the livestock considering that decoupling involves in particular the “livestock” and “other livestock” sectors. As a consequence, the reduction in the demand for livestock implies a reduction of its value.

Table 3 - Scenario C1

Impact on the price of production factors
(in % variation with respect to results of scenario A)

Dependent labour	0.20
Farm labour	2.16
Capital	0.24
Land	-9.95
Milk	4.17
Livestock	-8.81
Other livestock	-38.05

The following table shows the impacts on farmers' land allocation per agricultural sector.

Table 4 - Scenario C1

Percentage of land used in production

	Benchmark	Simulation
CEREALS	97.58	97.46
VEGETABLES	99.05	99.04
INDUSTRIAL CROPS	96.88	96.72
VITICOLTURE	98.70	98.42
OLIVE	99.46	99.43
FRUIT	99.70	99.64
FLORICOLTURE	96.76	96.46
MILK	94.95	93.37
LIVESTOCK BEEF	96.55	96.24
OTHER LIVESTOCK	96.18	95.28

Impacts on the available income, aggregate consumption, leisure consumption and welfare levels of the agricultural, rural and urban household types are shown in the following table. As for scenario B, agricultural households gain from the changes in agricultural policies described in scenario C, while rural and urban households suffer negligible losses. With respect to scenario B, though, all households types are better-off. Therefore, the social state associated with scenario C is welfare improving from the Italian society's stand point.

Table 5 - Scenario C1

Impact on agricultural, rural and urban households
(in % variation with respect to results of scenario A)

	Available income	Aggregate consumption	Leisure	Welfare
Limited resources	1.28	0.87	1.10	1.01
Retirement	1.19	0.91	1.00	0.97
Residential	1.29	0.99	1.11	1.03
Professional with low work remuneration	0.81	0.48	0.64	0.53
Professional with high work remuneration	1.86	1.49	1.72	1.51
Large	1.15	0.85	0.98	0.87
Molto large	1.08	0.81	0.89	0.84
Rural	0.09	-0.22	-0.09	-0.15
High income	0.13	-0.02	-0.08	-0.06
Mid income	0.11	-0.05	-0.10	-0.08
Low income	0.12	-0.05	-0.09	-0.07

Results: Sub-scenario C2

Table 1 - Scenario C2

Impact on production, exports, imports and prices, for the 28 sectors
(in % variation with respect to results of scenario A)

	Production	Exports	Imports	Consumer prices	Producer prices
CEREALS	-12.64	-24.77	8.06	13.29	15.60
VEGETABLES	9.01	10.51	1.78	-4.42	-4.62
COLTIVAZIONI INDUSTRIALI	-4.79	-7.82	1.82	2.24	4.43
VITICOLTURE	3.14	8.13	-2.97	-3.55	-3.57
OLIVE	2.86	8.67	-2.71	-3.81	-3.82
FRUIT	6.21	7.21	1.32	-2.91	-3.16
FLORICOLTURE	6.13	8.93	-0.89	-1.52	-3.93
MILK	-2.52	-4.20	0.91	2.15	2.44
BEEF	-5.46	-9.38	1.84	4.68	5.33
OTHER LIVESTOCK	-5.64	-8.62	1.07	3.83	4.89
FISHING	-0.02	0.13	0.27	0.16	0.20
MEAT	-1.92	-2.24	0.07	1.23	1.41
MILK AND MILK PRODUCTS	-1.10	-0.92	-0.07	0.63	0.73
BREAD PASTA TRASF. CEREALS	-4.18	-4.49	-0.56	2.53	2.60
ORTO-FRUIT	1.40	2.03	-0.01	-0.55	-0.73
OILS AND FATS	1.02	2.34	-0.52	-0.64	-0.88
FEED	-8.88	-13.33	1.60	6.29	7.70
OTHER FOOD INDUSTRIES	-0.87	-0.76	0.06	0.57	0.65
BEVERAGES	0.23	0.57	0.16	-0.01	-0.02
FUEL E LUBRIF.	0.04	0.18	0.29	0.15	0.18
ELECTRIC POWER	0.08	0.20	0.32	0.14	0.17
WATER	0.83	0.22		0.16	0.16
CONCIMI	0.57	0.21	0.80	0.16	0.16
PESTICIDI	0.98	0.21	1.53	0.10	0.17
OTHER CHEM. AND PHARM. PROD.	0.06	0.21	0.25	0.11	0.16
OTHER INDUSTRIES	0.11	0.16	0.37	0.15	0.19
TRANS. - COMM. - CRED. - INS.	0.04	0.19	0.26	0.17	0.17
OTHER SERVICES	0.04	0.15	0.31	0.18	0.19

Table 2 - Scenario C2

Impact on the demand of the 28 sectors
(in % variation with respect to results of scenario A)

	Dependent work	Farm work	Capital	Land
CEREALS	-2.13	-3.47	-2.16	-23.95
VEGETABLES	4.69	3.25	4.66	13.00
COLTIVAZIONI INDUSTRIALI	-1.57	-2.92	-1.60	-7.59
VITICOLTURE	-0.01	-1.38	-0.04	8.06
OLIVE	-0.47	-1.83	-0.49	7.44
FRUIT	3.29	1.87	3.26	11.51
FLORICOLTURE	2.85	1.43	2.82	11.16
MILK	2.63	1.22	2.60	11.63
BEEF	-0.34	-1.71	-0.37	7.72
OTHER LIVESTOCK	-0.81	-2.17	-0.84	7.52
FISHING	0.01		-0.02	
MEAT	-0.72		-0.75	
MILK AND MILK PRODUCTS	-0.55		-0.58	
BREAD PASTA TRANSF. CEREALS	-1.87		-1.90	
ORTO-FRUIT	0.48		0.45	
OILS AND FATS	-0.06		-0.09	
FEED	-2.04		-2.07	
OTHER FOOD INDUSTRIES	-0.40		-0.43	
BEVERAGES	0.04		0.01	
FUEL E LUBRIF.	0.04		0.01	
ELECTRIC POWER	0.07		0.04	
WATER	0.81		0.78	
FERTILIZERS	0.55		0.52	
PESTICIDES	0.97		0.94	
OTHER CHEM. AND PHARM. PROD.	0.04		0.01	
OTHER INDUSTRIES	0.12		0.09	
TRANSP. - COMM. - CRED. - INS.	0.03		0.00	
OTHER SERVICES	0.05		0.02	

Table 3 - Scenario C2

Impact on the productive factors price
(% variation with respect to results of scenario A)

Dependent work	0.18
Farm work	1.86
Capital	0.22
Land	-8.58
Milk	3.35
Beef	-5.65
Other Livestock	-30.03

Table 4 - Scenario C2

Percentage change in land allocation

	Benchmark	Simulation
CEREALS	97.58	97.48
VEGETABLES	99.05	99.04
COLTIVAZIONI INDUSTRIALI	96.88	96.75
VITICOLTURE	98.70	98.46
OLIVE	99.46	99.43
FRUIT	99.70	99.65
FLORICOLTURE	96.76	96.51
MILK	94.95	93.62
LIVESTOCK BEEF	96.55	96.29
OTHER LIVESTOCK	96.18	95.43

Table 5 - Scenario C2

Impact on households
(in % variation with respect to results of scenario A)

	Available income	Aggregate consumption	Leisure	Welfare
Limited resources	1.16	0.82	1.00	0.93
Retirement	1.08	0.84	0.90	0.89
Residential	1.17	0.91	1.01	0.94
Professionals with low labour wage	0.73	0.45	0.58	0.49
Professionals with high labour wage	1.68	1.38	1.55	1.39
Large	1.04	0.79	0.89	0.81
Very large	0.97	0.75	0.80	0.77
Rural	0.08	-0.18	-0.09	-0.13
High income	0.11	-0.02	-0.07	-0.05
Mid income	0.10	-0.04	-0.09	-0.07
Low income	0.10	-0.04	-0.08	-0.06

Results: Sub-scenario C3

Table 1 - Scenario C3

Impact on production, exports, imports and prices, for the 28 sectors
(% variation with respect to results of scenario A)

	Production	Exports	Imports	Consumer prices	Producer prices
CEREALS	-11.80	-23.23	7.48	12.30	14.42
VEGETABLES	8.54	9.96	1.69	-4.20	-4.39
COLTIVAZIONI INDUSTRIALI	-5.14	-8.37	1.91	2.39	4.74
VITICOLTURE	2.99	7.70	-2.81	-3.37	-3.39
OLIVE	2.70	8.22	-2.58	-3.62	-3.63
FRUIT	5.89	6.83	1.26	-2.77	-3.00
FLORICOLTURE	5.81	8.46	-0.83	-1.44	-3.73
MILK	-2.33	-3.88	0.85	1.99	2.26
BEEF	-5.07	-8.72	1.72	4.34	4.94
OTHER LIVESTOCK	-5.23	-8.01	1.01	3.55	4.53
FISHING	-0.02	0.13	0.26	0.15	0.19
MEAT	-1.78	-2.07	0.08	1.14	1.32
MILK AND MILK PRODUCTS	-1.02	-0.85	-0.05	0.58	0.69
BREAD PASTA TRASF. CEREALS	-3.88	-4.17	-0.51	2.35	2.42
ORTO-FRUIT	1.33	1.93	0.00	-0.52	-0.69
OILS AND FATS	0.94	2.18	-0.47	-0.59	-0.81
FEED	-8.27	-12.44	1.50	5.84	7.14
OTHER FOOD INDUSTRIES	-0.93	-0.84	0.04	0.60	0.68
BEVERAGES	0.23	0.55	0.16	-0.02	-0.02
FUEL E LUBRIF.	0.04	0.17	0.28	0.14	0.18
ELECTRIC POWER	0.08	0.19	0.31	0.14	0.16
WATER	0.81	0.21		0.15	0.15
FERTILIZERS	0.54	0.20	0.77	0.16	0.16
PESTICIDES	0.93	0.20	1.45	0.10	0.16
OTHER CHEM. AND PHARM. PROD.	0.06	0.20	0.24	0.11	0.16
OTHER INDUSTRIES	0.11	0.15	0.36	0.15	0.18
TRANS. - COMM. - CRED. - INS.	0.04	0.18	0.25	0.16	0.17
OTHER SERVICES	0.03	0.15	0.30	0.18	0.19

Table 2 - Scenario C3

Impact on the demand of the 28 sectors
(in % variation with respect to results of scenario A)

	Dependent work	Farm work	Capital	Land
CEREALS	-1.97	-3.25	-2.00	-22.47
VEGETABLES	4.45	3.09	4.42	12.30
COLTIVAZIONI INDUSTRIALI	-1.69	-2.97	-1.72	-8.17
VITICOLTURE	0.00	-1.30	-0.03	7.65
OLIVE	-0.46	-1.75	-0.49	7.04
FRUIT	3.13	1.78	3.09	10.90
FLORICOLTURE	2.71	1.37	2.67	10.57
MILK	2.44	1.11	2.41	10.95
BEEF	-0.30	-1.60	-0.33	7.33
OTHER LIVESTOCK	-0.74	-2.04	-0.77	7.16
FISHING	0.00		-0.03	
MEAT	-0.66		-0.69	
MILK AND MILK PRODUCTS	-0.51		-0.54	
BREAD PASTA TRASF. CEREALS	-1.73		-1.76	
ORTO-FRUIT	0.46		0.43	
OILS AND FATS	-0.06		-0.09	
FEED	-1.89		-1.92	
OTHER FOOD INDUSTRIES	-0.43		-0.46	
BEVERAGES	0.04		0.01	
FUEL E LUBRIF.	0.04		0.01	
ELECTRIC POWER	0.07		0.04	
WATER	0.78		0.75	
FERTILIZERS	0.53		0.49	
PESTICIDES	0.91		0.88	
OTHER CHEM. AND PHARM. PROD.	0.04		0.01	
OTHER INDUSTRIES	0.12		0.09	
TRANSP. - COMM. - CRED. - INS.	0.03		0.00	
OTHER SERVICES	0.04		0.01	

Table 3 - Scenario C3

Impact on the productive factors price
(% variation with respect to results of scenario A)

Dependent work	0.17
Independent work	1.76
Capital	0.21
Land	-8.17
Milk	3.12
Beef	-6.22
Other Livestock	-29.98

Table 4 - Scenario C3

Percentage change in land allocation

	Benchmark	Simulation
CEREALS	97.58	97.48
VEGETABLES	99.05	99.04
COLTIVAZIONI INDUSTRIALI	96.88	96.75
VITICOLTURE	98.70	98.48
OLIVE	99.46	99.44
FRUIT	99.70	99.65
FLORICOLTURE	96.76	96.52
MILK	94.95	93.70
LIVESTOCK	96.55	96.31
OTHER LIVESTOCK	96.18	95.47

Table 5 - Scenario C3

Impact on households
(% variation with respect to results of scenario A)

	Available income	Aggregate consumption	Leisure	Welfare
Limited resources	1.13	0.81	0.97	0.91
Retirement	1.05	0.83	0.88	0.87
Residential	1.14	0.89	0.98	0.92
Professionals with low labour remuneration	0.71	0.45	0.56	0.48
Professionals with high labour remuneration	1.64	1.35	1.51	1.37
Large	1.01	0.77	0.86	0.79
Very large	0.95	0.73	0.78	0.75
Rural	0.07	-0.18	-0.08	-0.13
High income	0.11	-0.02	-0.07	-0.05
Mid income	0.09	-0.04	-0.09	-0.07
Low income	0.10	-0.04	-0.08	-0.06

d. Scenario D (Decoupling, with degressivity)

In this scenario we consider both decoupling and degressivity. In the last year of gradual implementation of the degressivity scheme all direct payments will be reduced as follows:

a) No reductions for premiums below 5000 euros;

b) A 5% cut for premiums above 5000 euro;

Table 1 - Scenario D

Impact on production, exports, imports and prices, for the 28 sectors (in % variation with respect to results of scenario A)

	Production	Exports	Imports	Consumer prices	Producer prices
CEREALS	-15.68	-30.15	10.16	16.97	20.00
VEGETABLES	10.91	12.70	2.13	-5.29	-5.53
INDUSTRIAL CROPS	-4.15	-6.65	1.53	1.92	3.80
VITICOLTURE	3.74	9.80	-3.62	-4.26	-4.29
OLIVE	2.63	8.51	-2.79	-3.71	-3.72
FRUIT	7.48	8.67	1.56	-3.50	-3.79
FLORICOLTURE	7.37	10.78	-1.12	-1.82	-4.71
MILK	-3.22	-5.39	1.12	2.74	3.11
LIVESTOCK BEEF	-6.89	-11.77	2.26	5.94	6.77
OTHER LIVESTOCKS	-7.11	-10.84	1.31	4.85	6.21
FISHING	-0.01	0.14	0.30	0.17	0.22
FRESH BEEF	-2.45	-2.86	0.03	1.53	1.76
MILK AND MILK PRODUCTS	-1.40	-1.21	-0.13	0.77	0.91
BREAD PASTA TRASF. CEREALS	-5.27	-5.68	-0.76	3.18	3.27
ORTO-FRUIT	1.63	2.37	-0.05	-0.66	-0.87
OILS AND FATS	0.79	2.27	-0.68	-0.60	-0.83
FEEDS	-11.08	-16.53	1.96	7.97	9.78
OTHER FOOD INDUSTRIES	-0.73	-0.60	0.11	0.52	0.59
BEVERAGES	0.24	0.63	0.16	-0.02	-0.02
FUEL AND LUBRIF.	0.05	0.20	0.31	0.16	0.19
ELECTRIC POWER	0.08	0.23	0.33	0.15	0.18
WATER	0.88	0.25		0.17	0.17
FERTILIZERS	0.61	0.23	0.87	0.18	0.18
PESTICIDES	1.14	0.22	1.76	0.11	0.18
OTHER CHEM. AND PHARM. PROD.	0.06	0.23	0.27	0.12	0.18
OTHER INDUSTRIES	0.12	0.18	0.39	0.17	0.21
TRANS. – COMM. - CRED. – INS.	0.04	0.21	0.28	0.18	0.19
OTHER SERVICES	0.04	0.17	0.33	0.20	0.21

Table 2 - Scenario D

Impact on demand of 28 sectors
(in % variation with respect to results of scenario A)

	Dependent labour	Farm Labour	Capital	Land
CEREALS	-2.70	-4.26	-2.71	-29.16
VEGETABLES	5.66	3.96	5.64	15.80
INDUSTRIAL CROPS	-1.40	-2.98	-1.42	-6.44
VITICOLTURE	-0.05	-1.66	-0.07	9.71
OLIVE	-1.34	-2.92	-1.35	8.14
FRUIT	3.96	2.28	3.94	13.96
FLORICOLTURE	3.40	1.73	3.38	13.51
MILK	3.32	1.66	3.30	14.31
LIVESTOCK BEEF	-0.46	-2.06	-0.48	9.28
OTHER LIVESTOCK	-1.07	-2.66	-1.08	9.01
FISHING	0.01		-0.01	
FRESH BEEF	-0.93		-0.95	
MILK AND DERIVED PRODUCTS	-0.71		-0.73	
BREAD PASTA TRASF. CEREALS	-2.37		-2.38	
ORTO-FRUIT	0.54		0.52	
OILS AND FATS	-0.24		-0.26	
FEEDS	-2.59		-2.60	
OTHER FOOD INDUSTRIES	-0.34		-0.36	
BEVERAGES	0.02		0.00	
FUEL AND LUBRIF.	0.03		0.02	
ELECTRIC POWER	0.05		0.04	
WATER	0.84		0.82	
FERTILIZERS	0.59		0.57	
PESTICIDES	1.12		1.10	
OTHER CHEM. ABD PHARM. PROD.	0.04		0.02	
OTHER INDUSTRIES	0.12		0.11	
TRANS. - COMM. - CRED. – INS.	0.02		0.01	
OTHER SERVICES	0.05		0.03	

Table 3 - Scenario D

Impact on price of productive factors
(% variation with respect to results of scenario A)

Dependent Labour	0.20
Independent Labour	2.17
Capital	0.22
Land	-10.22
Animals 8	4.20
Animals 9	-8.82
Animals 10	-38.06

Table 4 - Scenario D

Percentage change of land allocation

	Benchmark	Simulation
CEREALS	97.97	97.46
VEGETABLES	99.04	99.04
INDUSTRIAL CROPS	96.72	96.72
VITEICOLTURE	98.41	98.42
OLIVOE	99.43	99.43
FRUIT	99.63	99.64
FLORICOLTURE	96.45	96.46
MILK	93.32	93.37
LIVESTOCK BEEF	96.23	96.24
OTHER LIVESTOCKS	95.25	95.28

Table 5 - Scenario D

Impact on households
(% variation with respect to results of scenario A)

	Available Income	Aggregate consumption	Leisure	Welfare
Limited resources	1.20	0.79	1.02	0.94
Retirement	1.12	0.84	0.92	0.90
residential	1.21	0.91	1.03	0.95
Professionals with low remuneration of labour	0.76	0.44	0.60	0.49
Professionals with high remuneration of labour	1.73	1.37	1.59	1.39
Large	1.08	0.78	0.91	0.81
Very large	1.01	0.75	0.83	0.78
Rurals	0.10	-0.20	-0.08	-0.14
High income	0.14	-0.01	-0.07	-0.05
Mid income	0.12	-0.04	-0.09	-0.07
Low income	0.13	-0.04	-0.08	-0.06

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Appendice: descrizione del modello

a. I settori

Il modello comprende 28 settori, indicati con *i* e *y*; 7 fattori della production indicati con *f*: lavoro [*lab*], capital [*cap*], independent labour [*labind*], land [*land*], animals per il settore "milk" [*anim8*]; animals per il settore "livestock beef" [*anim9*], ed animals per il settore "other livestock" [*anim10*]; 11 classi di consumatori.

Si suppone una situazione di concorrenza perfetta in ogni settore produttivo e che i fattori produttivi siano perfettamente mobili tra i settori, eccezion fatta per la land ed il independent labour che sono limitati alla componente agricola del modello e per gli animals che vengono impiegati in un determinato settore.

Ogni settore produce un bene perfettamente omogeneo. La quantity prodotta dal settore *i*, indicata con Xs_i, è funzione (di tipo Cobb-Douglas) del valore aggiunto (VA_i) e dell'input intermediario aggregato ($INTtot_i$). Il valore aggiunto è a sua volta funzione (di tipo CES) della quantity utilizzata di fattori produttivi f ($FACTd_{i,f}$), mentre l'input intermediario aggregato è funzione (di tipo CES) delle quantity che il settore *i* acquista dagli altri settori y (INT_{yi}). Il prezzo di vendita del bene è rappresentato da Pd_i.

Pva_i e $P\text{int}_i$ rappresentano i prices impliciti relativi alle quantity aggregate, mentre w_f rappresenta il costo dei fattori produttivi.

τ_{p_i} e c_{p_i} rappresentano rispettivamente l'aliquota di tassazione indiretta sulla production ed i contributi alla production (espressi in forma di aliquota), mentre $c_{i,f}$ rappresenta il contributo percepito per ogni unità di fattore *f* impiegato.

$Ptax_i(t)$ rappresenta il prezzo di vendita che comprensivo dell'aliquota di tassazione indiretta sul consumo.

La funzione di profitto per il generico settore *i* è la seguente:

$$Pd_i \cdot Xs_i \cdot \left(1 - \tau_{p_i} + c_{p_i}\right) - \left[Pva_i \cdot VA_i + P\text{int}_i \cdot INTtot_i\right]$$

dove $Pva_i \cdot VA_i$ rappresenta il costo complessivo dei fattori produttivi, mentre $P\text{int}_i \cdot INTtot_i$ rappresenta il costo complessivo per l'utilizzo di beni intermedi.

La struttura produttiva, descritta da una funzione di production a due livelli, è la seguente:

$$\begin{cases} Xs_i = A_i \cdot VA_i^{\alpha_{Xs_i}} \cdot INTtot_i^{1-\alpha_{Xs_i}} \\ VA_i = \left\{ \sum_f \alpha_{VA_i} \cdot FACTs_{i,f}^{-\rho_{VA_i}} \right\}^{-\frac{1}{\rho_{VA_i}}} \\ INTtot_i = \left\{ \sum_y \alpha_{INT_{yi}} \cdot INT_{yi}^{-\rho_{INT_i}} \right\}^{-\frac{1}{\rho_{INT_i}}} \end{cases}$$

Le condizioni del primo ordine per la massimizzazione del profitto dato il vincolo tecnologico sono le seguenti:

per il primo livello:
$$\begin{cases} Pva_i \cdot VA_i = \alpha_{Xs_i} \cdot Pd_i \cdot Xs_i \cdot \left(1-\tau_{p_i}+c_{p_i}\right) \\ P\text{int}_i \cdot INTtot_i = \left(1-\alpha_{Xs_i}\right) \cdot Pd_i \cdot Xs_i \cdot \left(1-\tau_{p_i}+c_{p_i}\right) \end{cases}$$

per il secondo livello:
$$\begin{cases} FACTd_{i,f} = \left(\alpha_{VA_i}\right)^{\sigma_{VA_i}} \cdot \left(\frac{Pva_i}{w_f - c_{i,f}}\right)^{\sigma_{VA_i}} \cdot VA_i \\ Pva_i \cdot VA_i = \sum_f \left(w_f - c_{i,f}\right) \cdot FACTd_{i,f} \\ INT_{yi} = \left(\alpha_{INT_i}\right)^{\sigma_{INT_i}} \cdot \left(\frac{P\text{int}_i}{Ptax_y}\right)^{\sigma_{\text{int}_i}} \cdot INTtot_i \\ P\text{int}_i \cdot INTtot_i = \sum_y Ptax_y \cdot INT_{yi} \end{cases}$$

Una parte della production è venduta sul mercato interno (Xxd_i) mentre l'altra viene esportata (E_i), ossia:

$Xs_i = Xxd_i + E_i$.

b. Situazioni particolari relative ad alcuni settori agricoli

b1. Set – aside

Per quanto riguarda il fattore produttivo land, la quantity impiegata nell'attività produttiva non rappresenta la totalità della quantity effettivamente a disposizione del settore. Dunque, una parte della land viene impiegata per la production di beni (ed è remunerata in base alla sua produttività marginale, w_{land_i}) e la parte rimanente rimane a riposo (ed è remunerata in base ai contributi versati dallo Stato per mantenere il terreno a riposo , c_{land_i}).

Indicando con $LandT_i$ la domanda complessiva di land da parte del settore *i*, con $FACTd_{i,land}$ la quantity impiegata nella production, e con $Land_{i,inut}$ la quantity di land che rimane a riposo, la condizione che indica l'impiego ottimale di land è la seguente:

$$\begin{cases} FACTd_{i,land} = \alpha_{land_i}{}^{\sigma_i} \cdot \left(\frac{w_{land_i}}{wT}\right)^{\sigma_i} \cdot LandT_i \\ Land_{i,inut} = \alpha_{inut_i}{}^{\sigma_i} \cdot \left(\frac{c_{land_i}}{wT}\right)^{\sigma_i} \cdot LandT_i \\ wT \cdot LandT_i = w_{land_i} \cdot FACTd_{i,land} + c_{land_i} \cdot Land_{i,inut} \end{cases}$$

dove wT rappresenta la remunerazione media della land, identica per ogni settore, data l'ipotesi di perfetta mobilità del fattore tra i settori produttivi.

b2. Prices di intervento

Nei settori in cui viene applicato un prezzo di intervento, una parte della production è venduta sul mercato (interno ed estero) al prezzo di mercato Pd_i e una parte, l'eccedenza produttiva, è venduta al governo al prezzo di intervento $\overline{P}_i$ fissato dallo Stato.

La parte venduta sul mercato è costituita dalla somma delle vendite sul mercato domestico e delle exports ($Xxd_i + E_i$) e viene indicata con $XXDE_i$. La parte venduta al governo è invece indicata con $Dstock_i$.

Allo stesso bene prodotto sono dunque associati due prices differenti. Ciò viene modellizzato ipotizzando che il bene venduto sul mercato e quello venduto al governo siano sostituti imperfetti. Ciò viene descritto nel modello utilizzando una struttura CET. L'obiettivo del settore in cui viene applicato il prezzo di intervento, è di determinare la ripartizione migliore della production tra vendite sul mercato ($XXDE_i$) e vendite al governo ($Dstock_i$).

La condizione del primo ordine è:

$$\begin{cases} Dstock_i = \left(\frac{\overline{P}_i}{PP_i}\right)^{\sigma} \cdot Xs_i \\ XXDE_i = \left(\frac{Pd_i}{PP_i}\right)^{\sigma_{m_i}} \cdot Xs_i \\ PP_i \cdot Xs_i = \overline{P}_i \cdot Dstock_i + Pd_i \cdot XXDE_i \end{cases}$$

dove PP_i rappresenta il ricavo medio delle vendite ed è dato dalla media ponderata tra il prezzo di mercato ed il prezzo di intervento.

La condizione di equilibrio sul mercato interno, che determina il prezzo di equilibrio interno (Pd_i), è data dall'uguaglianza tra l'offerta sul mercato interno e la domanda complessiva:

$$XXDE_i = Xxd_i + E_i$$

Si può notare che una riduzione del prezzo di intervento determina la decisione da parte delle imprese di ridurre le vendite al governo e di incrementare le vendite sul mercato. L'aumento dell'offerta sul mercato provoca la riduzione del prezzo di equilibrio.

b3. Quote latte

I vincoli alla production possono essere introdotti nel modello fissando l'offerta al livello massimo consentito dalla legge. Questo tipo di modellizzazione non è però corrispondente alla realtà italiana, dal momento che la production è superiore a quella consentita. La conseguenza è che i produttori italiani sono costretti a pagare una multa per la production in eccesso.

$$Pd_i \cdot Xs_i \cdot \left(1 - \tau_{p_i} + c_{p_i}\right) - m_i \cdot \left(Xs_i - \overline{Xs}_i\right) - \left[Pva_i \cdot VA_i + P\text{int}_i \cdot INTtot_i\right],$$

dove $\overline{Xs}_i$ rappresenta la quota massima di production fissata dallo Stato e m_i rappresenta la multa (espressa in valore) applicata sull'eccedenza produttiva. Naturalmente, se la production è inferiore alla quota concessa, la multa è nulla.

La funzione di profitto può essere riscritta nel seguente modo:

$$Pd_i \cdot Xs_i \cdot \left(1 - \tau_{p_i} + c_{p_i}\right) - m_i \cdot Xs_i \cdot \frac{\lambda_i}{1+\lambda_i} - \left[Pva_i \cdot VA_i + P\text{int}_i \cdot INTtot_i\right],$$

dove λ_i rappresenta l'eccedenza produttiva in termini percentuali rispetto alla production massima consentita, vale a dire $\frac{Xs_i}{\overline{Xs}_i} - 1$.

Le nuove condizioni del primo ordine per il primo livello sono le seguenti:

$$\begin{cases} Pva_i \cdot VA_i = \alpha_{Xs_i} \cdot \left[Pd_i \cdot Xs_i \cdot \left(1 - \tau_{p_i} + c_{p_i}\right) - m_i \cdot \frac{\lambda_i}{1+\lambda_i}\right] \\ P\text{int}_i \cdot INTtot_i = \left(1 - \alpha_{Xs_i}\right) \cdot \left[Pd_i \cdot Xs_i \cdot \left(1 - \tau_{p_i} + c_{p_i}\right) - m_i \cdot \frac{\lambda_i}{1+\lambda_i}\right] \end{cases}$$

mentre per il secondo livello non c'è alcuna modifica.

Si può facilmente notare che un incremento della multa applicata sull'eccedenza produttiva determina la riduzione sia del valore aggiunto, e di conseguenza della domanda di tutti i fattori produttivi, che della domanda intermedia aggregata, e di conseguenza della domanda di tutti gli input intermedi.

c. Gli investimenti

La funzione di investimento è di tipo CES, dove la quantity aggregata di bene d'investimento lordo ($INVEST$) dipende dalle quantity dei differenti beni (INV_i) utilizzate per tale production.

$$INVEST = \left\{ \sum_i \alpha_{INV_i} \cdot INV_i^{-\rho_{INV_i}} \right\}^{-\frac{1}{\rho_{INV_i}}}.$$

Le condizioni del primo ordine per la minimizzazione del costo d'investimento data la tecnologia di investimento sono le seguenti:

$$\begin{cases} INV_i = (\alpha_{inv_i})^{\sigma_{inv_i}} \cdot \left(\frac{Pinv}{Ptax_i} \right)^{\sigma_{inv_i}} \cdot INVEST \\ Pinv \cdot INVEST = \sum_i Ptax_i \cdot INV_i \end{cases}$$

dove $Pinv$ rappresenta il prezzo implicito del bene d'investimento aggregato.

d. Le famiglie

Le preferenze di ciascuna tipologia familiare sono descritte nel modello mediante una funzione di welfare a due stadi. Nel primo stadio, l'obiettivo di ciascuna classe è di scegliere il livello di consumo aggregato C_j e di leisure $LEIS_j$ in modo da massimizzare il livello di welfare nel rispetto del vincolo di bilancio e di tempo totale disponibile. La funzione di welfare di tipo CES è la seguente:

$$U_j = \left\{ betaC_j \cdot C_j^{-\rho leis_j} + betaLEIS_j \cdot LEIS_j^{-\rho leis_j} \right\}^{-\frac{1}{\rho leis_j}}.$$

Il available income, al netto della tassazione diretta e dei contributi sociali (dove τ e τ_{cs} indicano le rispettive aliquote), dipende dalla remunerazione dei redditi da dependent labour e indipendente, dalla remunerazione della land, del capital, degli animals, dalle pensioni percepite e dagli interessi sul debito pubblico:

$$\begin{aligned} &YH_j = \\ &\sum_f [1-\tau] \cdot w_f \cdot FACTs_{j,f} + \\ &[1-\tau-\tau_{cs}] \cdot w_{lab} \cdot FACTs_{j,lab} + \\ &[1-tdir] \cdot PENS_j + \\ &[1-tdir] \cdot r \cdot Pg \cdot BOND_j \end{aligned}$$

L'offerta di independent labour, di land, di capital e di animals è ipotizzata fissa, mentre l'offerta di dependent labour si ricava dalla risoluzione del problema di massimizzazione dell'welfare. Il tempo totale disponibile è dunque ripartito tra l'offerta di dependent labour ed il leisure:

$$TIME_j = FACTs_{j,lab} + LEIS_j$$

Una frazione del available income, ipotizzata costante, è destinata al consumo di beni e di leisure:

$$Pu_j \cdot U_j = (1 - s_j) \cdot YH_j$$

Le condizioni del primo ordine per la massimizzazione dell'welfare sono le seguenti:

$$\begin{cases} C_j = (betaC_j)^{\sigma leis_j} \cdot \left(\frac{Pu_j}{Pc_j} \right)^{\sigma leis_j} \cdot U_j \\ LEIS_j = (betaLEIS_j)^{\sigma leis_j} \cdot \left(\frac{Pu_j}{w_{lab}} \right)^{\sigma leis_j} \cdot U_j \\ Pu_j \cdot U_j = Pc_j \cdot C_j + w_{lab} \cdot LEIS_j \end{cases}$$

dove Pc_j rappresenta l'indice del prezzo al consumo, w_{lab} il costo del leisure (pari alla remunerazione del dependent labour) e Pu_j il prezzo implicito legato all'welfare.

Nel secondo stadio della funzione di welfare ciascuna classe deve decidere la ripartizione ottimale del consumo aggregato tra i beni prodotti dai 28 settori. Il secondo livello della funzione di welfare è descritto da una funzione di tipo CES e dipende dal livello di domanda del bene *i* da parte della classe *j* $Xd_{j,i}$:

$$C_j = \left\{ \sum_i \alpha cons_{gi} \cdot Xd_{j,i}^{-\rho cons_i} \right\}^{-\frac{1}{\rho cons_i}}$$

Le condizioni del primo ordine sono le seguenti:

$$\begin{cases} Xd_{j,i} = (\alpha cons_{j,i})^{\sigma cons_j} \cdot \left(\frac{Pc_j}{Ptax_i} \right)^{\sigma cons_j} \cdot C_j \\ Pc_j \cdot C_j = \sum_i Ptax_i \cdot Xd_{j,i} \end{cases}$$

e. Il governo

Le entrate del governo sono rappresentate dei contributi sociali, dalla tassazione indiretta applicata alla production e al consumo dei beni, alla tassazione diretta applicata sulla remunerazione dei fattori produttivi, sulle pensioni e sugli interessi sui titoli di Stato.

Le uscite sono costituite dall'acquisto di beni sul mercato, dal pagamento degli interessi sul debito pubblico, delle pensioni e dei contributi legati al non utilizzo della land. La differenza tra entrate e uscite, che rappresenta (se positiva) il risparmio del governo ($GOVsav$) è dunque:

$$
\begin{aligned}
&GOVsav \;=\\
&\sum_i \left(\tau_{p_i} - c_{p_i}\right) \cdot Pd_i \cdot Xs_i +\\
&\sum_i \left(\tau_{IVA_i} + \tau_{M_i}\right) \cdot P_i \cdot X_i +\\
&tdir \cdot \sum_f \sum_j w_f \cdot FACTs_{j,f} +\\
&\tau_{cs} \cdot \sum_j w_{lab} \cdot FACTs_{j,lab} +\\
&tdir \cdot \sum_j PENS_j +\\
&tdir \cdot \sum_j r \cdot Pg \cdot BOND_j \quad -\\
&\left[Pg \cdot G + \sum_j r \cdot Pg \cdot BOND_j + \sum_j PENS_j + \sum_i c_{land_i} \cdot Land_{i,inut} \right]
\end{aligned}
$$

I aggregate consumption del governo sono rappresentati da una funzione di tipo CES dei singoli consumi governativi settoriali.

$$G = \left\{ \sum_i \alpha_{gov_i} \cdot Ggov_i^{-\rho_{gov_i}} \right\}^{-\frac{1}{\rho_{gov_i}}}$$

La tassazione indiretta sul consumo dei beni è applicata alla quantity complessivamente disponibile sui mercati (X_i). G rappresenta il consumo aggregato del governo per tutti i beni. Pg rappresenta il prezzo aggregato di tale paniere di consumo. Il livello della domanda per ogni singolo bene e la relazione tra i prices sono dati dalle seguenti condizioni del primo ordine:

$$
\begin{cases}
Ggov_i \;=\; (\alpha_{gov_i})^{\sigma_{gov_i}} \cdot \left(\dfrac{Pg}{Ptax_i} \right)^{\sigma_{gov_i}} \cdot G \\
Pg \cdot G = \sum_i Ptax_i \cdot Ggov_i
\end{cases}
$$

f. Il resto del mondo

La quantity disponibile per ogni bene, indicata con X_i, è composta dai beni prodotti in Italia e che non sono esportati (Xxd_i) e dalle imports (M_i). Al bene composito (X_i) viene associato un prezzo aggregato P_i, mentre il prezzo delle vendite domestiche e i prices mondiali sono rispettivamente Pd_i e Pw_i.

Nel modello si considera l'ipotesi di Armington, secondo cui i beni domestici e quelli importati non sono perfettamente sostituti a causa del differente luogo di origine.

$$X_i = \left\{ \alpha_{m_i} \cdot M_i^{-\rho_{m_i}} + \alpha_{xxd_i} \cdot Xxd_i^{-\rho_{m_i}} \right\}^{-\frac{1}{\rho_{m_i}}} .$$

Le condizioni del primo ordine sono le seguenti:

$$\begin{cases} M_i = (\alpha_{m_i})^{\sigma_{m_i}} \cdot \left(\frac{P_i}{Pw_i}\right)^{\sigma_{m_i}} \cdot X_i \\ Xxd_i = (\alpha_{xxd_i})^{\sigma_{m_i}} \cdot \left(\frac{P_i}{Pd_i}\right)^{\sigma_{m_i}} \cdot X_i \\ P_i \cdot X_i = Pw_i \cdot M_i + Pd_i \cdot Xxd_i \end{cases}$$

dove P_i rappresenta quindi il prezzo medio al consumo.

Il resto del mondo detiene una certa quantity di capital all'interno della nostra economia ($capROW$). Tale quantity, ipotizzata costante, permette al resto del mondo di percepire dei redditi che vengono utilizzati per importare i beni. L'equilibrio della bilancia dei pagamenti è la seguente:

$$Pe \cdot Etot = \sum_i Pw_i \cdot M_i + Pinv \cdot capROW .$$

Il resto del mondo presenta quindi un deficit della bilancia commerciale che viene compensato dai redditi da capital ricevuti. $Etot$ rappresenta la quantity massima (in termini aggregati) che il resto del mondo può importare.

$$Etot = \left\{ \sum_i \alpha_{\exp_{gi}} \cdot E_i^{-\rho_{\exp_i}} \right\}^{-\frac{1}{\rho_{\exp_i}}}$$

La composizione settoriale è descritta dalle condizioni del primo ordine seguenti:

$$\begin{cases} E_i = (\alpha_{\exp_i})^{\sigma_{\exp_i}} \cdot \left(\frac{Pe}{Pd_i}\right)^{\sigma_{\exp_i}} \cdot Etot \\ Pe \cdot Etot = \sum_i Pd_i \cdot E_i \end{cases}$$

g. Condizioni di equilibrio

Le condizioni di equilibrio consistono nell'uguaglianza tra domanda e offerta per tutti i mercati, dei beni, dei fattori produttivi e degli attivi finanziari.

Mercato dei beni:

$$X_i = \sum_j INT_{ij} + \sum_j Xd_{j,i} + Ggov_i + INV_i$$

Ciò significa che la quantity di bene composito (X_i) è acquistata dai diversi settori, è consumata dalle famiglie e dal governo, ed è utilizzata per la costituzione del bene di investimento.

Mercato del dependent labour:

$$\sum_i FACTd_{i,lab} = \sum_j FACTs_{j,lab}$$

Mercato del independent labour:

$$\sum_i FACTd_{i,labind} = \sum_j FACTs_{j,labind}$$

Mercato del capital:

$$\sum_i FACTd_{i,cap} = \sum_j FACTs_{j,cap} + capROW$$

Mercato della land:

$$\sum_i LandT_i = \sum_j FACTs_{j,land}$$

Mercato degli animals utilizzati nel settore "milk":

$$\sum_i FACTd_{i,anim8} = \sum_j FACTs_{j,anim8}$$

Mercato degli animals utilizzati nel settore "livestock beef":

$$\sum_i FACTd_{i,anim9} = \sum_j FACTs_{j,anim9}$$

Mercato degli animals utilizzati nel settore "other livestock":

$$\sum_i FACTd_{i,anim10} = \sum_j FACTs_{j,anim10}$$

To conclude, the numeraire is represented by the world good. This implies that the price of the imported goods is fixed ($Pw_i = 1$) and that all prices in the model are expressed in function of the world prices.