Construction and Simulation of the General Economic Equilibrium Model Meg-Ismea for the Italian Economy

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1. Introduction[+]

The objective of this study is the construction of a model of general economic equilibrium for the Italian economy with special reference to the agricultural and agroindustrial sector. The model has been constructed with the aim of assessing, both "ex ante" and "ex post", the impact of economic policies on the behaviour of businesses and consumers and on the distribution of income.

The model, denominated MEG-Ismea in reference to the institution that commissioned the research, has been developed with a micro-macro approach that allows zooming in from the macro to the micro level and zooming out in the opposite direction, maintaining the coherence between the aggregate behaviour of the representative agent and the heterogeneous behaviour of the agents in the marketplace. The micro-macro modelling is based on the decisional micro-unit which most resembles a macro economy, that is to say the micro model of the farm households, which, if described as a closed, walled-off economy, may be considered a model of general equilibrium involving production and consumption.

The objective of formally linking the macro level of general economic equilibrium analysis with the micro-model of the farm household, and of rural household in general, is one of the priorities of research in the field of the theory of general economic equilibrium.

One of the greatest limitations to implementing the micro-macro approach lies in the design of the database, which traditionally is limited to information relating only to the area of agricultural production. The survey of the socio-economic characteristics of farms carried out

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by Ismea in 1995, henceforth referred to as the Ismea Survey, allows this limitation to be overcome because the design of the questionnaire does not take the farm as its unit of reference, but rather the farm household as a unit both of production and consumption (Ismea, 2005).
The MEG-Ismea is based on a Social Accounting Matrix (Sam) which incorporates the input-output matrix of Italian agriculture in 1995 and seven typologies of farm household, one typology of rural family and three urban classes with low, mid and high incomes. This macro level of analysis is statistically linked to the micro level of analysis, represented by the farm household, because the Sam has been constructed from the microdata on the farm household revealed by the Ismea Survey. This data is unusual in that it exhaustively satisfies the demand for information needed to construct the component relating to the agricultural sector of a model of general equilibrium, that is to say information on agricultural production and the use of the factors, on the consumption of the families and on their income and capital. The agricultural input-output matrix has been extended to the Sam of the whole Italian economy, completing the information relating to production, using the Input-Output Table of the Italian economy (Istat, 2000), to consumption, using the Istat data on family consumption, and to income and wealth, using the "Banca d'Italia" data (the last two both 1995).
The social dimension of the accounting matrix, which takes into account the differentiation of the distribution effects between the family types, allows identification of who, and in what measure, is greatest influenced by economic policies, in both the "ex ante" analysis phase, so that the reform process can incorporate appropriate compensation, and the "ex post" phase, so as to assess the impact of the reform.
This study describes analytically the sources of information used to construct the Sam and the MEG-Ismea applied model of general equilibrium. The presentation gives particular emphasis to the techniques of modelling the action of economic policy in agricultural markets and the consequent failures in the markets when competitive operation of the same is restricted, as happens, for example, when quantitative limits such as milk quotas or set-aside are placed on production, or when price-support mechanisms are introduced.
The model has been validated by studying its behaviour through two experiments which assess "ex ante" the impact of hypothetical international trade and fiscal reforms on Italian agriculture. The economic robustness of the results shows the high level of reliability of the model, which allows future implementation of the Cap reform approved in Luxembourg in 2003 (the so-called medium-term review of the Cap, henceforth called the Cap Reform), not considered in the model presented in this study.
The paper is structured as follows. In Section 2, there is a general introduction to the structure of the MEG-Ismea model. In the two subsequent sections the sources and data used in the construction of the model and of the Sam are described. The fifth section contains a more detailed description of the MEG-Ismea model, while the sixth section contains the results of two simulations relating to a fiscal and international trade reform. Section 7 concludes the study.

2. The structure of the MEG-Ismea model

The MEG-Ismea model is a multisector model of general economic equilibrium focused, for the Italian economy, on agriculture and the agro-foodstuffs industry. The MEG-Ismea is therefore positioned amongst the models of general equilibrium with national validity dedicated to the agricultural sector, such as, for example, the French Inra model (MEGAAF), the Irish model (IMAGE), the United States' Usda/Ers and the Dutch (WAGEM).
MEG-Ismea was constructed with the objective of assessing the impact on the agro-foodstuffs system deriving from the implementation of national and Community policies. In particular, attention will be focused on the production in each economic sector, on the demand for production factors, on the market prices of goods and factors, on the demand for goods on the

part of the consumer and, in conclusion, on the level of affluence of the agricultural, rural and urban families which comprise Italian society.
The model represents a Walrasian economy in which the markets are perfectly competitive. As such, businesses produce goods with the aim of maximizing their profits. Production factors are paid for on the basis of their marginal productivity. Families make their consumer choices by maximizing their own welfare, welfare that depends both on the consumption of goods and on their leisure. Given this Walrasian economy, examination is made of the implementation of the Common Agricultural Policy (Cap) and its distorting effects on production choice and the allocation of factors.
The principal characteristics of the MEG-Ismea model are illustrated in table B1 in Appendix B. The model foresees 41 sectors, as shown in table B2. Agriculture is divided into 23 sectors and the food industry into 9. The other sectors of the economy have been aggregated on the basis of their links with the primary and agroindustrial sector, as seen in the Ismea inter-sectorial tables.
The disaggregation of the agricultural and agro-foodstuffs system permits adequate assessment of the impact of agricultural policies which, in most cases, relate to individual products rather than aggregates of these. Duties and contributions to agriculture, for example, are linked to individual sectors rather than to macro-sectors. Consequently, a detailed picture of the agro-foodstuffs economy allows us to carry out the analysis at a level compatible with the operative level of the policy maker.
With regard to production factors, the agricultural sectors use five, as can be seen from table B3: independent and subordinate work, the land (divided into three types), agricultural capital and animals (divided into four types). The non-agricultural sectors use two production factors: non-agricultural capital and subordinate work.
The MEG-Ismea distinguishes between two institutional sectors: the families and the government. One element of great significance is the disaggregation of the families into eleven categories. As can be seen from table B4, seven classes of agricultural family, one class of rural family[1] and three classes of urban family have been taken into consideration. Classification of the agricultural families is based on the typology set out in Ismea (2005)[2]. The three classes of urban family are classified according to the income bands as detailed in "The budgets of Italian families" (Banca d'Italia, 1995).
The level of disaggregation introduced into the model therefore allows us to analyze the impact of the implementation of a certain agricultural policy on different family types in terms of distribution and of welfare, and consequently allows us to identify which types benefit and which are disadvantaged.
Finally, MEG-Ismea provides for two trade areas: the European Union (EU) and the Rest of the World (RoW), given the need to examine the specificity of Italian agricultural policy, which, naturally, is a European policy.

3. The data for construction the Social Accounting Matrix and the MEG-Ismea model

The data used in the construction of the MEG-Ismea model comes almost exclusively from the Ismea Survey. This ensures a high level of homogeneity in the assembly of the data and in particular of the Sam (cf. Section 4).
The survey was designed with reference to the collective model of the farm household (Caiumi, Perali, 1997). The collective theory of the family (Chiappori, 1992) was adopted because it allows estimation of individual preferences and assessment of the level of affluence

[1] The rural families are defined from the starting point of Istat data, limiting them to those resident in scattered housing, or "Those houses spread over the municipality's territory at a distance between them which does not even allow them to be considered an inhabited unit" (Istat, 2001).
[2] The seven types of farm households have been identified via the application of multivariate analysis techniques to the Ismea sample.

of the individual, in order to understand their behaviour in relation, for example, to the choice of job offers inside and outside the farm.
The Ismea Survey is the comprehensive result of four lines of enquiry into: (1) farm budgets, taking into account the use of the production factors in the different activities in order to construct the agricultural part of the Input-Output Table; (2) the use of time; (3) the consumption of farm households and (4) the incomes of farm households.
In order to construct the Sam and the model of general economic equilibrium relating to the Italian economy, the urban, rural and farm households have been disaggregated into different socio-economic groups using the information on the characteristics of the farm and the family contained in the Ismea dataset (Perali, Salvioni, Tommasi, 2005) and the Istat data on Italian family consumption for the urban and rural families. The family types are as follows: 1) limited resources; 2) retirement; 3) residential; 4) farming occupation/lower-sales; 5) farming occupation/higher-sales 6) large family farms; 7) very large family farms; 8) rural; 9) urban high income; 10) urban middle income; 11) urban low income. The model also includes leisure, which is measured in the section on the use of time, an unusual feature of the Ismea Survey. Leisure is defined as the hours per week dedicated to recreational activities, personal care and rest.
Table B5 shows the sources of the data used in the construction of the Italian Sam. The Ismea Survey provides the information needed to construct the part of the Sam relating to agricultural sector of the Italian economy. The other national sources included in the table, i.e. "L'indagine sul consumo delle famiglie" (Istat, 1995), "L'indagine sui redditi delle famiglie italiane" (Banca d'Italia, 1995) and "L'indagine sull'uso del tempo delle famiglie italiane" (Eurisko, 1995), have been used to complete the Sam of the Italian economy. Appendix A describes the work involved in collecting and processing the data in detail.

4. The Social Accounting Matrix

MEG-Ismea, like every applied model of general equilibrium, requires the construction of a Sam. The Sam is a double-entry square matrix where the rows and columns are identified by the economic sectors, production factors, institutional sectors, accounts relating to the formation of capital (savings and investments) and the rest of the world. The Sam thus represents an extension of the traditional input-output statement and allows us to pick up on the relationships between the production entity, the distribution of income to the socio-economic groups and the make-up of spending by socio-economic group. The Sam, which began construction starting from the "Table of sectoral interdependency in the Italian agro-foodstuffs system" (Ismea, 1997), is shown in compact form, that is to say where the 41 sectors and 11 family types have been aggregated, in table B6.
As far as the production aspect is concerned, table B7 shows the input-output table (where the 41 sectors have been aggregated into 8 macro-sectors), whereas table B8 contains the data relating to the use of production factors by the agricultural sectors. Where the families are concerned, tables B9, B10 and B11 contain the information relating to consumption of goods, use of leisure and earned income. Regarding international trade, tables B12 and B13 relate to exports and imports to and from Europe and the Rest of the World.

5 The Ismea General Equilibrium Model (MEG) of the Italian Economy

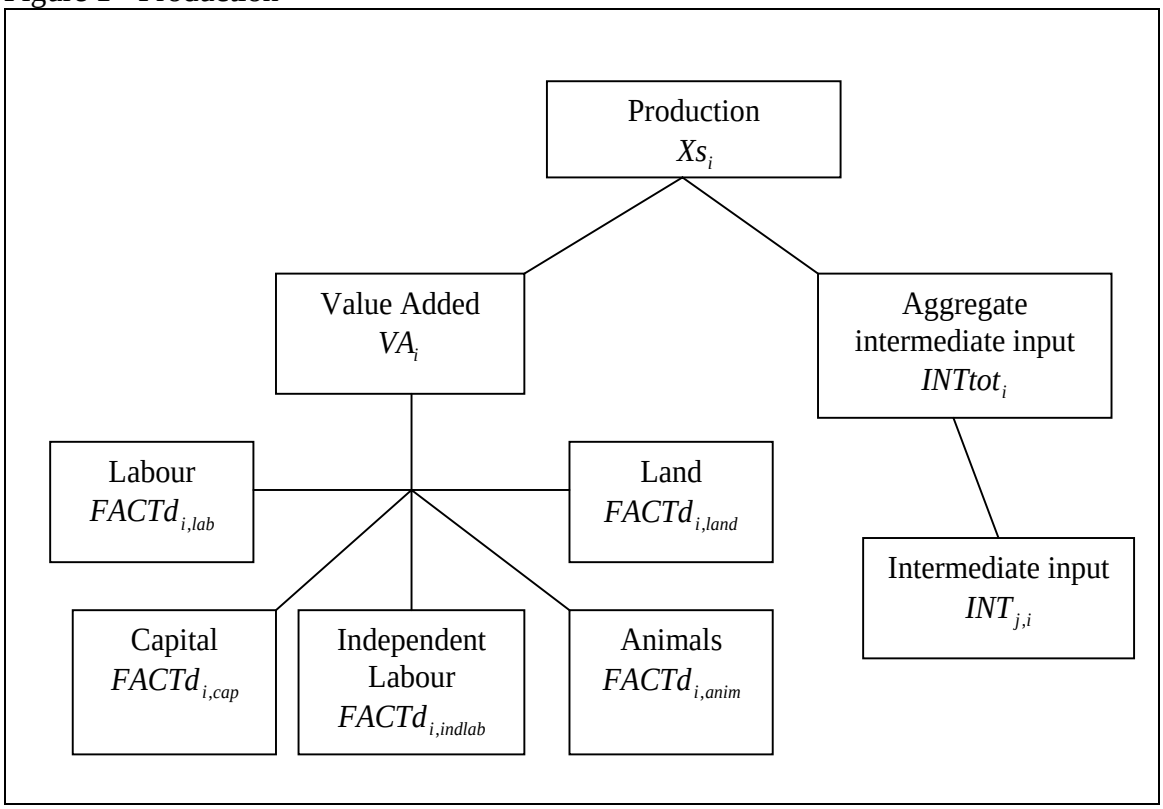
This section describes the computable general equilibrium model of the Italian economy (MEG) developed for Ismea, the Italian Institute for Services in Agricultural and Agri-food Markets.

5.1 Sectors

5.1.1 Production

Each sector produces a perfectly homogeneous good. The production structure is described by a two-levels CES function, as described in the figure 1.

Figure 1 - Production



In the first level, the quantity produced in sector *i*, Xs_i, is represented with a CES technology employing the value added (VA_i) and the intermediate aggregate input ($INTtot_i$) as factors. The value added is a CES function of the employed quantity of aggregate factors *f* ($FACTd_{i,f}$), while the intermediate aggregate input is a CES function of the quantity that sector *i* obtains from other sectors *y* (INT_{yi}).

The profit function for sector *i* is given by the difference between net returns and total costs (total factor cost and total cost of intermediate goods):

$$\pi_i = Pd_i \cdot Xs_i \cdot \left(1 - \tau_{p_i} + c_{p_i}\right) - \left[\sum_f \left(w_f - c_{i,f}\right) \cdot FACTd_{i,f} + \sum_y Ptax_y \cdot INT_{yi}\right] \qquad (5.1)$$

where Pd_i represents the selling price of the good, w_f represents the factors cost and $Ptax_i$ refers to the gross price comprehensive of the in direct consumption tax. The terms τ_{p_i} e c_{p_i} represent the indirect tax rate on production and production payments expressed as a rate respectively, while $c_{i,f}$ is the payment received per unit of factor *f* employed. The first order conditions for profit maximization for a given technology are:

I level:
$$\begin{cases} VA_i = f\left[\dfrac{Pd_i \cdot \left(1-\tau_{p_i}+c_{p_i}\right)}{Pva_i}\right] \\ INTtot_i = f\left[\dfrac{Pd_i \cdot \left(1-\tau_{p_i}+c_{p_i}\right)}{P\,int_i}\right] \end{cases} \tag{5.2}$$

II level:
$$\begin{cases} FACTd_{i,f} = f\left(\dfrac{Pva_i}{w_f - c_{i,f}}\right) \\ Pva_i \cdot VA_i = \sum_f \left(w_f - c_{i,f}\right) \cdot FACTd_{i,f} \\ INT_{yi} = f\left(\dfrac{P\,int_i}{Ptax_y}\right) \\ P\,int_i \cdot INTtot_i = \sum_y Ptax_y \cdot INT_{yi} \end{cases} \tag{5.3}$$

The notation Pva_i e $P\,int_i$ represents the implicit prices of aggregate quantities.

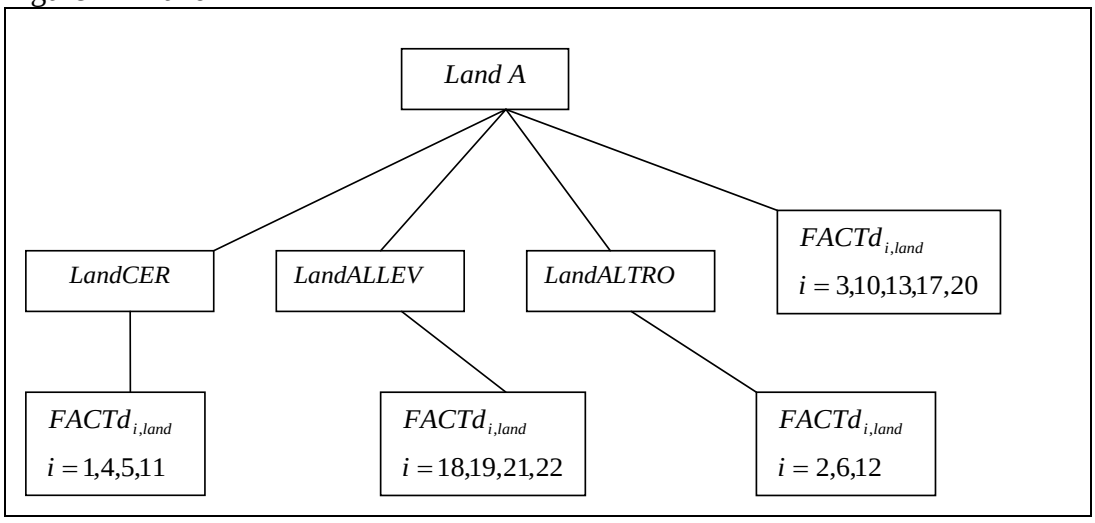
The assumptions about factor mobility are the following: dependent labor is perfectly mobile in every sector; non agricultural capital is perfectly mobile in every non agricultural sector; agricultural capital and independent farm labor are perfectly mobile in every agricultural sector and animals are considered as a specific factor.

We consider different land types and we associate them with different substitutability levels. The assumptions about land mobility are explain in the following section. table C1 shows the elasticity of substitution used in the Ces sectoral production function.

5.1.2 Land

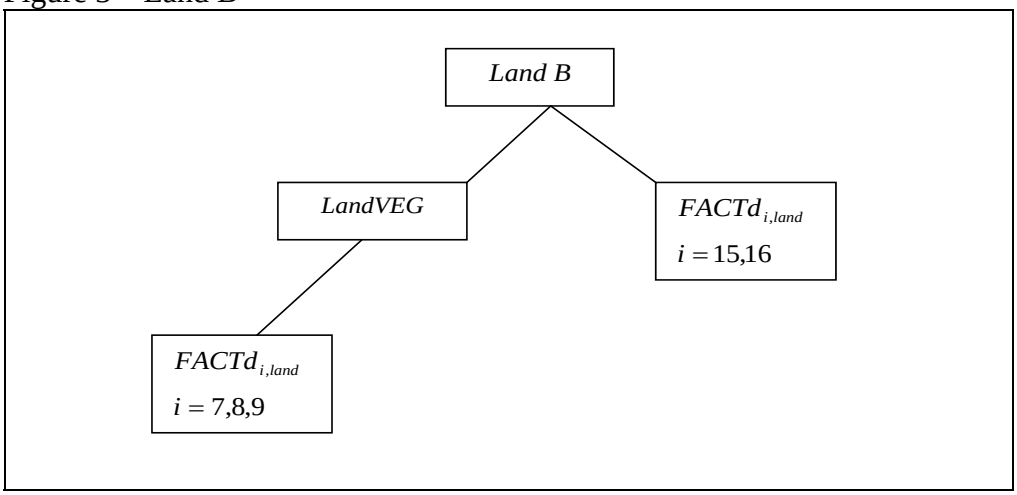
The model considers three types of land that allows us to include in the model agronomic, climatic and technical constraints. We also model the constraints imposed by the Cap reform in order to obtain the single farm payment (Ismea, 2004). Land is "mobile" within group. Because of the strong separability between the groups, land cannot move from one group to the other and land is not perfectly mobile within the two groups too. This imperfect substitutability is introduced with a CES function. Land A is used in the cereals production (soft wheat, corn, irrigated fodder, soy-bean), not irrigated crops (durum wheat, dried fodder and others industrial crops), rice, sugar beet, crude tobacco and in the livestock sectors. Land A also includes floriculture and forestry. The figure 2 shows the different level of substitution among the Land A sectors.

Figure 2 – Land A



Land B is used in vegetables sector, legumes, olives and fruit. The figure 3 shows the different level of substitution among the Land B sectors.

Figure 3 – Land B



Land used in viticulture represents the third type which is the Land C. This land, devoted to grapes for wine production, is maintained fixed in line with the wine CMO regulation which imposes maximum quotas to MSs for areas allocated to grapes plants. Table C2 shows the elasticity of substitution used for land mobility.

5.1.3. Set-aside

The mid-term review prescribes that the farm producing soft wheat, durum wheat, corn, vegetables, soy-bean, and other industrial crops must set-aside a minimum of 10 percent of the land devoted to such crops. This means that these sectors are free to lose the land allocation given the respect of the constraint of 10% of land which has to be set-aside.

The quantity of agricultural land in each sector ($LandT_i$) can be allocated to production ($FACTd_{i,land}$) or can be set-aside ($Land_{i,inut}$), in order to maximize the total land remuneration.

If wT is the average use value of land the problem is the following:

$$\begin{cases} Max\ wT \cdot LandT_i \\ s.t.\ LandT_i = CET\left(FACTd_{i,land},\ Land_{i,inut}\right) \end{cases} \tag{5.4}$$

The optimal choice is given by the following first order conditions:

$$\begin{cases} FACTd_{i,land} = f\left(\dfrac{w_{land\,i}}{wT}\right) \\ Land_{i,inut} = f\left(\dfrac{c_{land\,i}}{wT}\right) \\ wT \cdot LandT_i = w_{land\,i} \cdot FACTd_{i,land} + c_{land\,i} \cdot Land_{i,inut} \\ \dfrac{Land_{i,inut}}{LandT_i} \geq 10\% \end{cases} \tag{5.5}$$

where w_{land_i} represents the remuneration of the land allocated to production and c_{land_i} represents the use value of land corresponds to the public payment (set-aside) received by the farmer on a per hectare basis.

5.1.4. Intervention prices

In some agricultural sectors, the Cap determines price floors in order to support the farm income. That means that if the market price comes down under the price floors part of the production is bought from the government in order to support the level of the market demand. This support mechanism can be introduced in the model or through a subsidy to the export or, like it has been assumed in our model, through the governmental purchase of one amount of stock $Dstock_i$. This aspect is described from the following complementariness condition:

$$Dstock_i \cdot \left(Pd_i - \overline{P}_i\right) = 0 \tag{5.6}$$

That means that is $Dstock_i = 0$ (e.g. no governmental purchase), if the domestic price Pd_i, in a determined market, is greater of the intervention price $\overline{P}_i$. When the intervention price $\overline{P}_i$ is greater of the domestic price Pd_i then $Dstock_i > 0$ and the amount of purchased stock must be such for which ($Pd_i - \overline{P}_i = 0$).

5.1.5. Milk Quotas

The Cap determines moreover of production constraints, in particular for milk sector, in which the supply is fixed to the maximum limit institutionally fixed with the quota system. When the production is higher than what Italy would be allowed to produce then Italian milk producers are compelled to pay the fee for the excess production as:

$$\pi = Pd_i \cdot Xs_i \cdot \left(1 - \tau_{p_i} + c_{p_i}\right) - m_i \cdot \left(Xs_i - \overline{Xs}_i\right) - \left[Pva_i \cdot VA_i + P\text{int}_i \cdot INTtot_i\right] \tag{5.7}$$

where $\overline{Xs}_i$ is the maximum amount of production institutionally fixed and m_i represents the fee applied on the quantity of milk exceeding the quota. When the production is below the quota, no fees are due. The profit function in the milk can then be rewritten as:

$$\pi = Pd_i \cdot Xs_i \cdot \left(1 - \tau_{p_i} + c_{p_i}\right) - m_i \cdot Xs_i \cdot \frac{\lambda_i}{1+\lambda_i} - \left[Pva_i \cdot VA_i + P\text{int}_i \cdot INTtot_i\right] \tag{5.8}$$

where λ_i is the excess production expressed as a percentage of the permitted quota, $\frac{Xs_i}{\overline{Xs}_i} - 1$.

The associated first order conditions are:

$$\begin{cases} Pva_i \cdot VA_i = \alpha_{Xsi} \cdot \left[Pd_i \cdot Xs_i \cdot \left(1 - \tau_{p_i} + c_{p_i}\right) - m_i \cdot \dfrac{\lambda_i}{1+\lambda_i}\right] \\ P\text{int}_i \cdot INTtot_i = \left(1 - \alpha_{Xsi}\right) \cdot \left[Pd_i \cdot Xs_i \cdot \left(1 - \tau_{p_i} + c_{p_i}\right) - m_i \cdot \dfrac{\lambda_i}{1+\lambda_i}\right] \end{cases} \tag{5.9}$$

while the second level is not modified. It is immediate to note that an increase in the size of the fee applied on the quota exceeding milk induces the reduction of both value added (and consequently of factor demands) and of the intermediate aggregate demand.

5.1.6. Investments

The investment function is of the CES type, where the aggregate quantity of the gross investment ($INVEST$) depends upon the quantity of the goods used (INV_i):

$$\begin{cases} \min \quad Pinv \cdot INVEST \\ s.t. \quad INVEST = CES\left(INV_i\right) \end{cases} \tag{5.10}$$

The first order conditions for the minimization of the cost of the investment given the investment technology are:

$$\begin{cases} INV_i = f\left(\dfrac{Pinv}{Ptax_i}\right) \\ Pinv \cdot INVEST = \sum_i Ptax_i \cdot INV_i \end{cases} \quad (5.11)$$

where $Pinv$ represents the implicit price of the aggregate investment good.

5.2 The households

5.2.1 The welfare maximization

The preferences of each household typology are described in the model using a two-stage unitary utility function. In the first stage, the objective of each class is to choose the welfare maximizing level of aggregate consumption C_j and leisure $LEIS_j$ given the budget and time constraint. In the second stage, from the consumption side of the welfare function maximization, each class decides how to optimally allocate the aggregate consumption across the goods produced by the 41 sectors.

The household welfare function is specified as a CES:

$$U_j = CES\left\{C_j\left(Xd_{j,i}\right),\ LEIS_j\right\} \quad (5.12)$$

Available income, net of direct taxation denoted by τ, depends on the level of the off-farm wages and farm shadow wages, the use value of land, capital, livestock, pensions, interests on public debt and decoupled payments:

$$YH_j = \sum_f (1-\tau)\cdot w_f \cdot FACTs_{j,f} + (1-\tau)\cdot PENS_j + (1-\tau)\cdot r \cdot Pg \cdot BOND_j + Cfix_j \quad (5.13)$$

The supply of land, capital and livestock are fixed, while the supply of independent on-farm labor and the supply of off-farm labor are derived as the solution of the welfare maximization problem. The full income $Yfull_j$ is obtained adding to the disposable income the implicit price of the leisure:

$$Yfull_j = Y_j + w_{lab,j} \cdot LEIS_j \quad (5.14)$$

Indicating with s_j the marginal propensity to the saving, assumed constant, the budget constraint becomes:

$$(1-s_j)\cdot Yfull_j = Pc_j \cdot C_j + w_{lab,j} \cdot LEIS_j \quad (5.15)$$

5.2.2. The aggregate consumption and leisure

The first order condition of welfare maximization allow to determine the level of consumption aggregate and the optimal amount of leisure:

$$\begin{cases} C_j = f\left(\dfrac{Pu_j}{Pc_j}\right) \\ LEIS_j = f\left(\dfrac{Pu_j}{w_{lab}}\right) \\ Pu_j \cdot U_j = Pc_j \cdot C_j + w_{lab,j} \cdot LEIS_j \end{cases} \quad (5.16)$$

where Pc_j is the consumer price index, w_{lab} is the cost of leisure and Pu_j is the implicit price of utility.

5.2.3 The consumption of the single goods

The first order conditions about the allocation of the aggregate consumption across the goods produced by the 41 sectors are:

$$\begin{cases} Xd_{j,i} = f\left(\dfrac{Pc_j}{Ptax_i}\right) \\ Pc_j \cdot C_j = \sum_i Ptax_i \cdot Xd_{j,i} \end{cases} \tag{5.17}$$

5.2.4. The off-farm and on-farm labour supply

The time dedicated to the job $Labour_j$ is given from the difference between the time total available $TOTtime_j$ and the leisure $Leis_j$ determined in the first stage of welfare maximization:

$$Labour_j = TOTtime_j - Leis_j \tag{5.18}$$

In the second stage, from the time allocation side of the welfare function maximization, each class decides how to allocate optimally the amount of time to devote to work off and on-farm. Assuming that the two types of job are not perfectly substitutes, with different remuneration, the objective of each unit are to maximize the total remuneration:

$$\begin{cases} Max \quad w_{lab,j} \cdot LABOUR_j \\ s.t. \quad LABOUR_j = CET\left(FACTs_{j,labind},\ FACTs_{j,labdip}\right) \end{cases} \tag{5.19}$$

The first order conditions determining the on and off-farm labor supply are:

$$\begin{cases} FACTs_{j,labdip} = f\left(\dfrac{w_{labdip}}{w_{lab}}\right) \\ FACTs_{j,labind} = f\left(\dfrac{w_{labind}}{w_{lab}}\right) \\ w_{lab} \cdot LABOUR_j = w_{labdip} \cdot FACTs_{j,labdip} + w_{labind} \cdot FACTs_{j,labind} \end{cases} \tag{5.20}$$

where w_{lab} represents the average remuneration of labor and, at the same time, the opportunity cost of leisure under perfect competition.

5.2.5. Supply of animals

In this model the supply of animals is endogenous. That allows to consider the convenience to increase or to diminish the dimension of the breeding in function of the productivity of the animals and of the policy scenarios.

This behavior has been introduced in the model indicating, for each type of animal, the supply of animals, in function of the evolution of the remuneration with respect to the initial remuneration:

$$FACTs_{j,anim} = f\left(\frac{w_{anim}}{w0_{anim}}\right) \tag{5.21}$$

where $w0_{anim}$ is the the initial remuneration.

5.3. The government

The government revenues come from social payments, indirect taxation of products and consumption goods, direct taxation of production factors, pensions and interests on state bonds. The government spends to acquire goods on the market, pay interests on public debt, pensions and legal payments associated with unused land. The difference between revenues and expenditures gives the size of the government savings when positive ($GOVsav$):

$$\begin{aligned} GOVsav = & \\ & \sum_i \tau_{p_i} \cdot Pd_i \cdot Xs_i + \sum_i \tau_{IVA_i} \cdot P_i \cdot X_i + \sum_i \tau_{m_i} \cdot \mathrm{Pr}ow_i \cdot Mrow_i + \\ & \tau \cdot \sum_f \sum_j w_f \cdot FACTs_{j,f} + \tau \cdot \sum_j PENS_j + \tau \cdot \sum_j r \cdot Pg \cdot BOND_j \quad - \\ & Pg \cdot G - \sum_j \left(r \cdot Pg \cdot BOND_j + PENS_j \right) \quad - \\ & \sum_i \left(c_{p_i} \cdot Pd_i \cdot Xs_i + \sum_j c_{i,f} \cdot FACTs_{j,f} + c_{land\,i} \cdot Land_{i,inut} \right) \end{aligned} \tag{5.22}$$

The government's aggregate consumption is represented by a CES function of the government consumption by sector:

$$\begin{cases} \min \quad Pg \cdot G \\ s.t. \;\; G = CES\left(Ggov_i\right) \end{cases} \tag{5.23}$$

Indirect taxation is implemented on the total quantity available on the markets (X_i). The term G denotes aggregate government consumption. The term Pg is the associated aggregate price. The quantity demanded of each good, and the relationship among the prices, are derived from the following first order conditions:

$$\begin{cases} Ggov_i \;\; = \;\; f\left(\dfrac{Pg}{Ptax_i} \right) \\ Pg \cdot G = \sum_i Ptax_i \cdot Ggov_i \end{cases} \tag{5.24}$$

5.4. International trade

International trade is introduced in the model by considering two trade areas: European Union (EU) and the rest of the world (RoW). The total quantity produced by each sector may be sold on the domestic market or exported (in Europe or in the rest of the world). The good sold on the domestic market and the exported good are considers perfectly substitutes, consequently:

$$Xs_i = Xxd_i + Eeu_i + Erow_i \tag{5.25}$$

Such assumption implies that the selling price on the domestic, European and world market, coincides. The exports in the European Union and in the rest of the world are described by a demand function decreasing in the domestic price Pd_i:

$$\begin{cases} Eeu_i = f\left(Pd_i\right) \\ Erow_i = f\left(Pd_i\right) \end{cases} \tag{5.26}$$

The quantity for each good available in the market, that will be sold as intermediate good to firms or as final consumption good to households and government, is composed by the goods produced in Italy and not exported Xxd_i, imports from Europe Meu_i, and imports from the rest of the world $Mrow_i$. We consider two cases:

- Italy is a "large country" for some agricultural goods which implies that the domestic price is endogenous and it is determined by domestic demand and supply levels. As a consequence we make the hypothesis that the domestic good and the imported good are not perfectly substitutes and then their prices are different, according to the Armington hypothesis. The objective of the economy consists in to minimize the cost of purchase of every good:

$$\begin{cases} \min \ \ P_i \cdot X_i \\ s.t. \ \ X_i = CES\left(Xxd_i, \ \ Meu_i, \ \ Mrow_i\right) \end{cases} \tag{5.27}$$

The first order condition are the following:

$$\begin{cases} Xxd_i = f\left(\dfrac{P_i}{Pd_i}\right) \\ Meu_i = f\left(\dfrac{P_i}{Peu_i}\right) \\ Mrow_i = f\left(\dfrac{P_i}{\Pr ow_i \cdot \left(1+\tau_{m_i}\right)}\right) \\ P_i \cdot X_i = Pd_i \cdot XXD_i + Peu_i \cdot Meu_i + \Pr ow_i \cdot \left(1+\tau_{m_i}\right) \cdot Mrow_i \end{cases} \tag{5.28}$$

- Italy is a "small country" with respect to the rest of the world for soft wheat, durum wheat and soy-bean; this implies that the domestic price does not depend on the internal market conditions but it is fixed at the world price level; in this case, the good imported from the rest of the world is considered as a perfect substitute of the domestic good, while the good imported from Europe remains an imperfect substitute good. Also in this case the objective of the economy consist in to minimize the cost of purchase of every good:

$$\begin{cases} \min \ \ P_i \cdot X_i \\ s.t. \ \ X_i = CES\left(Xxd_i + Meu_i, \ \ Mrow_i\right) \end{cases} \tag{5.29}$$

The first order condition are the following:

$$\begin{cases} Xxd_i + Meu_i = f\left(\dfrac{P_i}{Peu_i}\right) \\ Mrow_i = f\left(\dfrac{P_i}{\Pr ow_i \cdot \left(1+\tau_{m_i}\right)}\right) \\ P_i \cdot X_i = Peu_i \cdot \left(XXD_i + Meu_i\right) + \Pr ow_i \cdot \left(1+\tau_{m_i}\right) \cdot Mrow_i \end{cases} \tag{5.30}$$

5.5. Equilibrium conditions

The equality of demand and supply gives the clearing conditions for the goods and the factors:

Goods

$$X_i = \sum_j INT_{ij} + \sum_j Xd_{j,i} + Ggov_i + INV_i \quad (5.31)$$

which means that the quantity of the composite good (X_i) is acquired by the different sectors, consumed by the households and the government and used to produce the investment good.

Dependent labor

$$\sum_i FACTd_{i,lab} = \sum_j FACTs_{j,lab} \quad (5.32)$$

Farm (independent) labor

$$\sum_i FACTd_{i,labind} = \sum_j FACTs_{j,labind} \quad (5.33)$$

Agricultural capital

$$\sum_i FACTd_{i,capagr} = \sum_j FACTs_{j,capagr} \quad (5.34)$$

Capital

$$\sum_i FACTd_{i,cap} = \sum_j FACTs_{j,cap} + capROW \quad (5.35)$$

Land

$$\sum_i LandT_i = \sum_j FACTs_{j,land} \quad (5.36)$$

Land in the viticulture sector

$$\sum_i LandT_{14} = \sum_j FACTs_{j,land14} \quad (5.37)$$

Milk

$$\sum_i FACTd_{i,anim18} = \sum_j FACTs_{j,anim18} \quad (5.38)$$

Bovine

$$\sum_i FACTd_{i,anim19} = \sum_j FACTs_{j,anim19} \quad (5.39)$$

Sheep and goats

$$\sum_i FACTd_{i,anim21} = \sum_j FACTs_{j,anim21} \quad (5.40)$$

Other livestock

$$\sum_i FACTd_{i,anim22} = \sum_j FACTs_{j,anim22} \quad (5.41)$$

6. Example simulations

In this section two simulations are presented by way of example with the aim of validating the model and of demonstrating its potential in "ex ante" analysis of the impact following implementation of certain economic policies by verifying the robustness of the results against economic theory.

6.1 Simulation relating to international trade

The first simulation consists of a 50% reduction in the duties charged on imports from the rest of the world of cereals, vegetables and industrial crops. This scenario is in line with the growing opening-up of international markets following negotiations conducted at the Wto.

The initial level of the duties, indicated in percentage terms of the value of the imports from the rest of the world, are shown in table D1.

The results, as it was logical to expect, show that the reduction in duties has a significant impact on the sectors that benefited from greater protection, that is to say common wheat, durum wheat, rice and tomatoes.

The direct effect of the reform consists in the reduction of the world price at import and a consequent increase in imports from the rest of the world. In particular, imports from the rest of the world of common wheat increase by 66%, those of durum wheat by 105%, those of rice by 18% and those of tomatoes by 59%.

The impact on the domestic price of common and durum wheat is nil, given the hypothesis that in these sectors Italy is considered a small country compared with the European Union, and that the reform does not affect the European price. Given the hypothesis of perfect substitutability, imports from the European Union are significantly reduced for common wheat (-17%) and durum wheat (-98%), as shown in table D2.

The impact on production is favourable for common wheat (+3%), durum wheat (+4%), rice (+1%) and pasta (+3%). As can be seen from table D3, the variations in production and imports determine an increase in the composite good of common wheat (+8%), durum wheat (+9%), rice (+2%) and pasta (+3%).

The variation in the demand for factors from the economic sectors has a slight impact on their price. The impact on disposable income, while modest, is positive for all family types (Table D4) .

The impact of the policy on the welfare of the families, in terms of equivalent variation, has also been measured. This consists in determining the amount of income that each class of family would expect to receive if the reform was not implemented. Naturally, a positive value indicates that the reform produces an improvement in the level of affluence. Table 19 shows the distance, expressed in percentage terms, between this level of income and the initial level of income. As can be seen, the impact is positive for all classes of family, and in particular, with reference to the farming families, the increase in welfare is between 0.5% and 1.1%.

To conclude, the model allows us to analyse the impact of a policy of greater liberalization in trade in the agricultural markets from the point of view of production and of the allocation of production factors, and from the point of view of the consumption of the families and their level of affluence. As the results demonstrate, in conformity with the economic theory on international trade, greater liberalization produces better allocation of resources and an increase in affluence.

6.2 Fiscal simulation of moving from taxation based on land registry income to taxation on annual accounts

In this section we present the results of a simulation of a modification to the regime of taxation applied to agricultural income.

The current tax regime bases the calculation of the tax (Irpef) on agricultural income figures obtained from land registry data. The simulation has as its objective the assessment of the impact of the application, as a replacement for the simplified regime described above, of a tax

regime in which tax is calculated on the yearly profits (Irpeg), a method normally applied to non-agricultural farm.
With reference to the initial situation, identified as scenario A, a special regime is applied to the farm household in which the tax due from each farm household (indicated by T_j^A) is determined by applying the average rates, which differ depending on the type of family, to the remuneration from the capital and land factors[3]. These rates are obtained from a non-behavioural simulation of the assessable value and of the taxes paid on agricultural income (agrarian and land registry income), carried out using the Ismea Survey data and the land registry data (Ismea, 2003).

$$T_j^A = \tau_j^A \cdot \left(w_{capagr} \cdot FACTs_{j,capagr} + w_{land} \cdot FACTs_{j,land} \right) \qquad \text{with } j = 1,...,7. \tag{6.1}$$

On the other hand, in scenario B, or the IRPEG scenario, the situation has been simulated in which the farming families pay a tax the assessable value of which is given by the operating profit resulting from the balance sheet. The tax paid by these types, indicated by T_j^B, has been calculated by applying the IRPEG rate of 36% to a proxy of the operating profit, obtained as the sum of remuneration from independent work, capital and land.

$$T_j^B = \tau_j^B \cdot \left(w_{labind} \cdot FACTs_{j,labind} + w_{capagr} \cdot FACTs_{j,capagr} + w_{land} \cdot FACTs_{j,land} \right) \tag{6.2}$$

with $j = 1,..., 7$.

The rates applied in the model are shown in table D5. As appears evident, the small and medium size farm household gain a clear advantage from the tax regime, in terms of both a low rate and of a low assessable value.
The impact of this fiscal reform is essentially one of redistribution, that is to say that it influences the level of income and affluence of the families, whilst the impact on the production structure, of an indirect type, is almost negligible.
As can be seen from table D6, the fiscal reform produces a sizeable reduction in disposable income for the types of farm households subject to the new taxation. The reduction in the disposable income of the families is greater than might be expected. Nevertheless, it must be borne in mind that the income of farm households is also made up of other incomes (in particular from subordinate work and from non-agricultural capital), which, in contrast to the agricultural income, are not subject to the increase in taxation.
The impact on the welfare of the farm households, measured in terms of equivalent variation, is the same. In particular, the farms with limited resources suffer a loss in affluence of 5%, the large farm household of 5.4% and the very large family farm of 6.1 %.

7. Conclusions

The MEG-Ismea model is innovative inasmuch as the macro model of general equilibrium is strongly micro-based in relation both to the description of the behaviour of the economic agents in response to the variations in economic policies and to the connection with microdata. The latter aspect is a distinctive peculiarity of the MEG-Ismea model, in that the micro base of information used to construct the Sam, on which the model is calibrated, has also served to define the production and consumption technologies of the farm household and the family types.

[3] Italian legislators have decided to facilitate farmers, and particularly tenant farmers, by exempting from taxation income from independent manual work and farm profits. For this reason the assessable value used here for the simulation does not include remuneration from independent work, but only that relating to the land factor (income from farmlands) and to working capital (agrarian income).

This micro-macro connection allows us to determine the impact of economic policies both on the choices of the farms and on the affluence of the farming families, differentiated by various types. This allows targeting of policies directed at specific sectors of agriculture or farms with particular structural characteristics, and in general a more efficient use of public funds.
The model is also at the forefront in the techniques adopted for modelling the operation of economic policy in the markets and the consequent failures in the markets, with special regard to direct price support measures, trade policies, quantitative limits on production such as the milk quotas, set-aside, decoupled policies and the single payment.
This study sets itself the task of describing a) the information, starting with the Ismea Survey data, used to construct the Italian Social Accounting Matrix, making recourse to complementary sources of information relating to the non-agricultural sector; b) the Social Accounting Matrix; c) the applied model of general equilibrium; and d) the simulations relating to international trade and to the hypothesis of fiscal reform, to validate the model.
The simulation relating to international trade, implemented via a reduction on import duties, was conducted with the aim of taking into consideration the trend in world markets towards greater trade liberalization, in line with the policies agreed at the Wto.
The simulation of fiscal reform was conducted with the objective of harmonizing the taxation of sufficiently large farms with that applied to non-family farms.
Analyses of the “ex ante” assessment of the scenarios described above have shown that the model’s results are in line with expectations and are robust from the economic point of view. In particular, the simulation relating to greater liberalization in agricultural markets has highlighted better allocation of resources and an increase in affluence, in conformity with economic theory on international trade. On the other hand, the fiscal reform proposed in this study has shown a negative redistributive impact on the farm households affected by the higher taxation.
The model presented is a core model which functions as a reference for possible improvements aimed at: a) rendering the macro model even more micro-based; b) allowing use of the macro model on a territorial basis; c) encouraging the “modularization” of the model, with specialized modules on specific subjects such as the environment, trade, tax, inequality and poverty or other aspects of political interest; and d) improving the quality of the econometric calibration.
We believe we can conclude that the MEG-Ismea model is an effective tool for bringing the multiple instances of the many agricultural Italies to the attention of the national and international community with the backing of reliable scientific evidence available in real time, deriving from “ex ante” analysis of reform proposals or “ex post” analysis of the frequent changes in the social, economic and political situations.

Appendix A – Data collection and processing

The information relating to the agricultural sector comes almost exclusively from the Ismea Survey of 1995, thanks to the holistic design of the questionnaire (Ismea, 2005). The Table of Sectorial Interdependence in the agro-foodstuffs system was derived from the Ismea microdata and subsequently integrated with the input-output table of the Italian economy.

The information relating to the rural and urban families comes from "L'indagine sul consumo delle famiglie" (Istat, 1995) regarding family spending, "L'indagine sui redditi delle famiglie italiane" (Banca d'Italia, 1995) regarding the information on work and capital income, and "L'indagine sull'uso del tempo delle famiglie italiane" (Eurisko, 1995) regarding the use of time. It should be noted that the same information, albeit in briefer form, is contained in the Ismea questionnaire, in the section concerned with consumption, income and the use of time. The section relating to consumption is based on the statements of spending and on the average quantities consumed in the week preceding the interview for food, in the previous month for semi-durable goods and in the year preceding the survey for durable goods. The format of the questions was kept similar to that of Istat and the "Banca d'Italia", with the idea of making the possibility of integrating the database on the farming families with that on the non-farming families easier. The section on the use of time in the Ismea questionnaire represents a summarized time report for each family member. In contrast to the Eurisko questionnaire, which reveals to a high degree of detail the activities carried out every quarter of an hour, also taking account of the different use of time on Saturday and Sunday, the Ismea questionnaire shows the time employed in the various activities of the farming family with reference to the average day of the week.

The farming families are divided into seven classes (Perali, Salvioni, Tommasi, 2005), while the non-farming families are divided into rural and urban. These last are in turn divided into three classes according to their income band[4]. The investigation into the consumption of the families distinguishes the units according to their location in centres, other inhabited units or scattered housing. In this study the expression "scattered housing" has been adopted as the identifier for the rural families[5].

The construction of a macro model starting from individual microdata requires that the sample data be projected to the population through the use of expansion techniques, explained below, for the most important aggregates of interest such as the consumption of the families, subordinate and independent work, capital, land, pensions and leisure.

Expansion of the information to the macroeconomic level was implemented in three phases:

Phase 1: projection of Ismea sample data to the universe and the definition of the agricultural component for the variables of interest;

Phase 2: derivation of the dimension relating "to the non-agricultural economy" as the difference between Table of Sectorial Interdependence, from Ismea sources, and the agricultural component indicated above;

Phase 3: distribution of the two macro dimensions "agricultural" and "non-agricultural" among the institutional classes made up of the seven types of farm household, the rural class and the three urban classes.

[4] The subdivision by income class (high, low and medium) of the urban families was made using "L'indagine sul consumo delle famiglie" (Istat, 1995) and "I bilanci delle famiglie italiane" (Banca d'Italia, 1995) together.

[5] This choice is in line with the literature on the subject of rurality (Kayser, 1990) and with the manner of classification used by the Oecd (1996), which classifies the rurality of territories as a function of their density of habitation. That notwithstanding, is should be pointed out that additional availability of information on the density of habitation of units and centres would allow better definition of rural families, given that many inhabited units and a few centres have a low density compatible, for example, with the Oecd threshold of "rurality" of 150 inhabitants per km^2.

A1. The variables of interest.

a. Private consumption

For the reconstruction of private consumption by Italian families, the Ismea Survey and "L'indagine sul consumo delle famiglie" (Istat, 1995) were used in the following manner:

i) harmonization of the consumption categories of the survey on family budgets and on family consumption with the 41 sectors of the Input Output Table, and thus with the aggregate categories in the Ismea Survey. The following table contains the main descriptive characteristics for some categories of food consumption:

ii) distribution of the aggregate consumption data among the seven types of farm household;

iii) projection to the universe of the vector of the sample consumption to obtain the consumption of the farming families at population level;

iv) definition of global level of consumption of the non-agricultural families as the difference between the total private consumption, which can be deduced from the Tables of Sectorial Interdependence of the Italian agro-foodstuffs system, and that of the agricultural families, obtained at point (iii);

v) distribution of the consumption of the non-agricultural families between the rural class and the three urban classes using the information from the "Indagine sul consumo delle famiglie" (Istat, 1995) and "I bilanci delle famiglie italiane" (Banca d'Italia, 1995).

This procedure enabled us to construct the table A1 on the consumption of Italian families.

Table A1 - The consumption of Italian families

Variables	Mean	Std. Dev	Min	Max	Variables	Mean	Std. Dev	Min	Max
Bread, Pasta, other cereals	27.72	17.13	0	201.76	Bread, Pasta, other cereals	32.12	23.38	0	525.00
Meat and fish	55.68	40.82	0	606.05	Meat and fish	91.84	63.56	0	750.00
Oils and Fats	9.22	16.56	0	784.28	Oils and Fats	11.08	13.39	0	255.50
Milk and Dairy Products	25.86	17.23	0	182.25	Milk and Dairy Products	23.48	24.25	0	403.49
Vegetables and Fruits	26.28	18.58	0	274.65	Vegetables and Fruits	24.09	19.72	0	264.00
Sugar, Coffee and Others	11.99	10.33	0	149.03	Sugar, Coffee and Others	9.23	8.18	0	130.30
Beverages	14.85	16.78	0	348.36	Beverages	22.79	25.64	0	226.00
Source Istat 1995. Nr. Obs 32458					Source Ismea 1995. Nr. Obs. 1777				

b. Leisure

The amount of leisure has been calculated for each family type, limited to married or common-law couples. In the Ismea questionnaire, leisure includes the hours of recreation (alone and in the company of other people), the hours of rest and the hours used in personal care, whilst in the Eurisko questionnaire on the use of time, leisure is given by the sum of the hours set aside for personal care, the hours set aside for non-work activities outside the home, corresponding to the hours of recreation according to the Ismea definition, and rest time. The hours set aside for the various activities are expressed as a fraction of the 168 hours in a week. For the non-agricultural classes, the Eurisko and "Banca d'Italia" data were subjected to matching, using as linking variables the geographical distribution and the number of family members.

c. Production factors

The production factors considered in the model are distinguished according to the sectors involved. For the agricultural sector, the variables of interest are subordinate work, independent work, capital and land. For the non-agricultural sectors only, the factors

considered are two: subordinate work and capital. By differentiating between subordinate and independent work in the agricultural sector, it has been possible to assign different remuneration to the two types of work.

c1. Subordinate work and capital
The basic assumption, backed up by a good degree of plausibility, is that subordinate agricultural workers are employed exclusively within the family farms. Any differences are linked to the presence of these agricultural workers in the rural sphere, but this number, considering the rural family identification procedure described earlier, is very limited. Given that assumption, the procedure is as follows:

i) projection to the universe of the vector of the sample values to obtain the remuneration from subordinate work of the agricultural families at population level;
ii) definition of the global level of remuneration from subordinate work relating to the non-agricultural institutional component, as the difference between the total remuneration, which can be deduced from the Tables of Sectorial Interdependence of the Italian agro-foodstuffs system (Ismea, 1997), and that of the agricultural families obtained at point (i);
iii) distribution of the data relating to remuneration from subordinate work among the seven types of farm households;
iv) definition of the "subordinate work remuneration" for the four non-agricultural classes via the construction of weighting vectors.

With regard to the remuneration form capital, the procedure adopted is the same. The sources employed are the Ismea Survey for the agricultural component and "I bilanci delle famiglie italiane" (Banca d'Italia, 1995) for the non-agricultural component.

c2. Independent work and land
As independent work and land are factors employed exclusively in the primary sector, it is sufficient to operate within the agricultural sector. The Ismea data are projected to the universe and distributed between the seven agricultural family classes.

d. Pensions
For this variable, the procedure is identical to that of subordinate work and capital:

i) projection to the universe of the sample values to obtain the value of the pensions received by the agricultural families at population level;
ii) definition of the global level of pensions relating to the non-agricultural institutional component, as the difference between the total pensions, which can be deduced from the Tables of Sectorial Interdependence of the Italian agro-foodstuffs system, and that of the agricultural families;
iii) distribution of the data relating to pensions among the seven types of farm household;
iv) definition of "pensions" for the four non-agricultural classes via the construction of weighting vectors.

The sources employed are the Ismea Survey for the agricultural component and "I bilanci delle famiglie italiane" (Banca d'Italia, 1995) for the non-agricultural component, cross-referenced with the information in "L'indagine sul consumo delle famiglie" (Istat, 1995). Again in this case, the variables of matching between the different sources are the geographical distribution and the number of family members.

A.2. Projection of data to the universe [Phase I]

The phase of projecting the data from the Ismea Survey to the universe rests on the assumption that the Ismea sample is representative at the level of North-West, North-East, Central, South and Islands macro-regional disaggregation, both for the farm unit and for the farming family unit. The value of the variables can be inferred at national population level by using coefficients of expansion obtained through the stratification carried out using the sampling variables OTE and UDE. Determination of the weight of projection to the universe comes about in four phases:

- Phase (a): stratification of the Ismea Survey sample using the variables OTE (with i=1, , 17) and UDE (with j=1, .., 3). There follows the calculation of the sample frequencies for each type of family farm (with k=0,1,…,7; where 0 indicates the non-family farms). Indicating with nc_{ij} the total sample numerosity within the stratification (ij), with nc_{ijk} the subdivision based on the type of family farm within the stratification and with fc_{ijk} the sample frequencies per typology, one obtains:

$$\sum_k nc_{ijk} \leq nc_{ij} \text{ with } k = 1, .., 7 \quad \text{(A.1)}$$

$$\sum_k nc_{ijk} = nc_{ij} \text{ with } k = 0, 1, .., 7$$

$$fc_{ijk} = \frac{nc_{ijk}}{nc_{ij}} \text{ e } \sum_k fc_{ijk} \leq 1 \quad \text{(A.2)}$$

The sample frequency of the k^{th} type is given by:

$$\frac{\sum_i \sum_j nc_{ijk}}{\sum_i \sum_j nc_{ij}} = fc_k \text{ with } i = 1, .., 3 \text{ e } j = 1, .., 17. \quad \text{(A.3)}$$

- Phase (b): indicating with nu_{ij} the numerosity of the farms exceeding 4 UDE, distributed according to the variables of stratification, it is possible to determine the numerosity of such farms projected to the universe for each of the types:

$$nu_{ijk} = nu_{ij} \cdot fc_{ijk} \quad \text{(A.4)}$$

$$\sum_i \sum_j nu_{ijk} = nu_k \quad \text{(A.5)}$$

- Phase (c): the correction, based on the assumption of uniform distribution, is made using a weighting vector (wgt_{ij}) obtained from the sample ratio between the numerosity of family farms and the overall farm numerosity, or:

$$wgt_{ij} = \frac{\sum_k nc_{ijk}}{nc_{ij}} \quad \text{(A.6)}$$

This allows us to rewrite equations (A.4) and (A.5) for the entire reference universe (N):

$$N_{ijk} = \frac{nc_{ij}}{wgt_{ij}} \cdot fc_{ijk} \quad \text{(A.7)}$$

$$\sum_i \sum_j N_{ijk} = N_k \quad \text{(A.8)}$$

- Phase (d): calculation of the projection weighting (Wcu_k) from the sample to the universe for each type of family farm, starting from the results of equations (A.3) and (A.8),

$$Wcu_k = \frac{fc_k}{N_k} \quad \text{(A.9)}$$

Via equation (A.9) it is possible to project the assumed values of the variables of interest from the sample level to that of the universe.

A.3 Definition of the variables of interest of the non-agricultural institutional components [Phase II]

The value of the non-agricultural components is calculated as the difference between the overall national value (*VItot*), which can be deduced from the Tables of Sectorial Interdependence of the Italian agro-foodstuffs system (Ismea, 1997), and that of the agricultural component projected to the universe (*Viu*). For example, the consumption of the rural and urban families is given by the difference between the total national family consumption and the consumption of farming families, obtained from the Ismea Survey data projected to the universe.

A.4 Calculation of the vectors of distribution [Phases III]

The next step in the construction of the data involves the distribution of variables of interest between the institutional components. The variables of interest (*VI*) are distributed at sample level (*VIc*) as follows:

$$VIc = \sum_k VIc_k \quad \text{with } k = 1, .., 7 \tag{A.10}$$

from which the coefficients of sample distribution (Wcr_k):

$$Wcr_k = \frac{VIc_k}{VIc} \quad \text{with} \quad \sum_k Wcr_k = 1 \tag{A.11}$$

At population level (*VIp*) the variable of interest is distributed thus:

$$VIP_k = VIp \cdot Wcr_k \quad \text{con} \quad \sum_k VIp_k = VIp \tag{A.13}$$

With regard to the non-agricultural families (with z = 1,…,4), the variables of interest at population level are distributed on the basis of the coefficients of sample distribution (Wcr_z). One thus obtains:

$$Wcr_z = \frac{VIc_z}{VIc} \tag{A.13}$$

$$(VItot - VIu)_z = (VItot - VIu) \cdot Wcr_z \tag{A.14}$$

$$\text{with} \quad \sum_z (VItot - VIu)_z = (VItot - VIu)$$

Appendix B

Table B1 - The structure of Italian CGE model (MEG model)

- A single country, multi-sector CGE model of the Italian economy focused on the primary and agri-food sector

- A static model calibrated on the 1995 Ismea I/O table.

- Perfect competition in all markets and neoclassical macroeconomic closure.

- 41 sectors: 23 in the primary sectors, 9 in the agro-food sector, 7 in the industrial sector, 2 in the service sector (for details see Table 2.3)

- 2 trade areas: the rest of the European Union (EU) and the Rest of the World (RoW)

- 2 institutional sectors: the households (11 household categories) and the Italian government.

- Multi-stage, constant-returns to scale production functions with imperfect substitution between inputs, including intermediate inputs using nested CES functions.

- 11 types of primary production factors: labor (dependent labor and farm independent labor); capital (capital and agricultural capital) land (three types of land), animals (four types of animals for the sectors 17, 18, 20, 21)
- Dependent labor and capital are perfect substitutes across all the 41 sectors; farm independent labor, agricultural capital, land and animals are perfect substitutes only across the primary sector

- Household preferences are described using a two-stage CES utility function. In the first stage, the utility depend on aggregate consumption and leisure. In the second step each class decides, on one hand, the optimal allocation of the aggregate consumption across the goods produced by the 41 sectors, and, on the other, the optimal allocation labor supply between dependent labor and farm independent labor.

- International trade. Domestic and foreign goods are "Armington" imperfect substitutes on the import side
On the export side, we adopt a large country hypothesis for all goods.
On the import side, we have two cases:
    1) large country hypothesis for some goods: imperfect substitution between production and import so that their prices are different and the market equilibrium price is endogenous.
    2) small country hypothesis with respect to the rest of the world for wheat, durum wheat, soy-bean assuming perfect substitution between production and import so that their prices are identical and the market equilibrium price is exogenously fixed at the world level.

- Modeling of the Common Agricultural Policy's main features such as the single farm payment, intervention price mechanism, import tariffs, production quotas, set-aside, decoupling.
- Political economy interpretation using collective choice rules.

Table B2 - Definition of the sectors		
Primary sector		
1	*CEREALS*	Soft Wheat
2		Durum wheat
3		Rice
4		Corn and other cereals
5		Fodder (mais silage)
6		Not irrigated Fodder
7	*VEGETABLES*	Potatoes
8		Tomatoes
9		Other vegetables and legumes (beans, peas, garlic, cabbages, mushrooms...)
10	*INDUSTRIAL CROPS*	Sugar beet
11		Soy-bean
12		Other industrial crops (hemp, linen, cotton, peanuts, sesame, other oil seeds)
13		Crude tobaccos
14	*VITICULTURE*	Grapes
15	*OLIVE*	Olives
16	*FRUIT*	Citruses, fresh and dry fruit
17	*FLORICOLTURE*	Floriculture and other products (flowers and seeds, spices, sugar, coffee…)
18	*MILK*	Bovine Milk
19	*BEEF*	Bovine meat livestock
20	*FORESTRY*	Forestry
21	*OTHER LIVESTOCK*	Sheep and goat
22		Pork, chicken, rabbits
23	*FISH*	Fish and other sea products
Agro-food sector		
24	*BOVINE*	Fresh and stored bovine meat
25	*MILK PRODUCTS*	Milk and milk products
26	*BREAD,PASTA, TRASF. CEREALS*	Cereal products, bread products and sweets, pasta products
27	*VEG-FRUIT*	Conservation and transformation of fruit and vegetables
28	*OIL AND FATS*	Olive oil, seeds, oil and fats
29	*FEED*	Feed
30	*TOBACCO*	Cigarettes
31	*OTHER AGRO-FOOD IND*	Sugar beet and other products
32	*BEVERAGES*	Wine, alcoholic beverages, beer, non alcoholic beverages, tea, coffee.
Other industries sector		
33	*FUEL AND LUBRIF*	Fuel and oils
34	*ENERGY*	Electric power
35	*WATER*	Water
36	*FERTILIZERS*	Fertilizer
37	*PESTICIDES*	Pesticides
38	*OTHER CHEMICAL AND PHARMACEUTICAL PROD*	Other chemical and pharmaceutical products
39	*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		
40	*TRCOMUNCRINS*	Transports and communication, credit and insurance
41	*OTHER SERVICES*	Other services (business, hotels and public services, leisure - cultural services, Public Administration services, public and private health services…)

Table B3 - Production factors

Factors	Typology	Variables	Factor mobility
Labor (2)	Dependent labor	*[labdip]*	across the 41 sectors
	Farm independent labor	*[labind]*	across the primary sector
Capital (2)	Capital	*[cap]*	across the 41 sectors
	Agricultural capital	*[agrcap]*	across the primary sector
Land (3)	Land A includes:		low between (a) (b) (c) 3, 10, 13, 17, 20
	(a) Land for cereals (1, 4, 5, 11)	*[landcer]*	high between four sectors
	(b) Land for livestock (18, 19, 21, 22)	*[landallev]*	high between four sectors
	(c) Land for arid-crops (2, 6, 12)	*[landaltro]*	high between three sectors
	Land B includes:		low between (d) 15, 16
	(d) Land for vegetables (7, 8, 9)	*[landord]*	high between three sectors
	Land 15 and 16 for olives and fruit		high between two sectors
	Land C includes:		
	Land 14 for grapes	*[land 14]*	no substitutes
Animals (4)	Cows used in milk sector	*[anim18]*	
	Cattle used in bovine sector	*[anim19]*	
	Sheep and goat	*[anim21]*	
	Animals used in other livestock	*[anim22]*	

Table B4 - Composition of the 11 households classes

Farm-households	1	Limited-resource	Any small farm with global family income, gross sales and total farm asset less than the first quartile of the respective distribution. Limited-resource farmers may report farming, a non-farm occupation, or retirement as their major occupation
	2	Retirement	Small farms whose operators report they are retired. (excludes limitedresource farms operating by retired farmers)
	3	Residential/lifestyle	Small farms whose operators report a major occupation other than farming (excludes limited resource farms with operators reporting a non-farm major occupation)
	4	Farming occupation lower-sales	Small farms with gross sales less than the first quartile of the distribution and whose operators report farming as their major occupation. (excludes limited-resource farms whose operators report farming as their major occupation)
	5	Farming occupation higher-sales	Any farm with gross sales between the second and the third quartile of the distribution and whose operators report farming as their major occupation.
	6	Large family farms	Any farm with gross sales over the third quartile of the distribution
	7	Very large family farms	Any farm with gross sales over an arbitrary threshold
Rural households	8	Rural	Istat “Spread Houses” definition
Urban households	9	High income	Any unit with income less than the first “terzile” of the respective distribution
	10	Mid income	Any unit with income between the first and second “terzile” of the respective distribution
	11	Low income	Any unit with income over the second “terzile” of the respective distribution

Table B5 – Data sources

Data	*Famiglie agricole*	*Famiglie rurali e urbane*
Farm and enterprises budget	ISMEA	Input-Output table (Istat, 2000)
Households consumption		"L'indagine sul consumo delle famiglie" (Istat, 1995)
Income and families wealth		"I bilanci delle famiglie italiane" (Banca d'Italia, 1995)
Leisure		"Il time budget degli italiani" (Eurisko, 1995)

Table B6- SAM (1995) data in milliards of euros

	Sectors	Factors	Households	Government	Investments	Exports	Total
Sectors	745.423		565.634	151.124	155.619	229.088	1846.888
Factors	804.738						804.738
Households		778.797		260.678			1039.475
Government	93.580		283.078				376.658
Savings			190.763	-35.144			155.619
Imports	203.147	25.941					229.088
Total	1846.888	804.738	1039.475	376.658	155.619	229.088	

Table B7- Input Output table (1995) data in milliards of euros

	CEREALS	VEGETABLES	INDUSTRIAL CROPS	FRUITS AND FLORIC.	LIVESTOCKS AND FORESTRY	AGRO-FOOD SECTOR	OTHER IND. SECTORS	SERVICES SECTORS	TOTAL
CEREALS	517	0	0	0	4354	6145	0	38	11054
VEGETABLES	0	168	0	0	55	728	0	1384	2335
INDUSTRIAL CROPS	0	0	123	0	3	1505	678	0	2309
FRUITS AND FLORICULTURE	0	0	0	521	34	6089	779	1176	8599
LIVESTOCKS AND FORESTRY	0	0	0	0	1106	12660	1763	1768	17297
AGRO-FOOD SECTOR	0	0	0	0	4915	11232	3188	22089	41424
OTHER INDUSTRIES SECTORS	1395	634	214	1319	823	6900	311538	95041	417864
SERVICES SECTORS	101	53	17	126	410	5882	79633	158324	244546
TOTAL	2013	855	354	1966	11700	51141	397579	279820	**745427**

Table B8 – Productivity factors use in agricultural sector

AGE sectors	Farm independent labor (hours for year)	Dependent labor (hours for year)	Agricultural capital milions of euros	Land hectars
Soft Wheat	165,388,653	49,646,583	4,810	2,443,474
Durum wheat	160,341,691	48,131,579	4,663	3,341,505
Rice	230,907,417	69,314,092	6,715	1,608,394
Corn and other cereals	333,370,283	100,071,530	9,695	4,670,521
Fodder (mais silage)	83,645,240	25,108,738	2,432	1,724,786
Not irrigated Fodder	85,742,526	25,738,304	2,493	8,792,485
Potatoes	38,262,150	30,681,279	1,117	256,452
Tomatoes	180,937,062	145,088,044	5,281	1,126,459
Other veget. and legumes	278,891,725	223,634,973	8,141	725,699
Sugar beet	64,203,188	31,142,787	3,397	1,045,517
Soy-bean	10,871,927	5,273,603	575	569,279
Other ind. crops	17,802,782	8,635,525	942	745,966
Crude tobaccos	897,761	435,473	47	64,096
Grapes	459,805,451	547,887,374	11,834	2,693,155
Olives	152,183,081	229,788,036	1,374	1,278,720
Citruses, fresh and dry fruit	552,133,351	593,311,823	13,591	2,420,758
Floriculture and other prod.	106,596,765	107,908,464	1,572	1,026,953
Bovine Milk	598,689,599	178,206,597	8,457	901,319
Bovine meat livestock	134,830,047	55,222,950	2,207	763,062
Forestry	2,964,137	3,000,612	44	401,268
Sheep and goat	34,217,689	24,984,319	763	167,256
Pork, and others	229,214,957	167,363,129	5,114	1,119,326
Totale	3,921,897,483	2,670,575,815	95,263	37,876,433

Table B9 – Households consumption, data in millions of euros (part I)

i	Sectors	Limited resources	Retirement	Residential life style
1	Soft Wheat	0	0	0
2	Durum wheat	0	0	0
3	Rice	0	0	0
4	Corn and other cereals	0	0	0
5	Fodder (mais silage)	0	0	0
6	Not irrigated Fodder	0	0	0
7	Potatoes	3	4	31
8	Tomatoes	2	2	17
9	Other veget. and legumes	20	24	186
10	Sugar beet	0	0	0
11	Soy-bean	0	0	0
12	Other ind. crops	0	0	0
13	Crude tobaccos	0	0	0
14	Grapes	0	0	0
15	Olives	0	0	0
16	Citruses, fresh and dry fruit	33	32	261
17	Floriculture and other prod.	0	0	0
18	Bovine Milk	0	0	0
19	Bovine meat livestock	0	0	0
20	Forestry	0	0	0
21	Sheep and goat	0	0	0
22	Pork, and others	17	8	143
23	Fish and other sea products	30	8	227
24	Fresh and stored bovine meat	213	155	1805
25	Milk and milk products	53	44	556
26	Cereal,bread and pasta products, sweets	83	56	734
27	Conservation and transformation of fruit and vegetables	4	5	78
28	Olive oil, seeds, oil and fats	12	10	127
29	Feed	0	0	0
30	Cigarettes	81	26	422
31	Sugar beet and other products	12	4	61
32	Wine, alcoholic and non alcoholic beverages	62	69	574
33	Fuel and oils	138	98	1382
34	Electric power	89	44	764
35	Water	55	24	656
36	Fertilizer	0	0	0
37	Pesticides	0	0	0
38	Other chemical and pharmaceutical products	25	22	301
39	Other industry	809	497	5847
40	Transports and communication, credit and insurance	48	29	341
41	Other services	2363	746	4135
	Total	4151	1907	18648

Households consumption, data in millions of euros (Table B9 - part II)

ii	Sectors	Farming occ. lover sales	Farming occ. higher sales	Large family farms	Very large family farms
1	Soft Wheat	0	0	0	0
2	Durum wheat	0	0	0	0
3	Rice	0	0	0	0
4	Corn and other cereals	0	0	0	0
5	Fodder (mais silage)	0	0	0	0
6	Not irrigated Fodder	0	0	0	0
7	Potatoes	20	14	9	4
8	Tomatoes	10	8	5	2
9	Other veget. and legumes	117	85	55	24
10	Sugar beet	0	0	0	0
11	Soy-bean	0	0	0	0
12	Other ind. crops	0	0	0	0
13	Crude tobaccos	0	0	0	0
14	Grapes	0	0	0	0
15	Olives	0	0	0	0
16	Citruses, fresh and dry fruit	146	142	101	29
17	Floriculture and other prod.	0	0	0	0
18	Bovine Milk	0	0	0	0
19	Bovine meat livestock	0	0	0	0
20	Forestry	0	0	0	0
21	Sheep and goat	0	0	0	0
22	Pork, and others	66	66	44	9
23	Fish and other sea products	86	98	69	10
24	Fresh and stored bovine meat	895	883	705	155
25	Milk and milk products	291	274	159	49
26	Cereal,bread and pasta products, sweets	376	343	193	51
27	Conservation and transformation of fruit and vegetables	48	37	28	11
28	Olive oil, seeds, oil and fats	62	63	42	10
29	Feed	0	0	0	0
30	Cigarettes	176	222	147	19
31	Sugar beet and other products	25	32	21	3
32	Wine, alcoholic and non alcoholic beverages	325	256	184	77
33	Fuel and oils	705	745	249	100
34	Electric power	458	365	197	40
35	Water	381	271	185	38
36	Fertilizer	0	0	0	0
37	Pesticides	0	0	0	0
38	Other chemical and pharmaceutical products	131	107	53	29
39	Other industry	3110	2692	868	327
40	Transports and communication, credit and insurance	180	130	72	11
41	Other services	5032	5317	2659	886
	Total	12639	12149	6046	1884

Households consumption, data in millions of euros (Table B9 - part III)

i	Sectors	Rural	Urban high income	Urban mid income	Urban low income
1	Soft Wheat	0	0	0	0
2	Durum wheat	0	0	0	0
3	Rice	0	0	0	0
4	Corn and other cereals	0	0	0	0
5	Fodder (mais silage)	0	0	0	0
6	Not irrigated Fodder	0	0	0	0
7	Potatoes	6	433	422	420
8	Tomatoes	3	230	224	223
9	Other veget. and legumes	38	2588	2525	2514
10	Sugar beet	0	0	0	0
11	Soy-bean	0	0	0	0
12	Other ind. crops	0	0	0	0
13	Crude tobaccos	0	0	0	0
14	Grapes	0	0	0	0
15	Olives	0	0	0	0
16	Citruses, fresh and dry fruit	61	2624	2560	2549
17	Floriculture and other prod.	0	0	0	0
18	Bovine Milk	0	0	0	0
19	Bovine meat livestock	0	0	0	0
20	Forestry	0	0	0	0
21	Sheep and goat	0	0	0	0
22	Pork, and others	18	426	416	429
23	Fish and other sea products	93	2105	2049	2006
24	Fresh and stored bovine meat	400	7317	7137	7107
25	Milk and milk products	99	4324	4217	4199
26	Cereal,bread and pasta products, sweets	158	4075	4175	4379
27	Conservation and transformation of fruit and vegetables	19	575	539	434
28	Olive oil, seeds, oil and fats	28	971	835	783
29	Feed	0	0	0	0
30	Cigarettes	96	3005	2928	2545
31	Sugar beet and other products	14	434	423	368
32	Wine, alcoholic and non alcoholic beverages	117	3239	3159	3147
33	Fuel and oils	260	7066	6893	6865
34	Electric power	167	1991	1942	1933
35	Water	103	0	0	0
36	Fertilizer	0	0	0	0
37	Pesticides	0	0	0	0
38	Other chemical and pharmaceutical products	46	9156	8931	8895
39	Other industry	1520	50458	49228	49031
40	Transports and communication, credit and insurance	91	8407	8201	8167
41	Other services	2859	60989	59515	59289
	Total	6194	170414	166320	165283

Table B10 - Percentage of weekly leisure for the head family	
Limited-resource	0.513
Retirement	0.543
Residential/lifestyle	0.463
Farming occupation lower-sales	0.532
Farming occupation higher-sales	0.518
Large family farms	0.512
Very large family farms	0.500
Rural	0.542
High income	0.723
Middle income	0.669
Low income	0.639

Table B11 - Family incomes, data in million of euros

Typology	Farm independent labor	Dependent labor	Agricultural capital	Land	Pensions	Interst	Total
Limited-resource	619	579	1908	447	408	1026	4987
Retirement	587	212	1150	298	303	620	3170
Residential/lifestyle	13862	959	4377	2414	274	2272	24158
Farming occupation lower-sales	9610	676	3595	1882	823	2324	18910
Farming occupation higher-sales	13855	1581	3793	9512	506	1983	31230
Large family farms	4690	2609	6541	8221	1602	1715	25377
Very large family farms	894	1246	1693	2061	587	887	7368
Rural	5245	0	3816	0	1791	1033	11884
High income	141873	0	161587	0	16903	64557	384920
Mid income	121937	0	126295	0	14232	47514	309979
Low income	62695	0	97605	0	11465	36410	208176
Total	375,866	7,862	412,360	24,834	48,893	160,341	1,030,159

Table B12 - Production value, domestic sales value and export value, data in millions of euros

i	Sectors	Domestic sales	Export UE	Export RoW	Production
1	Soft Wheat	1027	11	0	1038
2	Durum wheat	1110	17	0	1127
3	Rice	743	4	11	758
4	Corn and other cereals	3126	11	1	3139
5	Fodder (mais silage)	1975	0	0	1975
6	Not irrigated Fodder	1351	0	0	1351
7	Potatoes	1532	146	19	1698
8	Tomatoes	1300	79	15	1394
9	Other veget. and legumes	9130	554	120	9804
10	Sugar beet	720	0	0	720
11	Soy-bean	129	2	0	130
12	Other ind. crops	199	18	5	223
13	Crude tobaccos	135	98	70	303
14	Grapes	2055	309	77	2441
15	Olives	2056	0	0	2057
16	Citruses, fresh and dry fruit	9205	931	277	10413
17	Floriculture and other prod.	1027	351	79	1458
18	Bovine Milk	3129	5	5	3139
19	Bovine meat livestock	4919	2	13	4934
20	Forestry	275	4	1	280
21	Sheep and goat	727	14	3	743
22	Pork, and others	4547	71	6	4624
23	Fish and other sea products	7192	220	50	7462
24	Fresh and stored bovine meat	28585	729	179	29493
25	Milk and milk products	15565	494	245	16304
26	Cereal,bread and pasta products, sweets	22514	1652	946	25112
27	Conservation and transformation of fruit and vegetables	2782	1094	499	4374
28	Olive oil, seeds, oil and fats	3831	289	471	4591
29	Feed	2806	103	63	2972
30	Cigarettes	7139	3	3	7145
31	Sugar beet and other products	1941	55	14	2011
32	Wine, alcoholic and non alcoholic beverages	20721	1900	1155	23775
33	Fuel and oils	60613	1977	494	63084
34	Electric power	21471	153	38	21662
35	Water	2281	6	1	2288
36	Fertilizer	1347	0	0	1348
37	Pesticides	559	176	44	779
38	Other chemical and pharmaceutical products	55823	12930	3233	71986
39	Other industry	473565	132156	33039	638760
40	Transports and communication, credit and insurance	112357	14498	3624	130479
41	Other services	468962	10578	2644	482184

Table B13 - Composite good value and import value, data in millions of euros

i	Sectors	Import UE	Import RoW	Composite good
1	Soft Wheat	563	414	2004
2	Durum wheat	102	240	1452
3	Rice	4	14	761
4	Corn and other cereals	165	220	3510
5	Fodder (mais silage)	0	0	1975
6	Not irrigated Fodder	0	0	1351
7	Potatoes	63	31	1626
8	Tomatoes	25	0	1325
9	Other veget. and legumes	341	123	9594
10	Sugar beet	13	0	733
11	Soy-bean	0	278	406
12	Other ind. crops	36	677	913
13	Crude tobaccos	52	69	256
14	Grapes	10	4	2068
15	Olives	3	1	2060
16	Citruses, fresh and dry fruit	341	461	10007
17	Floriculture and other prod.	1471	364	2862
18	Bovine Milk	414	9	3552
19	Bovine meat livestock	524	141	5584
20	Forestry	529	133	938
21	Sheep and goat	227	239	1192
22	Pork, and others	339	164	5049
23	Fish and other sea products	1739	370	9301
24	Fresh and stored bovine meat	3775	966	33326
25	Milk and milk products	2564	201	18330
26	Cereal,bread and pasta products, sweets	616	67	23198
27	Conservation and transformation of fruit and vegetables	623	327	3731
28	Olive oil, seeds, oil and fats	951	545	5327
29	Feed	288	316	3410
30	Cigarettes	974	222	8335
31	Sugar beet and other products	228	62	2231
32	Wine, alcoholic and non alcoholic beverages	1383	199	22303
33	Fuel and oils	10374	3543	74529
34	Electric power	2932	772	25174
35	Water	0	0	2281
36	Fertilizer	4	1	1353
37	Pesticides	291	75	924
38	Other chemical and pharmaceutical products	19165	5139	80127
39	Other industry	88660	26612	588836
40	Transports and communication, credit and insurance	3733	933	117023
41	Other services	18395	4599	491956

Appendix C: The MEG Ismea model description

Sets

$i,y \in I,Y = \{1, 2, ..., 41\} =$ = Sectors (products)

$f \in F = \{Labdip, Labind, Capagr, Cap, Land A, Land B, Land C, Anim18, Anim19, Anim21, Anim22\}$ Production factors

$j \in J = \{1, 2, ...,11\}$ = Consumer's classes

Parameters

τ_{p_i}	Indirect tax rate on production
c_{p_i}	Production payments
$c_{i,f}$	Payment received per unit of factor *f* employed
$Cfix_j$	Decoupled payments
τ	Direct tax rate
τ_{m_i}	Tariff rate
m_i	Fee applied on the quantity of milk exceeding the quota
c_{land_i}	Set-aside payment
$\overline{Xs}_i$	Production quota
$\overline{P_i}$	Intervention price
Peu_i	Price level in the European market
$\Pr ow_i$	Price level in the rest of the world market
$TOTtime$	Total time available

Variables

Xs_i	Production in sector *i*
VA_i	Value added
$INTtot_i$	Aggregate intermediate input
$FACTd_{i,f}$	Factor demand
$INT_{y,i}$	Intermediate input
π_i	Profit for sector *i*
Pd_i	Domestic price of goods
w_f	Factors cost
$Ptax_i$	Gross price comprehensive of the direct consumption tax
Pva_i	Implicit price of value added
$P\text{int}_i$	Implicit price of aggregate intermediate input
$LandT_i$	Quantity of agricultural land in each sector
$Land_{i,inut}$	Quantity of agricultural land in each sector allocated to set-aside
wT	Average use value of land
w_{land_i}	Remuneration of the land allocated in the production of good *i*

λ_i	Excess production expressed as a percentage of the permitted quota
$XXDE_i$	Quantity sold in the market
Xxd_i	Domestic sales
$Dstock_i$	Quantity sold to the government
Eeu_i	Production exported in Europe
$Erow_i$	Production exported in the rest of the world
EXR	Exchange rate with respect to the rest of the world
X_i	Composite good
Meu_i	Imports from Europe
$Mrow_i$	Imports from the rest of the world
G	Aggregate government consumption
$Ggov_i$	Government consumption demand of each good
Pg	Implicit price of aggregate government consumption
$INVEST$	Aggregate gross investment
INV_i	Quantity of goods used
U_j	Utility level
Pu_j	Implicit price of a unit of leisure/marginal utility of consumption
C_j	Aggregate consumption
Pc_j	Implicit price of aggregate consumption
$LEIS_j$	Leisure
$Xd_{i,j}$	Consumption demand
$PENS_j$	Pensions
$BOND_j$	Bonds
YH_j	Available income
$w_{lab,j}$	Opportunity cost of leisure

Equations

Sectors

Profit and production functions:

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

$$\text{s.t.} \quad Xs_i = CES\ (VA_i, INTtot_i)$$

$$\text{FOC:} \quad \begin{cases} VA_i = f\left[\dfrac{Pd_i \cdot \left(1 - \tau_{p_i} + c_{p_i}\right)}{Pva_i}\right] \\ INTtot_i = f\left[\dfrac{Pd_i \cdot \left(1 - \tau_{p_i} + c_i\right)}{P\text{int}_i}\right] \end{cases}$$

Primary factors demand:

$$\text{Min} \quad Pva_i \cdot VA_i = \sum_f \left(w_f - c_{i,f}\right) \cdot FACTd_{i,f}$$

$$\text{s.t.} \quad VA_i = CES\ \left(FACTd_{i,f}\right)$$

$$\text{FOC :} \quad FACTd_{i,f} = f\left(\frac{Pva_i}{w_f - c_{i,f}}\right)$$

Intermediate factors demand:

$$\text{Min} \quad P\text{int}_i \cdot INTtot_i = \sum_y Ptax_y \cdot INT_{yi}$$

$$\text{s.t.} \quad INTtot_i = CES\ \left(INT_{i,j}\right)$$

$$\text{FOC :} \quad INT_{yi} = f\left(\frac{P\text{int}_i}{Ptax_y}\right)$$

Land demand with set-aside:

Max $wT \cdot LandT_i = w_{land_i} \cdot FACTd_{i,land} + c_{land_i} \cdot Land_{i,inut}$

s.t. $LandT_i = CET\left(FACTd_{i,Land} + Land_{i,inut}\right)$

FOC:
$$\begin{cases} FACTd_{i.Land} = f\left(\dfrac{w_{land_i}}{wT}\right) \\ Land_{i,inut} = f\left(\dfrac{c_{land_i}}{wT}\right) \\ with \quad \dfrac{Land_{i,inut}}{LandT_i} \geq 10\% \end{cases}$$

Intervention prices:

Max $PP_i \cdot Xs_i = \overline{P_i} \cdot Dstock + Pd_i \cdot XXDE_i$

s.t. $Xs_i = CET(XXDE_i + Dstock_i)$, where $XXDE_i = Xxd_i + E_i$

FOC:
$$\begin{cases} Dstock_i = f\left(\dfrac{\overline{P_i}}{PP_i}\right) \\ XXDE_i = f\left(\dfrac{Pd_i}{PP_i}\right) \end{cases}$$

Quota (milk)

Profit function:

Max $\pi = Pd_i \cdot Xs_i \cdot \left(1 - \tau_{p_i} + c_{p_i}\right) - m_i \cdot Xs_i \cdot \dfrac{\lambda_i}{1+\lambda_i} - \left(Pva_i \cdot VA_i + P\text{int}_i \cdot INTtot_i\right)$

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

HOUSEHOLDS

Utility function:

Max $U_j = CES\left(C_j, Leis_j\right)$

s.t. $Pu_j \cdot U_j = Pc_j \cdot C_j + w_{lab} \cdot LEIS_j$

Aggregate consumption and leisure choice:

FOC:
$$\begin{cases} C_j = f\left(\frac{Pu_j}{Pc_j}\right) \\ LEIS_j = f\left(\frac{Pu_j}{w_{lab}}\right) \end{cases}$$

Consumption demand:

Min $Pc_j \cdot C_j = \sum_i Ptax_i \cdot Xd_{j,i}$

s.t. $C_j = CES\left(Xd_{i,j}\right)$

FOC: $Xd_{i,j} = f\left(\frac{Pc_j}{Ptax_i}\right)$

Labor supply:

Max $w_{lab,j} \cdot LABOUR_j = w_{labdip} \cdot FACTs_{j,labdip} + w_{labind} \cdot FACTs_{j,labind}$

s.t. $LABOUR_j = CET\left(FACTs_{j,labdip}, FACTs_{j,labind}\right)$

FOC:
$$\begin{cases} FACTs_{j,labdip} = f\left(\frac{w_{labdip}}{w_{lab,j}}\right) \\ FACTs_{j,labind} = f\left(\frac{w_{labind}}{w_{lab,j}}\right) \end{cases}$$

Supply of animals

$$FACTs_{j,anim} = f\left(\frac{w_{anim}}{w0_{anim}}\right)$$

Available income:

$YH_j = \sum_f (1-\tau) \cdot w_f \cdot FACTs_{j,f} + (1-\tau) \cdot PENS_j + (1-\tau) \cdot r \cdot Pg \cdot BOND_j + Cfix_j$

available income includes also the single decoupled payment $Cfix_j$ for household *j* which is a per hectare lump-sum transfer.

INTERNATIONAL TRADE

Exports:

Max $Pxs_i \cdot Xs_i = Pd_i \cdot XXD_i + Peu_i \cdot Eeu_i + \Pr ow_i \cdot Erow_i$

s.t. $Xs_i = CET\left(XXD_i,\ Eeu_i,\ Erow_i\right)$

FOC:
$$\begin{cases} Xxd_i = f\left(\dfrac{Pd_i}{Pxs_i}\right) \\ Eeu_i = f\left(\dfrac{Peu_i}{Pxs_i}\right) \\ Erow_i = f\left(\dfrac{\Pr ow_i}{Pxs_i}\right) \end{cases}$$

Imports:

Two cases:

1) Large country hypothesis:

Min $P_i \cdot X_i = Pd_i \cdot XXD_i + Peu_i \cdot Meu_i + \Pr ow_i \cdot EXR \cdot \left(1+\tau_{m_i}\right) \cdot Mrow_i$

s.t. $X_i = CES\left(XXD_i,\ Meu_i,\ Mrow_i\right)$

FOC:
$$\begin{cases} Xxd_i = f\left(\dfrac{P_i}{Pd_i}\right) \\ Meu_i = f\left(\dfrac{P_i}{Peu_i}\right) \\ Mrow_i = f\left(\dfrac{P_i}{\Pr ow_i \cdot EXR \cdot \left(1+\tau_{m_i}\right)}\right) \end{cases}$$

2) Small country hypothesis with respect to the rest of the world:

Min $P_i \cdot X_i = \Pr ow_i \cdot EXR \cdot \left(1+\tau_{m_i}\right) \cdot \left(XXD_i + Mrow_i\right) + Peu_i \cdot Meu_i$

s.t. $X_i = CES\left(XXD_i + Mrow_i,\ Meu_i\right)$

FOC:
$$\begin{cases} Xxd_i + Mrow_i = f\left(\dfrac{P_i}{\Pr ow_i \cdot EXR \cdot \left(1+\tau_{m_i}\right)}\right) \\ Meu_i = f\left(\dfrac{P_i}{Peu_i}\right) \end{cases}$$

EQUILIBRIUM CONDITIONS

Goods: $X_i = \sum_y INT_{iy} + \sum_j Xd_{j,i} + Ggov_i + INV_i$

Factors: $\sum_i FACTd_{i,f} = \sum_j FACTs_{j,f}$

Table C1 - Elasticity of substitution among productivity sectors

Sectors	Input	Intermediate goods	Import	Export
Cereals	0.24	0.5	2.2	1.5
Vegetables	0.24	0.5	2.2	1.5
Fruit	0.24	0.5	2.2	1.5
Industrial crops	0.24	0.5	2.2	1.5
Bovine Milk	0.24	0.5	2.8	1.5
Bovine meat livestock	0.24	0.5	2.8	1.5
Sheep and goat	0.24	0.5	2.8	1.5
Pork, and others	0.24	0.5	2.8	1.5
Fish and other sea products	0.2	0.5	2.8	1.5
Fresh and stored bovine meat	1.12	0.5	2.8	1.5
Milk and milk products	1.12	0.5	2.2	1.5
Beverages	1.12	0.5	3.1	1.5
Other agroindustry	1.12	0.5	2.2	1.5
Industry	1.26	0.5	1.19	1.5
Services	1.26	0.5	1.19	1.5

Table C2 - Elasticity of substitution among land groups

Livestoks	(18, 19, 21, 22)
Cereals	(1, 4, 5, 11)
Industrial crops	(2, 6, 12)
Land A	(Livestocks., Cereals, Industrials Crops)
Vegetables	(7, 8, 9)
Land B	(Vegetables, 15, 16)
Land	(Land A, Land B, Land C)

Appendix D1 – Simulation relating to international trade

Table D1 – The initial level of dutes (% of the value of the imports from the rest of the world)

i	Sectors	%
1	Soft Wheat	60.8%
2	Durum wheat	95.4%
3	Rice	33.3%
4	Corn and other cereals	7.3%
5	Fodder (mais silage)	0.0%
6	Not irrigated Fodder	0.0%
7	Potatoes	5.3%
8	Tomatoes	49.6%
9	Other veget. and legumes	12.3%
10	Sugar beet	0.0%
11	Soy-bean	0.0%
12	Other ind. crops	0.0%
13	Crude tobaccos	8.1%

Table D2 – Percentage variation in the domestic sales, import and export.

i	Sectors	Domestic sales	Import from EU	Import from RoW	Export to EU	Export to RoW
1	Soft Wheat	3.33	-16.98	66.00	0.00	0.62
2	Durum wheat	3.98	-98.17	105.28	0.00	0.62
3	Rice	1.41	2.71	17.96	-3.92	-3.14
4	Corn and other cereals	-0.31	-0.06	8.47	-0.50	0.31
5	Fodder (mais silage)	-0.11	0.00	0.00	0.00	0.00
6	Not irrigated Fodder	-0.27	0.00	0.00	0.00	0.00
7	Potatoes	-0.03	-0.02	6.13	-0.21	0.60
8	Tomatoes	-0.05	-0.04	58.99	-0.21	0.60
9	Other veget. and legumes	-0.02	0.00	14.35	-0.21	0.60
10	Sugar beet	-0.01	0.22	0.00	0.00	0.00
11	Soy-bean	-0.25	0.00	-0.07	-0.19	0.00
12	Other ind. crops	-0.57	0.09	0.09	-1.01	-0.21
13	Crude tobaccos	-0.16	-0.05	-0.05	-0.32	0.48
14	Grapes	0.02	0.08	0.08	-0.26	0.55
15	Olives	0.10	0.32	0.32	-0.46	0.34
16	Citruses, fresh and dry fruit	-0.03	-0.02	-0.02	-0.19	0.62
17	Floriculture and other prod.	-0.02	0.03	0.03	-0.26	0.55
18	Bovine Milk	-0.08	-0.02	-0.02	-0.26	0.55
19	Bovine meat livestock	0.00	-0.02	-0.02	-0.16	0.65
20	Forestry	-0.13	-0.03	-0.03	-0.31	0.50
21	Sheep and goat	-0.20	0.05	0.05	-0.50	0.31
22	Pork, and others	0.15	-0.03	-0.03	0.04	0.85
23	Fish and other sea products	-0.01	-0.06	-0.06	-0.13	0.68
24	Fresh and stored bovine meat	0.00	-0.05	-0.05	-0.13	0.68
25	Milk and milk products	-0.04	-0.05	-0.05	-0.17	0.64
26	Cereal, bread and pasta prod.	2.76	0.86	0.86	2.17	3.00
27	Conse. Trans. of fruit and veget.	0.12	0.08	0.08	-0.14	0.67
28	Olive oil, seeds, oil and fats	0.19	0.20	0.20	-0.20	0.62
29	Feed	0.17	-0.08	-0.08	0.12	0.93
30	Cigarettes	-0.05	-0.07	-0.07	-0.15	0.66
31	Sugar beet and other products	0.11	0.16	0.16	-0.25	0.56
32	Wine, alc.and non alc. Bever.	0.05	0.01	0.01	-0.13	0.68
33	Fuel and oils	0.02	-0.02	-0.02	-0.14	0.67
34	Electric power	0.03	0.00	0.00	-0.15	0.66
35	Water	0.02	0.00	0.00	-0.15	0.66
36	Fertilizer	1.26	1.22	1.22	-0.14	0.67
37	Pesticides	0.65	0.61	0.61	-0.14	0.67
38	Other chem.. and pharm. Prod.	-0.01	-0.05	-0.05	-0.14	0.67
39	Other industry	-0.06	-0.09	-0.09	-0.14	0.67
40	Transp. Comm.., credit and ins.	0.01	-0.03	-0.03	-0.14	0.67
41	Other services	0.02	-0.04	-0.04	-0.12	0.69

Table D3 – Percentage variation of the: production, composite good, proce of composite good and domestic price.

i	Sectors	Production	Composite goods	Composite goods (price)	Domstic good (price)
1	Soft Wheat	3.31	8.08	-9.29	0.00
2	Durum wheat	3.93	9.01	-10.55	0.00
3	Rice	1.32	1.69	2.02	2.58
4	Corn and other cereals	-0.31	0.23	-0.24	0.21
5	Fodder (mais silage)	-0.11	-0.11	0.20	0.20
6	Not irrigated Fodder	-0.27	-0.27	0.49	0.49
7	Potatoes	-0.04	0.08	-0.08	0.01
8	Tomatoes	-0.05	-0.04	0.00	0.01
9	Other veget. and legumes	-0.02	0.16	-0.13	0.02
10	Sugar beet	-0.01	0.00	0.19	0.19
11	Soy-bean	-0.25	0.48	-0.61	0.00
12	Other ind. crops	-0.60	-0.05	0.12	0.55
13	Crude tobaccos	-0.06	-0.10	0.05	0.09
14	Grapes	0.00	0.02	0.05	0.05
15	Olives	0.10	0.10	0.19	0.19
16	Citruses, fresh and dry fruit	-0.03	-0.03	0.00	0.00
17	Floriculture and other prod.	-0.05	0.01	0.02	0.05
18	Bovine Milk	-0.08	-0.07	0.04	0.05
19	Bovine meat livestock	0.00	0.00	-0.02	-0.02
20	Forestry	-0.13	-0.06	0.02	0.08
21	Sheep and goat	-0.21	-0.11	0.13	0.21
22	Pork, and others	0.15	0.13	-0.14	-0.15
23	Fish and other sea products	-0.01	-0.02	-0.03	-0.04
24	Fresh and stored bovine meat	0.00	-0.01	-0.03	-0.04
25	Milk and milk products	-0.03	-0.04	-0.01	-0.01
26	Cereal, bread and pasta prod.	2.73	2.71	-1.50	-1.55
27	Conse. Trans. of fruit and veget.	0.12	0.11	-0.02	-0.03
28	Olive oil, seeds, oil and fats	0.21	0.20	0.00	0.01
29	Feed	0.19	0.13	-0.17	-0.21
30	Cigarettes	-0.05	-0.05	-0.02	-0.02
31	Sugar beet and other products	0.10	0.12	0.04	0.04
32	Wine, alc.and non alc. Bever.	0.07	0.05	-0.03	-0.04
33	Fuel and oils	0.02	0.01	-0.02	-0.03
34	Electric power	0.03	0.02	-0.02	-0.03
35	Water	0.02	0.02	-0.03	-0.03
36	Fertilizer	1.26	1.26	-0.03	-0.03
37	Pesticides	0.47	0.64	-0.02	-0.03
38	Other chem.. and pharm. Prod.	0.00	-0.02	-0.02	-0.03
39	Other industry	-0.04	-0.07	-0.02	-0.03
40	Transp. Comm.., credit and ins.	0.01	0.01	-0.03	-0.03
41	Other services	0.02	0.01	-0.04	-0.04

Table D4 – Impact on disposable income and family welfare (percentage variation and equivalent variation)

Families	Disposable income (%)	Consumption (%)	Leisure (%)	Price (%)	EV/inital income (%)
Limited-resource	0.09	0.11	-0.11	-0.06	0.07
Retirement	0.09	0.10	-0.05	-0.08	0.06
Residential/lifestyle	0.09	0.10	0.00	-0.09	0.06
Farming occupation lower-sales	0.07	0.09	0.00	-0.08	0.05
Farming occupation higher-sales	0.13	0.15	0.05	-0.08	0.09
Large family farms	0.15	0.19	-0.01	-0.08	0.08
Very large family farms	0.16	0.21	-0.06	-0.07	0.06
Rural	0.04	0.04	-0.01	-0.07	0.02
High income	0.03	0.04	-0.01	-0.07	0.01
Mid income	0.03	0.04	-0.01	-0.07	0.01
Low income	0.04	0.04	-0.01	-0.07	0.02

Appendix D2 – Fiscal simulation

Table D5– Rates applied in the model

Families	Scenario A	Scenario B
Limited-resource	7.91%	36%
Retirement	6.93%	36%
Residential/lifestyle	8.02%	36%
Farming occupation lower-sales	7.59%	36%
Farming occupation higher-sales	26.48%	36%
Large family farms	22.58%	36%
Very large family farms	19.97%	36%

Table D6 - Impact on disposable income and family welfare (percentage variation and equivalent variation)

Families	Disposable income (%)	Consumption (%)	Leisure (%)	Price (%)	EV/inital income (%)
Limited-resource	-5.41	-5.62	-2.17	0.58	-4.99
Retirement	-3.66	-3.82	-2.08	0.55	-3.33
Residential/lifestyle	-3.39	-3.44	-3.15	0.53	-3.31
Farming occupation lower-sales	-2.97	-3.02	-2.68	0.56	-2.87
Farming occupation higher-sales	-3.90	-4.02	-3.43	0.56	-3.67
Large family farms	-6.27	-6.69	-4.31	0.56	-5.41
Very large family farms	-7.61	-8.35	-4.23	0.56	-6.12
Rural	0.10	0.12	0.03	0.57	0.07
High income	0.15	0.18	0.06	0.55	0.09
Mid income	0.15	0.17	0.06	0.55	0.10
Low income	0.17	0.19	0.07	0.55	0.14

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