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ex Centro per la Formazione in Economia e Politica dello Sviluppo Rurale, Portici

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RISK MANAGEMENT TOOLS FOR ITALIAN FARMERS: PUBLIC SUPPORT, PROBLEMS AND PERSPECTIVES UNDER CAP REFORM

JEL classification: Q18, Q14, C15

Fabian Capitanio[1], Barry K. Goodwin[2], Geoffroy Enjolras[3], Felice Adinolfi[4]

Abstract. *Currently there is ample discussion among EU Institutions (European Commission, European Parliament, and Member States' governments) on the possibility of setting up a comprehensive EU-wide framework on risk and crises in agriculture. With the changes introduced in the proposed regulations on rural development for the period 2014 - 2020, the Commission not only confirms the provisions contained in Regulation 73/2009 (placing them, however, in the multi-annual setting of the funding for actions to support rural development), but introduces a new measure, called IST (the Income Stabilization Tool), aimed at supporting risk management for farm incomes using insurance principles. This paper therefore discusses the main issues related to public intervention for risk and crisis management in agriculture, with emphasis on the main criticisms of an overall public support policy aiming to manage risk in agriculture in Italy..*

Keywords: *crop insurance, risk management tools, public intervention*

1. Introduction

Alongside the particular characteristics of agricultural production there is no doubt that agriculture in developed countries has reached such levels of complexity that both the ranking of the various causes of income variability and the impact of a given variation in farm revenue on the viability of the farm enterprise have radically changed. The organization of agricultural production and its integration in the agro-food chain, the increased use by farmers of services such as credit, professional technical assistance, finance and insurance, the regulatory system within which farms operate and the diversification of income-generating activities within rural households are all factors that make the risk faced by today's farmers in developed economies something profoundly different and more articulated than it was only a few decades ago.

The topic of risk management in agriculture has always been at the margin of the European debate. The main reasons lie firstly in the structure of EEC/EC/EU intervention, which, for nearly half a century, has effectively ensured the presence of mechanisms to stabilize markets, and secondly, (in the subsequent development) in the use of hedging instruments within individual

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Member States (MS), covering, in particular, production risks, many of which have developed along very different trajectories, creating prospects for intervention that have not evolved according to common paths. This diversity of available instruments, the ongoing process of EU enlargement and the specific features of the various "agricultures", have led to a complex set of risk management systems in different Member States, which differ in the measures adopted and the degree of coverage that the practices achieve.

With the phasing out of guarantees provided by the CAP to European farmers in terms of stabilizing markets, the issue of risk management tools is gradually acquiring an ever more important role, this being reflected in a series of innovations that first appeared in the 2009 'Health Check' and then in the proposed Commission regulation for rural development policy 2014-2020.

With the changes introduced in the proposed regulations on rural development for the period 2014 - 2020, the Commission not only confirms the provisions contained in Regulation 73/2009 (placing them, however, in the multi-annual setting of the funding for actions to support rural development), but introduces a new measure, called IST (the Income Stabilization Tool), aimed at supporting risk management for farm incomes using the mechanism of insurance.

The IST aims to create a safety net for farmers, protecting them from the negative consequences that may arise from adverse trends in income. A risk that includes not only production, but is all-encompassing, referring to the income of farmers, and therefore, to all the adverse circumstances that might affect a farm's performance.

The IST, therefore, while framed in the same logic of risk-management measures already available, is a much more ambitious tool, aiming to supplement and strengthen the safety net already provided by direct payments, but which discounts the absence of a connection with market trends. The Commission's proposal defines the admissible costs for financing and, if only in part, the characteristics of how the instrument itself functions, especially by establishing its operational limits which should be consistent with the commitments undertaken at the WTO.

This study is intended to contribute to the debate, initiated by the Commission in 2005 among EU instutions and stakeholders (EC- Commission of the European Communities, 2005a, 2005b), on private strategies that could be adopted by farmers to manage their risk and on the role that public policies might play in supporting such strategies. The ultimate objective is the definition of a framework of policy instruments that could be adopted in Italy to effectively confront the problem of risk and crisis management in agriculture.

2. Welfare analysis of risk

The ultimate effect of risk on the economic welfare of agents is conceivably the result of both the characteristics of the potentially dangerous random events and of the complex set of public and private actions that can be taken, both ex-ante and ex-post.

Risk generating events can be distinguished according to:

- the frequency of the event, from rare to frequent;
- the severity of damages caused, from negligible to significant;
- the degrees of correlation between affected units, from idiosyncratic (i.e. events that independently affect single units) to systemic (i.e. events which simultaneously affect many units).

A fourth dimension in terms of predictability should also be added, to distinguish predictable risks from unpredictable crisis.

Considering these four dimensions, different strategies may be suitable for managing risky events, reducing the risk or mitigating its consequences, that include private and public actions, both ex-ante and ex-post.

Through private actions, when the potential damage is limited, risk can be retained and farmers can cope with the consequences of bad outcomes by taking ex-post actions. The most common risk-coping strategy is based on the use of personal financial reserves, such as savings, or of credit, which smooth consumption in face of varying income. Avoidance, instead, is a better strategy when the potential damage is very high. In such cases, risk is evaded by not taking risky actions or by preventatively eliminating its negative effects, for example by investing in physical protection devices or by taking the so-called income-skewing decisions, i.e. the decision to engage in lower risk-lower income activities (Dercon, 2004). In many cases, the most effective risk reduction strategy is diversification, by engaging in various uncorrelated risky activities. Diversification, however, always comes at the cost of foregoing possible gains due to specialization in the activities which have the highest expected return. Apart from extreme situations of negligible or very damaging risks, the vast majority of economically relevant risks can be transferred onto other subjects.

The typical risk transfer tool is insurance, the efficiency of which might be limited by the presence of informational problems such as asymmetric information (leading to adverse selection) and hidden actions (generating moral hazard), which, in extreme cases, can be a cause for serious market failure. In agriculture, insurance often also faces a problem due to the systemic character of the risks, which may limit the effectiveness of risk pooling.

Public policies aimed at dealing with risks in agriculture can be classified as:

- direct measures, which include both ex-ante policies, such as preventive public investments that reduce the potential damage of negative events, and ex-post policies designed to mitigate the effects of damage suffered by farmers, usually consisting in ex-post compensatory payments;

and

- indirect measures, intended to increase the risk management ability of farmers, usually justified on efficiency grounds as corrections for various forms of market failure. Examples include:

(i) incentives for the development of insurance markets, through granting subsidies for premium payments; the provision of reinsurance; the provision of information to reduce asymmetry; and/or the assurance of competition in the insurance industry; (ii) institutional innovations for the functioning of financial markets capable of providing new risk management instruments; (iii) incentives to the formation of precautionary savings and/or to the access to credit, which might increase the ability of farmers to retain risk.; (iv) information gathering and distribution.

From the social point of the view, public actions intended at complementing the actions taken privately by economic agents can be justified when they determine a social welfare improvement. Traditionally, the welfare effects of behaviour under risk and related policy is analyzed through models of expected utility maximization. In this context, to assess the welfare effects of a risk- managing policy correctly, three aspects should be underlined:

1. models based on expected utility maximization under common specifications of the utility function may greatly underestimate the potential benefits of the elimination of extreme, rare losses;
2. the correct choice of the objective of economic agents facing income fluctuations should

be the stabilization of consumption rather than current income. The theory of consumer behaviour postulates that the yearly level of consumption is not directly linked to current income, but rather to the expected value of long term wealth, and this is widely confirmed by empirical evidence. This emphasizes the role of savings and borrowing as private risk-management tools;

3. finally, when it is considered that the relevant consumption decision unit is the rural household, whose income can be composed of revenues from farming as well as off-farm employment and other financial activities, the extent of the negative welfare consequences of farm income fluctuations might be reconsidered when other income-generating activities are present.

The assessment of the relative merits of different policy instruments aiming to achieve the same objective must consider the effects not only on the welfare of farmers, but also on that of other economic agents. Transfer efficiency is a useful instrument for this task, because it compares benefits accruing to agricultural producers with the costs borne by taxpayers and consumers. Assessment of transfer efficiency is particularly relevant when public policies are implemented in the context of market failure, such as when a monopoly power exists or there is incomplete information.

Besides distributive effects, the assessment of a policy must also evaluate other aspects such as policy-induced distortion in resource allocation, consistency with existing and possible future international trade agreements; coherence with other relevant policy objectives.

It must be noted that the presence of public policies that reduce risk exposure might generate incentives resulting in perverse policy effects, favouring the adoption of excessive risk-taking behaviour, with possible negative effects on resource allocation, negative environmental externalities and crowding-out of alternative possibly efficient private actions.

Regarding consistency with existing norms and regulations, analysis of the set of existing constraints imposed by WTO rules on risk and crisis policies, of the EU discipline on State aids and of the financial discipline of EU budget shows that, whereas both WTO rules and existing guidelines for state aids in agriculture are rather permissive and allow for introduction of generous income protection policies, the existing financial commitments of the new CAP are likely to impose severe constraints on the amounts of resources available for new policies to be implemented at a significant level.

3. Theoretical framework

The most widely used theoretical model of analysis of the consequences of the presence of uncertainty on economic behaviour is the so-called **expected utility** framework. It is based on the definition of the individual agent's structure of preferences for *lotteries,* (L). A lottery is defined by a complete set of possible outcomes[5] $\mathbf{X} = \{X_1, \ldots X_N\}$ and associated probabilities $\mathbf{p} = \{p_1, \ldots, p_N\}$.

[5] Notice that the theoretical framework is very general: the relevant outcome X is whatever generates "utility". Depending on the context, in specific applications it might be expressed in monetary levels, quantities of food, etc. something we will return to later.

Given a complete preference structure defined for lotteries[6], it can be demonstrated[7] that a Von Neumann-Morgestern (VNM) utility function U(X), defined for the levels of outcome X, and unique up to an affine transformation, exists such that to choose the 'best' lottery is equivalent to choosing the one that maximizes the expected value of the VNM utility defined as

$$E[U(X)] = \sum_i p_i U(X_i), \text{ for } i = 1, \ldots, N$$

Given the VMN utility function, the value of each risky prospect can be synthesized by the **certainty equivalent**, C(**X**,**p**), defined as the level of outcome X_c such that $U(X_c) = E[U(X)]$, in the sense that risky prospects ranked according to the expected utility could be equally ranked according to their certainty equivalent. The definition of certainty equivalent allows for the assessment of the cost imposed by the presence of uncertainty in a way that is fully consistent with the concept of consumer's surplus, an analytical device long accepted in the literature on welfare economics. Given the VMN utility function, in fact, the 'damage' caused by the presence of uncertainty could be, in principle, measured by the **risk premium**, RP(**X**,**p**), which is defined as the difference between the expected outcome of the lottery, E(**X**,**p**) and its certainty equivalent, C(**X**,**p**) and is commonly interpreted as the maximum amount, expressed in terms of units of the relevant outcome X, that an agent characterized by the preferences described by the VNM utility function U(X) would be willing to pay to give up the risky prospect in exchange for a certain amount equal to the expected outcome, E(**X**,**p**).

Notice that the risk premium is a function of the entire distribution of outcomes and it depends on the full structure of preferences. While it is possible, in principle, to measure it for a given individual facing a given risky prospect of which the probability distribution is known, and assuming a given structure of preferences, it is virtually impossible to estimate it in a theoretically consistent credible way from observed choices: there will simply never be enough data to be able to identify both the preference structure and the probability distribution.

The expected utility framework has also been used to provide a formal characterization of **risk aversion** based on the notion of risk premium. Essentially, an economic agent is said to be risk averse if her or his preferences over risky prospects express strictly positive risk premiums. The structure of the individual's preferences will naturally determine also the 'degree' of aversion towards a given risk prospect, degree which would, in principle, imply a strongly idiosyncratic component.

To measure the degree of risk aversion, the coefficient of (local) **absolute risk aversion**, r_A, is defined as the negative ratio between the second and the first derivative of the VNM utility function: $r_A(X) = - U''(X)/U'(X)$ and the coefficient of (local) **relative risk aversion** as $r_R = X\, r_A$. (Pratt, 1964). The advantage of using relative instead of absolute risk aversion lies in the fact that the former does not depend on the units of measurement of X, and therefore could allow, for example, for comparison between measures obtained for monetary outcomes measured in different currencies.

[6] The axioms on which the expected utility theorem of choice is based are (see Jensen, 1967): (completeness) for any pair of lotteries (L_A, L_B), the agent is always able to express one of the following preference orderings: either $L_A > L_B$; $L_B > L_A$, or $L_A \sim L_B$, where the symbol ">" means "strictly preferred to" and the symbol "~" means "equally preferred as"; (transitivity) $L_A > L_B$ and $L_B > L_C \Rightarrow L_A > L_C$; (convexity) the set of all possible lotteries is a convex set, which is equivalent to saying that given any three lotteries strictly preferred to each other, $L_A > L_B > L_C$, there exist $\alpha \in (0, 1)$ and $\beta \in (0, 1)$ such that $\alpha\, L_A + (1-\alpha)\, L_C > L_B$ and $L_B > \beta\, L_A + (1-\beta)\, L_C$ (independence) for any L_A, L_B and L_C, $L_A > L_B \Rightarrow \alpha\, L_A + (1-\alpha)\, L_C > \alpha\, L_B + (1-\alpha)\, L_C$, for any $\alpha \in (0, 1)$.[12] See Excellence model of the European Foundation for Quality Management (EFQM, 2003).

[7] See von Neumann and Morgerstern (1944)

Notice that both coefficients are local measures, that is, they are evaluated at a point in the range of outcome values, and they are functions, which means that their value is possibly different for different levels of X, even for the same individual. In practice, to know the coefficient of the absolute risk aversion function is equivalent to knowing the entire preference structure for lotteries as postulated by the Von Neumann – Morgerstern theorem. This, which may seem an advantage of the expected utility framework, is, in truth, a dangerous aspect in applied analyses if we duly consider the meaning of the converse of the reasoning just made: to select a specific form for the coefficient of risk aversion (such as for example to select a constant relative risk aversion, as is common in the literature) amounts to imposing a heavy structure on the preferences over the entire range of values of X. In other words, for example, to maintain that an individual has a constant coefficient of relative risk aversion means to assume that her or his preferences have a precise structure over all possible values of X, which implies, among other things, the fact of being always risk averse, or always risk-seeking, no matter what the 'riskiness' of the prospect one is facing. This is an observation that has generated strong criticisms of the validity of many expected utility analyses, based on the fact that even casual introspection would demonstrate that the propensity toward risk usually depends on the amount at stake (most of us would exhibit a certain degree of risk-seeking behaviour when the amounts at hand are very small, as for example when we buy a lottery ticket for which the expected outcome is much lower than the price of the ticket, and at the same time would reveal sizeable risk aversion when buying car-theft insurance. See Friedman and Savage, 1948).

It must be noted that the concept of risk aversion does not add to the definition of the preference structure through the VNM utility function. The way they are defined, the three concepts are, in fact, equivalent. Their precise meaning, when applied to real situations, is strongly linked to the basic assumption that underlies the whole theoretical construction, namely, that rational preferences are defined for *lotteries*, that is the combination of outcomes and associated probabilities, which requires that the agent is capable of fully characterizing the stochastic structure of all of the risky prospects over which the decision is taken. Unfortunately, such dependency and the heroic character of such an assumption is seldom recalled in applied analyses, when the concepts of risk aversion and measures of risk premiums are presented in a much more casual way than the rigor of the theory would authorize.

3.1. Interpreting the results of economic analyses of risky prospects

The relevance of the points raised in the previous section will become evident when we critically review the procedures which are usually followed by analysts engaged in risk assessments. In most cases, an economic analysis of a risky situation is performed as follows: a certain functional form is chosen for the VNM utility function, usually taken from a class of function that would allow for a simple characterization of the coefficients of risk aversion, one or two parameters defining the degree of risk aversion are assumed, justified on the basis of the limited number of studies that have claimed to have empirically assessed them; then, the risk prospect that needs to be assessed is described by only a limited number of parameters (usually just the mean and the variance) and the analysis is performed by calculating the value of the risk premium associated with the particular prospect, taking it as an indication of the welfare cost of the risk.

From the discussion in the previous section, it should be clear that the figure that comes out of such a kind of analysis, if any, is mainly the result of the assumptions maintained by the analyst rather than a credible indicator of the social cost imposed by the presence of risk. Unfortunately,

the assumptions are almost invariably kept in the background and therefore an assessment of the real value of the analyses is difficult. In the following sections, we will list some of the most common mistakes that could be made in conducting risk analysis and that might be useful in critically reviewing the discussions that have been presented on the role of risk in the conditions of the reformed European agriculture. The three mistakes can be synthesized as:

(i) incorrect specification of the *distribution of outcomes*,
(ii) incorrect choice of the *utility function*, and
(iii) incorrect choice of the *argument of the utility function.*

3.2. Incorrect specification of the distribution of outcomes

From the axiomatization on which the expected utility approach to decision-making under uncertainty is based, it should be clear that to evaluate the welfare effect of the presence of risk necessarily requires the complete definition of the probability distribution of outcomes. In other words, a synthesis of the work of Bernoulli (1738), Von Neumann and Morgerstern (1944), and Friedman and Savage (1948) could be made by saying that both the levels and the variability matter in a way that does not in general allow for separation of the two effects.

As a result, if one wants to discuss the economic cost of risk and be coherent with the expected utility approach, 'risk' cannot be taken as simply 'the probability of a bad outcome' or as 'the variability of outcomes': it must be defined as the 'uncertainty of the outcomes', intended as the characterization of the entire random distribution of the possible outcomes (Hardaker, 2000). To rely on synthetic measures of variability such as the coefficient of variation, albeit very convenient from a computational point of view, might be highly misleading in cases in which the distribution of outcomes is far away from a normal distribution, such as for example, when rare but severe damage interrupts a series of relatively stable outcomes, the cases typically dealt with by insurance and which are also the most relevant ones from a social welfare point of view.

In other words, in evaluating the impact of a change in the risk structure faced by a farmer, as for example following the introduction of a public price-stabilization scheme, one should characterize the complete probability distribution of the relevant outcome before and after the intervention. To simply consider the coefficient of variation (as is done in many cases of applied analysis, and often with no other justification than the need to ease the computation) is not enough to characterize the entire distribution, given that there exist an infinite number of distributions with the same coefficient of variation, unless one restricts attention to a specific class of distributions, such as the Normal distribution, which is fully characterized by the first two moments. The point we want to stress here is that often to use mean-variance approach or to rely on the coefficient of variation to measure uncertainty amounts to imposing strong unwarranted conditions on the structure of the preferences which would affect the results of the analysis.

3.3. Incorrect choice of the utility function

As in the standard economic theory of consumption, in the theoretical setting outlined above preferences are given. The utility function is taken to be a fundamental individual characteristic. As with demand elasticity, risk aversion coefficients should be estimated empirically from representative samples of the population, and projections outside the sample should always be taken with some degree of caution.

Unfortunately, as opposed to traditional demand estimation, in this case it is virtually impossible to find sufficient data to identify the structure of the risk preference from, for example, the

underlying distribution of the relevant variable. For example, does the fact that a farmer does not buy insurance means that he is not risk averse, or that he does not believe a bad outcome would occur? The simple observation of not buying insurance could be used as evidence of lack of risk aversion, if one is willing to *assume* the probability distribution of outcomes, or of evidence that the subjective distribution of outcomes is not very wide if one *assumes* a certain degree of risk aversion.

As difficult as it might be, however, to distinguish between the two, it is imperative from a policy point of view. In the previous example, if the farmer is not risk averse, why should he be compensated in the case of a bad outcome when he decided not to insure? After all, no government would ever engage in compensation to unlucky gamblers. The case would be different if real damage occurred for lack of sufficient information on the probability distribution of the events, in which case compensation might be morally justifiable[8].

Put it in a simpler way, it is always possible to justify an intervention in favour of an agent or a group of agents by *assuming* that they suffer damage facing whatever the current conditions are. The point is that the customary habit of analysts in these cases has been to *assume* a certain degree of risk aversion, which would invariably lead to 'discover' that facing a risky prospect implies damage and therefore that an intervention is justified, without taking the care of checking whether the assumed degree of risk aversion is consistent with other observed behaviour of the agents.

A better 'code of best practice', as Hardaker suggests, would be to focus on trying to address the 'objective' probabilities of the possible outcomes, and therefore to make the best use of observed behaviour to try to assess the real propensity of farmers towards risk, and perhaps one would discover that 'agricultural economists have paid too much attention to risk aversion' (Hardaker, 2000, p.13) and that 'from a social welfare perspective, most risks faced by individual farmers or groups of farmers are very unimportant.' (ibid.)

3.4. Incorrect choice of the argument of the utility function

A third problem that afflicts the welfare analysis of the presence of risk in economic activities concerns the definition of what is the fundamental variable of interests, i.e. in formal terms, what is the agent's relevant argument of the utility function.

Since the work of Friedman and Savage (1948), and Markowitz (1952) who discussed the expected utility approach to cases of monetary outcomes, it is clear that the argument of the VNM utility function should be **wealth**, not income, i.e. a measure of a monetary stock and not of a flow, and there is a good reason for that: what really provides utility should never be considered to be 'money' per se, but rather, it is the level of consumption that money permits that individuals care about. It is well established that consumption is much more closely linked to wealth, or what we could term as 'permanent' income rather than to current or 'transitory' income (Friedman, 1957). Of course, income contributes to wealth formation, and transitory fluctuations in income may have consequences. However, the impact in terms of welfare of a *temporary* change in current income, and therefore what would justify public intervention, is admittedly much lower than the impact of a similar change in *permanent* income, something we will return to when discussing the meanings of 'risk' and 'crisis'.

The relationship between the cost of uncertainty in total wealth as opposed to uncertainty in

[8] Subsidizing insurance on the grounds that farmers do not buy it would not be the best policy anyhow, since it does not address the real problem. On the contrary, providing means to improve the forecasts of bad outcomes would certainly be beneficial.

current income can be highlighted by following the simple example of Hardaker (2000, pp. 9-11).

Let us indicate with W_0 the initial wealth and with X a random additive component (such as current income might be). Uncertain wealth will therefore be:

$$W = W_0 + X$$

For the sake of simplicity, let us assume constant absolute risk aversion for wealth and keep W_0 constant. This would imply that $r_A(W) = r_A(X)$. But what does it mean in terms of *relative* risk aversion with respect to income fluctuations? By recalling that, by definition, $r_R(W) = W\ r_A(W)$, and that $r_R(X) = X\ r_A(X)$, we have $r_A(W) = r_R(W)/W$, which implies that $r_R(X) = (X/W)\ r_R(W)$ that is, that the coefficient of relative risk aversion expressed in terms of income is equal only to a fraction of the coefficient of relative risk aversion expressed in terms of wealth, where the fraction is given by the ratio between current income and total wealth. Given a fundamental attitude towards risk, the lower is the share of X over W, the lower should be the relative risk aversion towards variations in X.

4. The Italian system

Public intervention in agricultural risk management in Italy has a long tradition. The "Fondo di Solidarietà Nazionale in Agricoltura (FSN)" was instituted in 1974 with the aim of providing farmers with the means to effectively manage their production risk. The system has evolved over the years with numerous reforms until recently, when, in the Legislative Decree n° 102 of the 29th of March 2004, Italy adopted the Community guidelines for state aid in the agricultural sector regarding compensation for damage and insurance premium subsidies, The Decree defines new operational rules for the FSN and regulates financial tools for risk management and incentives for capitalisation for farms.

The Italian FSN erogates two different services: financing for insurance policies and ex-post payments, although this general principle is subject to many exceptions that will be described in the following paragraphs.

A) Ex post compensation

The Law establishing the FSN states that, in the case of an exceptional event, farmers are entitled to compensation for the damage suffered. The regulation of compensatory aid has not changed much over time. In order to initiate the process of compensation, the status of exceptional event needs to be officially recognized by the Central Government. To this end, when an adverse event occurs (most commonly drought, flood and late frost) the Regional Governments involved file a request to the Ministry of Agriculture which, in turn, after assessing the actual extent of damage, issues the decree which entitles farmers to ask for compensation.

Compensation is then paid based on various criteria determined by the Ministry of Agriculture, mostly depending on the availability of funds, rather than on the actual extent of the damage. In fact, over the years there has been a rather weak correlation between actual losses and compensation paid.

Compensation is, moreover, usually paid several years after the occurrence of the damaging events. These drawbacks, coupled with the unpredictability of the budget cost due to ex-post compensation, have led to several attempts to shift the bulk of the intervention of the FSN towards subsidy to crop insurance.

B) Insurance policy

The current status of public involvement in the crop insurance industry in Italy is regulated by the Legislative Decree n° 102 of 2004, with rules for implementation set out in several Ministerial decrees.

The main features of the system are:

- Every year, an Annual Insurance Plan is issued by the Ministry of Agriculture, determining which crops/types of damage are deemed insurable. For an insurable combination of crop/damage, producers are no longer entitled to ex-post compensation financed by the FSN.
- Insurance policies written for the crop/damage included in the Annual Insurance Plan are entitled to a subsidy for the premium, according to parameters fixed by the Ministry (accounted, on average, at around 40% of paid premiums in recent years).
- Starting from 2006, subsidised insurance is allowed also for losses deriving from cattle disease.
- According to Legislative Decree n° 102-2004, the insurance schemes entitled to state subsidy are: single-peril, combined/named perils, and multi-peril policies, depending on whether the insurance contract covers one or more predetermined perils.
- Since last year, the State contribution is granted up to a maximum of 80% of the premium only to those policies that pay an indemnity when at least 30% of the average production is damaged.

The actual incidence of State intervention is defined in the Annual Insurance Plan and depends on the budget allowance and on the number of farmers who have subscribed to policies.

The terms through which public subsidy is granted are subordinated to the actual availability of public resources (Ministerial Decree of 15th of July 2004).

Starting from the 1st of January 2005, farmers are obliged to take on crop insurance for the whole area devoted to the crop they want to insure that falls within the borders of the township they belong to. Subscription of policies can be both on an individual and on a collective basis, through Consorzi di Difesa, cooperatives and their operating consortia.

The current legislation also allows farmers to create mutual funds. They operate in favour of insured crops and structures and for those crops and structures which have been damaged and are not included in the annual insurance plan. The condition for acceding to payments is that loss regards at least 30% of crop production. Aids can consist in different kinds of intervention, such as: investment grants, five year graduated payment loans, national insurance contributions, deferment of credit operations.

The first year of full implementation of reform of the Italian crop insurance system was 2005. Available data do not seem to show a significant change in comparison with the situation prevailing in the past: the number of contracts signed has not increased radically. In terms of hectares insured, there has been an increase mainly due to the obligation of insuring the entire cropped area of a given product, rather than to a real expansion of insurance coverage to new producers.

The state contribution is constantly increasing in nominal terms, although this is mostly due to the increased share of combined perils policies that benefit from higher public subsidy to premiums (80%). Tariffs show a significant reduction between 2007 and 2011. (Table 1).

Tab. 1 - The crop insurance market in Italy

		2004	2005	2006	2007	2008	2009	2010	2011
Certificates	n°	212.231	212.445	211.444	236.922	264.698	226.177	208.204	207.762
Quantities insured	.000 t	14.894	14.837	14.805	16.329	20.416	18.218	20.090	19.872
Hectares insured	.000 ha	982	1.074	1.125	1.051	1.450	1.355	1.153	1.164
Value insured	.000 €	3.710.212	3.810.222	3.789.132	4.379.809	5.436.140	5.131.045	5.312.829	6.145.146
Total Premiums collected (TP)	.000 €	177.439	269.124	265.033	292.888	338.059	317.210	285.502	287.461
Indemnities (VR)	.000 €	152.165	159.984	149.975	184.626	272.711	234.781	169.259	171.534
Public Contribution *	%	56,80	65,90	66,62	66,78	66,34	67	66,41	66,12
Average tariffs	%	7,5	7,4	7,5	7,22	6,75	6,70	5,78	5,74
VR/TP	%	66,2	59,6	55,4	64	81	75	60	58

* premiums/insured value
Source: Ismea

What is rather striking is that, in the most recent four years for which data are available, the loss ratio has been well below unity. This means that the amount of premiums paid (inclusive of public subsidy) has been almost double the indemnities received by farmers, which questions the need for such a high level of subsidy.

In particular, policies covering damage from hail have diminished in favour of an increased number of policies for named perils, most of all "wind and hail" policies.

Another aspect to be emphasized is that the highest number of the insurance certificates issued in 2011, slightly less than 80%, are underwritten in the northern regions with a high prevalence of the North East which accounts for almost half of the total. The insured values reflect the spatial distribution of certificates, although compared to those in the South and especially in the Centre, the incidence is greater. This reflects the fact that the average values insured in the Centre and in the South are greater than in northern regions (Table 2).

Tab. 2 - Geographical distribution of crop insurance in Italy

Region	Certificates n°	Insured Value €	Premium Collected €	Indemnities €	c/b %
	a	b	c	d	
North East	108.351	2.395.663.321	178.040.328	142.136.898	7,4%
	48,2%	47,4%	57,9%	61,7%	
North West	68.605	1.485.679.557	69.066.291	33.523.735	4,6%
	30,5%	29,4%	22,5%	14,6%	
Centre	14.928	419.503.783	20.409.592	16.761.289	4,9%
	6,6%	8,3%	6,6%	7,3%	
South	33.037	753.880.448	39.925.862	37.860.871	5,3%
	14,7%	14,9%	13,0%	16,4%	

Source: our elaboration on Ismea data

5. The definition of a new strategic framework of risk and crisis management in agriculture and associated tools

The rhetoric that surrounds the debate on public support to privately delivered insurance in agriculture often claims that the benefit to a State because of the widespread use of insurance in agriculture lies in sharing with private insurance companies a part of the financial burden imposed by the need to compensate farmers for damage due to natural causes.

The evidence, however, seems to point against the merit of such an argument, especially in the case of USA, where increasing subsidies to insurance premiums have never succeeded in reducing ad hoc compensatory payments (Glauber, 2004).

In this context, and following what has been said above, to implement a new strategic framework for risk and crisis management in agriculture would require some elements to be clearly defined:

1. understanding the relevance of the risk factors and their potential effect on farmers' welfare;
2. unambiguous distinction between normal enterprise risk and truly disastrous events;
3. definition of the scope for public intervention.

In fact, there are risks that can be most efficiently managed by farmers' own resources, either by diversification of income sources or by coping with the consequences of limited income fluctuations by self insurance. At the opposite end of the risk spectrum, we found risks for which there is no alternative to the reliance on some form of public solidarity, when predictability is so limited that no preventive action might be conceived. Most of the relevant agricultural risks are "in between" risks, with various combinations of frequency, significance and correlation. Hence, no single instrument is ideal under all circumstances. Any sensible policy framework should allow for a sufficient degree of flexibility to adapt to the different conditions.

In the context of agricultural risk management, this requires a preliminary and clear distinction of what constitutes normal enterprise risks in agriculture from what can truly be called a crisis.

Public action that tends to substitute for possible private action should always be avoided. Farmers should retain the main responsibility for management of normal enterprise risk and a clearer distinction needs to be made between normal enterprise risk and truly catastrophic events.

The study makes clear that risk must be measured against the potential consequences on the levels of consumption, not of current income, and that in most cases consumption depends on what is considered the expected permanent level of total family income. Such a position leads to the need to reconsider the predictable welfare implications of exposure of farming to such things as natural hazards or to market crises for specific, single products, and therefore of the benefits associated with direct public intervention. At the same time, the focus of the policy should be on the agricultural consumption units, rather than on production, and therefore less emphasis should be given to what has usually been done on prices, yields, or even income fluctuations per se.

In the strategic design of a new framework for risk and crisis management in agriculture a few points must be considered.

1. Direct ex-post compensation cannot be avoided for unforeseen, systemic dangerous events.
2. Incomplete markets for risk transfer and other forms of market failure prevent private actions from achieving a desirable level of risk protection from society's point of view, and therefore public action other than direct compensation of damage is needed.
3. Public policies, however, might influence incentives for the use of private instruments, creat-

ing a potential for widespread distortion and hindering the development of efficient private markets.

4. Public policies must therefore integrate, recognize and promote to the maximum possible extent, individual farmer responsibility in confronting risky choices.
5. The best level of public intervention should be set, according to the subsidiarity principle.

Two levels of **public intervention** can be envisaged **to manage crisis**.

Compensation for damage is the only option in the short-medium term. However, because the risk of political failures at the local level is higher, it becomes crucial to set unambiguous rules at Community level, stating when such interventions might be triggered. The responsibility for assessing conditions that trigger public transfers ought to be separated from the political authority and delegated to an independent agency. **Only damage to farm assets should be directly compensated**, whereas damage to current production should be excluded. Compensation might take the form of both direct transfer of money, and of financial participation in interests payments on loans specifically intended for damage recovery. In the medium-long term preventive private action that reduces the possible extent of damage caused by natural disaster should be supported.

In the medium-long term, private action that might reduce the extent of damage caused by natural disaster should be supported, for example by **providing incentives to farmers to move from disaster-prone areas, or to make investments in protective infrastructures. Direct public investment in protective infrastructures** might be needed, too.

When normal enterprise risk is considered, as entrepreneurs, farmers should develop their own risk management abilities by making use of private markets for insurance, credit and financial instruments.

In this case, public intervention should act in order to promote the private market or to favour the development of private ability to manage risk. Several actions can help in this direction:

- **providing the needed regulatory institutions and informational support** in order to promote the expression of the private demand for market-based risk management tools, while guaranteeing competition on the supply side.
- **promoting the constitution of precautionary saving accounts** through direct and indirect incentives, such as fiscal benefits, in order to increase the potential of self- insurance against some of the less severe risks at the individual farm level
- **promoting concentration of the demand for risk management instruments** in order to have more efficient access to all of these markets. In this case, supporting the operation of **mutual funds** is an effective way of fostering the development of risk markets. In addition, to improve efficiency in risk transfer, the concentration of demand will also have the effect of internalizing monitoring costs, thus increasing the scope for mutual management of some of the risks which, by their nature, might be difficult to transfer because of the presence of asymmetric information.

It should be evident that the institution of such a framework will require a thorough revision of existing policy within the CAP. With a new EU risk policy put in place, there would no longer be justification for the market stabilisation features of various CMOs. In fact, although the role of price intervention has been widely reduced, several CMOs still grant forms of market stabilization aimed at smoothing price variability. This set of measures still absorbs a non-negligible share of the overall EU budget devoted to agriculture. Removal of these market stabilization measures would release financial resources that could be more effectively employed within the new risk management framework.

6. Conclusions and recommendations

On the basis of what we have said in the previous parts of this study, a few important conclusions and recommendations may be drawn.

First, and most important, it should be emphasized that we need a new policy framework of risk and crisis management. It is quite evident that, after the CAP reform and in a new EU risk policy framework, there is no longer justification for continuing measures which support market stabilisation the effects of which are far from clear and that might create conflict between instruments. This is especially significant considering that public resources available for an effective risk and crisis policy are rather limited.

In this context, the income stabilization tool (IST) is one of the major novelties of the proposed Regulation for Rural Development 2014-2020, and entails a quantum leap compared to the risk management measures currently available under the CAP. The IST aims to protect farmers from the risk of excessive reduction in annual income, providing comprehensive coverage, not limited to traditional production risks, but extending to any event which may have a negative impact on farm income.

Given the innovative scope of the measure, and the benefits that it can bring to an agricultural sector increasingly exposed to fluctuations in international markets, it seemed appropriate to verify its applicability and sustainability within Italy in the medium and long term.

Currently, great uncertainty surrounds the IST with regard to the estimates of expenditure for two reasons:

- As a new measure it is difficult to make accurate predictions about the number of farms taking part;
- The diverse nature, and often systemic aspects of the risks covered make it difficult to estimate the annual value of any losses incurred.

Under such conditions of uncertainty, it becomes risky to programme the measure, particularly in Regions with large budgets and little aptitude for risk management by farms, as is the case for various Regions of the country.

Regardless of the resolution of doubts at EU level and the critical issues raised, in order to evaluate the implementation of the IST in Italy it is necessary to estimate the cost of the instrument and verify its sustainability over time.

Second, one of the main themes of the discussion included in this study is that, in both technical and political discussions on the consequences of risk and the role of public policies, a clearer distinction ought to be made between normal enterprise risk and truly catastrophic events. Without such a precise distinction, the possibility of confusion and of inappropriate competition among public and private actions for risk management becomes real. The use of private instruments, which in many cases are efficient enough to guarantee socially acceptable protection to farmers at a limited cost, will be greatly hindered by the presence of public policies that, even if well intentioned, could imply large inefficiencies and unjustifiable distributional effects.

The discussions so far may have given the impression that the tendency has been to overvalue the welfare cost possibly associated with income fluctuations that are not so uncommon as to constitute a risk of which farmers might be unaware, and therefore to suggest a larger public involvement (under the two forms of ad hoc relief payments and of State participation in the crop insurance market) than was really needed, whose distributive effects are often uncertain.

To conclude, the following recommendation can be put forward:

For catastrophic risks:

1. Private insurance against truly catastrophic damages seems unfeasible, unless on a global scale, and therefore the direct role of government through direct compensation for damage via operation of national solidarity funds seems to be unavoidable.
2. Only that damage which is in excess of the normal enterprise risk must be considered in direct compensation. And only that which truly compromises the viability of the enterprise.
3. The exposure of solidarity funds could be hedged on the global financial market.
4. The resources to finance solidarity funds might be in part obtained by taxing risk-taking behaviour (such as lotteries) or luxury consumption (entertainment)(13).

For normal enterprise risks:

1. When the set of existing conditions and the policy of European agriculture are duly considered, enterprise risks in agriculture do not exceed in level and scope those of other sectors of the European economy. Therefore the question arises as to whether they should receive a differential treatment at all.
2. Nevertheless, private markets that could be effectively used to manage those risks are not yet fully developed. The main role of governments should be that of facilitating the operations of private markets, such as those of insurance and other financial instruments (namely, futures on commodity prices, options on agricultural yields, options on weather events) by directly targeting the cause of market failure, i.e., by providing regulatory institutions and informational support rather than by subsidizing premiums, which is like filling with water a tank with holes in it.
3. At the initial stage of development with financial instruments such as yield options or weather derivatives, the Governments could enter directly into the markets by issuing options covering both positions, on an experimental basis (i.e., trying to sell the guarantee against low rain in the summer to farmers and that against excessive rain in the summer to tour operators).
4. Financing of these instruments can be achieved by the MS without recurring to CAP funds, when the measures are clearly not market distorting.
5. Credit subsidy and other forms of intervention (such as tax deferral) can be used to help farmers overcome the negative impact of catastrophic events for the part that corresponds to normal enterprise risk.

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MODELLING CONSUMER PREFERENCES FOR EXTRA VIRGIN OLIVE OIL: THE ITALIAN CASE

JEL classification: C20, C25, D12

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Abstract. *The paper summarizes the results of a research project concerning Italian consumers' preferences as regards extra virgin olive oil and, in particular, it discusses an innovative statistical approach for modelling this type of data. The survey was carried out at the beginning of 2012 and was aimed at investigating the main key drivers of purchasing behaviour. Specifically, a class of models for ordinal data, namely CUB, have been studied in order to describe the importance that respondents assign to a list of intrinsic and extrinsic attributes and the level of agreement that consumers express with a number of statements concerning extra virgin olive oil. The CUB models allow measurement of the influence of the subjects' covariates and the effect of different eating habits on consumers' preferences.*

Keywords: *consumer satisfaction, extra-virgin olive oil, ordinal data modelling, CUB models.*

1. Introduction

Extra virgin olive (EVO) oil is one of the main products of the Mediterranean area which is fundamental in the daily life of the inhabitants. It is a part of national and traditional cultures, with deep roots in the history of many of these countries. This article presents the findings of a research project, carried out during 2012, aimed at studying the preferences of Italian purchasers and the main key drivers that motivate consumer behaviour.

The features of the product distinguish the study of consumer preferences in a particular way. In fact, EVO oil is not perceived as 'food' neither is it an 'additive' (such as salt, sugar, spices, etc.). It is a condiment that enters almost all dishes prepared and is connected to the daily diet of all Italian consumers. Moreover, in the collective imagination, EVO oil has a strong bond with the Italian countryside, with the ideas of 'beauty', 'antiquity', 'majesty' that the olive plants and, in general, the view of an olive grove suggest. Finally, the benefits in terms of healthy diet and the recent trends towards preference for so-called "natural food" significantly contribute to the definition of the image of the product. For this reason, the perception of EVO oil features is affected by various factors which are not necessarily related to nutrition and taste (see, amongst others, Fotopoulos and Krystallis, 2001; Espejel *et al.*, 2009; Scarpa *et al.,* 2004).

This study focuses on an innovative class of statistical models, namely CUB, which can be applied to gain further insights into the study of consumer preferences for EVO oil. This is a

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univariate mixture distribution defined by the convex Combination of a Uniform and a shifted Binomial distribution whose parameters may be related to rater's covariates (Iannario and Piccolo, 2005).

For reasons of space, we present only some of the typical findings that the proposed technique is able to achieve and we comment on the overall conclusions of the research. The paper is organized as follows: in the next section we briefly illustrate the data, focusing on the relevant variables which are the object of the subsequent analysis. In section 3 we introduce the class of CUB models and dwell on their interpretation and usefulness for the study of consumer preferences. Section 4 discusses the main results and, finally, some closing remarks conclude the work.

2. The sample

The survey involved a sample of 1,000 subjects belonging to the Nielsen Home Scan Panel. Each interviewee recruited had purchased at least one bottle of extra virgin olive oil over the last six months and, in addition, he/she was in charge of the purchases of the product for all the family.

The Nielsen Panel is often used for ad hoc surveys because of the high quality data that it can generate. The Panel, in fact, satisfies the basic requirements such as coverage, balancing and representativity of the Italian population. Moreover, it relies on automatic recording of the observations. Panelists regularly record their preferences by scanning the barcodes on their purchases and, in addition, they complete specific surveys on request. This makes it possible to gain access to a large number of covariates characterizing the subjects.

The interviewees were selected according to a stratified sampling design based on the following variables: Nielsen Area, family income, size of the settlement (in terms of population), age. In this regard, we recall that the territorial division, proposed by A. C. Nielsen and widely used in major market surveys, includes 4 large macro-regions comprising the 20 Italian administrative regions. Table 1 shows the allocation of interviewees to the various Nielsen areas in function of the size of the population living in each territory. Table 2 illstrates the characteristics of the sample with respect to the remaining stratifying variables.

Tab. 1 - Territorial distribution of the interviewees

Nielsen Area	**%**
Area 1: Piemonte, Val d'Aosta, Liguria, Lombardia	28.2
Area 2: Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia, Emilia-Romagna	23.5
Area 3: Toscana, Umbria, Marche, Lazio, Sardegna	22.3
Area 4: Abruzzo, Molise, Puglia, Campania, Basilicata, Calabria, Sicilia.	26.0

Tab. 2 - Other stratifying variables	
Settlement size (population)	**%**
<20.000	36.8
20.000 --| 100.000	32.3
100.000 --| 500.000	16.4
>500.000	14.5
Respondent's age	
18 --| 34	6.5
35 --| 44	26.8
45 --| 54	27.1
55 --| 64	18.6
>65	20.8
Level of income	
Low	21.3
Below the average	31.1
Over the average	29.0
High	18.5

The respondents were asked to express the level of agreement on a list of statements by means of a 7 point Likert scale where "1" means "totally disagree" and "7" means "totally agree". The statements concerned various aspects of oil consumption: consumer understanding of EVO oil quality, the utilisation, the reasons why consumers buy EVO oil, comparisons with other edible fatty substances, the assessment of product attributes, eating styles. Moreover, various socio-demographic variables characterizing the subjects (gender, age, number of family members, children under 13 years of age, family income) are considered as well as some information about the purchasing behaviour over the last year (place, characteristic of the product, frequency of purchase, price and other elements affecting the economic value of the product such as special offers and discounts, dietary habits and the general attitude towards food).

3. A mixture model for consumer preference

In this section we briefly illustrate the methodology which has been applied in order to model the ordinal data from the survey. Firstly, it is worth noting that models for consumer preferences usually rely on a classical paradigm: the probability distributions of ordered categorical response variables are defined by introducing a link function with the cumulative probabilities, such as the logit or probit function (Agresti 2002, 2010). Although models for ordinal data received some attention in the statistical literature of the 1960s and 1970s, a stronger focus on that type of data was inspired by the early contributions of Zavonia and McElvey (1975) and McCullagh (1980) with reference to the Generalized Linear Models (GLM) and by Goodman (1979) who investigated the log-linear modelling approach. Recently, important methodological developments originated from several critical issues raised by real applications (Tutz 2012). More emphasis is, nowadays, given to the data-generating process and to the interpretation of statistical results, especially, when the effects of explanatory variables on the response variable is present

(see for instance, Gambacorta and Iannario, 2013 for a discussion and a comparison between well-established and recent approaches).

In the following, we refer to the class of CUB models for describing the respondent preferences when they are faced with multiple ordinal items related to their food habits, purchase and consumption behaviour as regards EVO oil. This class of models stems from the consideration that two latent components move the psychological process of selection among discrete ordered alternatives: *attractiveness* of the item and *uncertainty* in the response (Piccolo 2003; D'Elia and Piccolo 2005). These latent components express the stochastic choice mechanism in term of *feeling*, which reflects the individual perception of a certain item, and of *uncertainty* which pertains to the way respondents choose a certain rate among the available range (Iannario and Piccolo, 2012). Although the latent variables are conceptually necessary in order to specify the nature of the CUB model as a mixture distribution, the related inferential procedures are not based upon the knowledge (or estimation) of cut-points as happens in the GLM. Thus, when a CUB model adequately fits the data, it is usually more parsimonious than alternative models.

In the rest of this article, we assume that respondents express their preferences (or opinions) according to an ordered Likert scale with $m>3$ categories, for a given m. Moreover, the observed ratings $(r_1, r_2, \ldots, r_n)'$, conveying such preferences (or opinions) are the result of a discrete random variable R whose probability mass distribution is given by:

$$\Pr(R = r) = \pi\, b_r(\zeta) + (1-\pi)\, U_r; \qquad r = 1,2,\ldots,m$$

where U_r denotes the Uniform and $b_r(\xi)$ indicates the shifted Binomial random variable distributions defined on the support $\{1,2,\ldots,m\}$, respectively. As a consequence, the mixture distribution is defined as follows:

$$\Pr(R = r) = \pi \binom{m-1}{r-1} (1-\zeta)^{r-1} \zeta^{m-r} + (1-\pi)\frac{1}{m}; \qquad r = 1,2,\ldots,m,$$

where the parameters belong to the space:

$$\Omega(\pi,\zeta) = \{(\pi,\zeta) : 0 < \pi \leq 1;\ 0 \leq \zeta \leq 1\}.$$

It is possible to prove that such a random variable is identifiable when $m>3$ (Iannario, 2010). Furthermore, the parameters (π,ζ) are related to the *uncertainty* and *feeling* components, respectively. More precisely, each respondent has a certain "propensity" to produce a thoughtful or a completely uncertain choice of the final rating, and these propensities are measured by π and $1-\pi$, respectively. In this sense, we state that $(1-\pi)$ is a *measure of uncertainty*. It is worth noting that the meaning of the uncertainty component is different from what is commonly denoted as accidental variability (that is, randomness) because that component is not induced by sampling selection or measurement errors. In our setting, uncertainty attains to the rater's decision process and it is explicitly modelled whereas randomness is generated by the well known sampling paradigm.

The other parameter $(1-\zeta)$ may be interpreted as a *measure of attraction* towards the object under evaluation. The meaning of ζ depends on the specific empirical application and is related to the predominance of "unfavourable" responses (that is, of rates below the midrange). Thus, depending on the special situation under investigation, the parameter $(1-\zeta)$ may be interpreted as the degree of importance, the measure of closeness, the level of satisfaction, the degree of concern, the pain threshold, the subjective probability, and so on.

It is immediately recognized that there is a one-to-one correspondence among the CUB probability distributions and the parameters. Thus, we may represent each CUB model in the unit square as a point with coordinates (π,ζ). In this way, the visualization of the estimated models becomes immediate adding further value to the interpretation of the experimental results based on ordinal data.

In some circumstances, by introducing a dummy variable to the standard CUB model we are able to depict a *shelter effect* (Iannario, 2012) related to a unique modality, *R=c,* caused by the respondents' predilection or disfavour for extreme values, the use of imprecise wording, the so- called laziness effect, etc.

From an operational point of view, we assess and summarize the rating distributions about several items as a collection of points in the parametric space and we verify the presence of a possible effect of covariates, when space, time and circumstances are modified.

The previous mixture distribution allows various extensions in several directions, though the relevant one for the present analysis refers to the introduction of subjects' covariates. In such a way, indeed, we are able to check, by means of statistical tests, whether the characteristics of the interviewees are relevant in explaining the *feeling* and the *uncertainty* components (Corduas *et al.*, 2009).

Formally, the CUB model may relate its parameters to subjects' covariates by means of a deterministic function (Piccolo, 2006; Iannario, 2009). This is usually (but not uniquely) given by the logistic function, so that we define:

$$\Pr(R = r) = \pi_i \binom{m-1}{r-1} (1-\zeta_i)^{r-1} \zeta_i^{m-r} + (1-\pi_i)\frac{1}{m};$$

$$\pi_i = \frac{1}{1+\exp(-y_i\beta)}, \qquad \zeta_i = \frac{1}{1+\exp(-w_i\gamma)}; \qquad i = 1,2,\ldots,n,$$

where $\boldsymbol{y}_i$ and $\boldsymbol{w}_i$ are the row vectors of covariates of the *i*-th subject.

The CUB models are able to fit also bimodal (multimodal) data since dichotomous (polytomous) covariates may determine different behaviour of the respondents. When statistically significant, the introduction of subjects' covariates improves both the fitting and the interpretation of the ordinal data distribution. As a matter of fact, in order to evaluate, *ceteris paribus,* the impact of a specific covariate *x* on the uncertainty (or, similarly, on the feeling), it is sufficient to evaluate the partial derivatives of $(1-\pi_i)$ (or $1-\zeta_i$), with respect to *x.* Thus, after some calculus, it can be deduced that, *ceteris paribus,* the variations of the uncertainty and of the feeling are related to the opposite sign of the parameters β_j or γ_j, respectively. This property will be exploited in the next section in order to check the relevance of the respondents' characteristics and eating habits on the consumption preferences for EVO oil.

The inferential aspects of CUB models and the maximum likelihood estimation procedure based on the EM algorithm have been discussed by Piccolo (2006); the routines developed in R language were developed and made available by Iannario and Piccolo (2009).

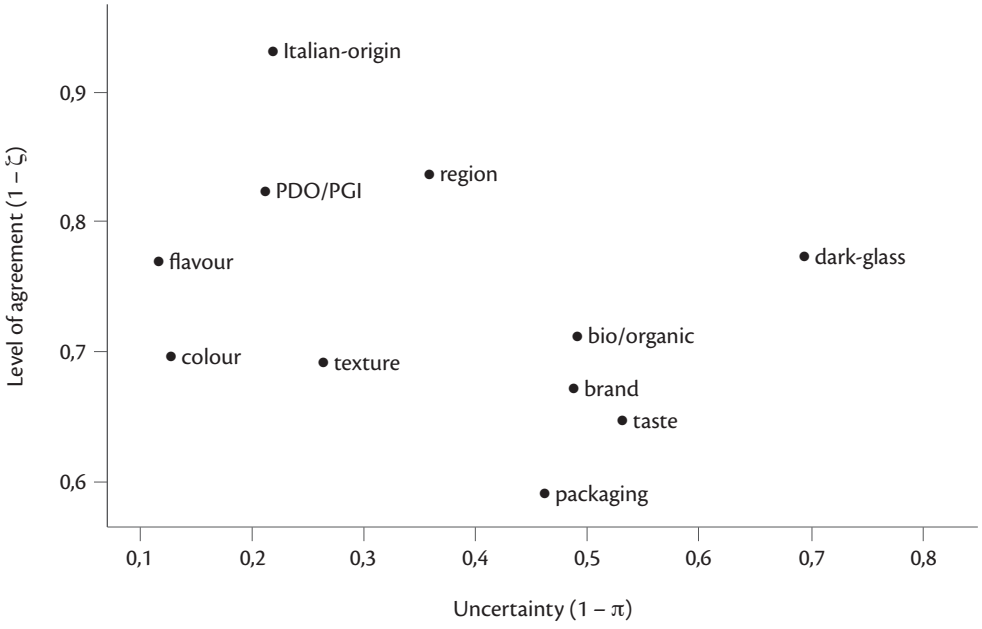
In the following, we will report the main results of the above-mentioned research project. In particular, for reasons of space, we will focus our attention only on the CUB models fitted to some representative items, providing a sort of prototypes of the kind of statistical analysis that may be implemented when a very extended data set is available. The results will be illustrated exclusively by means of graphical representations in order to help reading and interpretation. In particular, we will report the fundamental graph displaying the representation of CUB models

as points in the parametric space. This representation is conditional on the given values of the subjects' covariates and allows investigation of how *feeling* and *uncertainty* change according to the respondents' profiles.

4. The main results

First of all, we present the result from fitting the CUB model (with no covariates) to the rating distributions originating from the respondents' assessments of the importance of 11 EVO oil features for their purchase decisions (Italian origin, the specific Italian region, PDO/PGI certification, the dark glass bottle, the bio/organic agricultural practices, the commercial brand, the packaging, the colour, the oil texture, the flavour, the pungency/bitterness taste). Figure 1 illustrates the representation of the estimated coefficients in the parameter space where coordinates describe the uncertainty and degree of importance, respectively.

Fig. 1 - CUB models for the attributes of EVO oil



Certainty of Italian origin, the region where the olive trees were grown and territorial certification (PDO/PGI) are important drivers for purchases. Those items are located in the upper right region of the graph denoting a strong positive judgements about them. These findings are in accordance with several studies, carried out in other Mediterranean countries and showing that these cues are generally considered important, although the positive attitude of consumers is affected by the various cultural contexts (see for instance, Dekhili and d'Hauteville, 2009; Dekhili *et al.*, 2011). The intrinsic attributes (colour of the oil, texture, pungency/bitterness in taste) are also positively rated, but they have a relatively weaker effect on the consumer's decision process.

The pungency/bitterness of taste is the variable that consumers find more difficult to assess and that causes greater uncertainty in responses. In some respects, this fact may be justified by considering that bitterness and pungency are not universally recognized as a sign of quality, since inexpert consumers tend to dislike them. Note that the taste of oil may depend on harmonious food pairing (Cerretani *et al.*, 2007) and this makes oil tasting a rather complicated task for untrained consumers. Finally, despite recent trends in production and marketing of high quality EVO oil with refined taste, purchasers still prefer oils with neutral flavour and taste (Cicia *et al.*, 2013). Bio/organic agricultural methods of production also have a modest attraction for consumers and this is certainly associated with the increasing but still limited dimension of the organic food market. The lowest vertical position in the graph is occupied by the practicality of the packaging which is therefore much less important in purchasing decisions for EVO oil. Packaging is, in fact, strictly related to the type of oil that the consumer buys (for instance, small capacity containers are generally used for certified oils and 1litre containers for most brand oils).

Fig. 2 - Results of CUB Models for agreement with selected statements concerning EVO oil

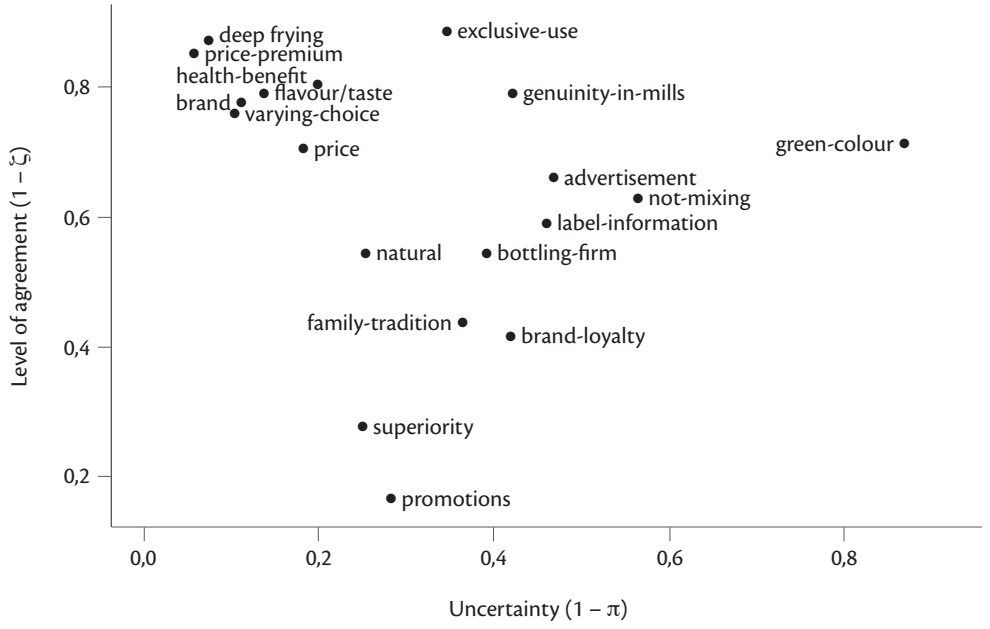


Figure 2 shows the graph referring to the CUB models fitted to the distribution of the degree of agreement with 19 statements concerning EVO oil. Specifically, the questions concerned: a) the use (deep *frying*, as cold additive *in cooked food*, *not mixing* it with other type of oils, choice of the EVO oil depending on cooking *preparations, exclusive use* for health purposes); b) the *neutral* flavor/taste; c) the economic drivers (*price*, sale *promotions* and discounts, willingness to pay a price *premium* for independent certification of the origin of raw material); d) the beliefs and signals about the quality and origin of the raw material (*green* colour, *brand*, genuinity of the product sold by *mills*, location of the *bottling firm* close to the olive- growing area, the *superiority*

of Italian olives, the natural *extraction* process); e) the sources of product information (*label* information, *advertisement* and marketing communications); f) the reasons for constant use (brand *loyalty, family* traditions); g) the *health* benefits.

The location of the various models in the graph highlights the good quality of the collected data because the preferences expressed by respondents are described by distributions having different shapes. In other words, the respondents have been very accurate in discerning the meaning of the questions and in giving their answers. Specifically, the graph shows that consumers strongly agree on the statements concerning the healthy use of EVO oil (for deep frying, as cold additive in cooked food, health benefits). The corresponding CUB distributions have low uncertainty and very similar levels of agreement. Moreover, consumers support the idea that certification of quality provided by an independent authority could be useful and for this reason they are willing to pay an extra price premium (the agreement in this case is very high).

The (low) price is another strong driver in the mind of purchasers though they do not believe that promotions are reliable and do not show much interest in them. The two items in fact lie in two opposite vertical positions of the graph.

Consumers, as mentioned earlier, attach great importance to the Italian origin of EVO oil and to territorial certification, but they recognize that the product of other Mediterranean countries are worthy of attention (the agreement with the statement concerning the superiority of Italian raw material is in fact located in the lowest part of the graph).

Finally, the remaining statements are located in the middle area of the graph denoting some balancing of positive and negative judgements. Specifically, these are related to brand loyalty, the sources of information and to some beliefs that arise from the erroneous interpretation of the product information (such as the idea that the growing area is close to the bottling place or that the green colour is a quality cue). The consumers agree with these statements although their perception is less selective than for the above mentioned items. The uncertainty varies and the green colour is the item which shows the greatest uncertainty, confirming that this belief is deep-rooted in the Italian population though it is not recognized as an unquestionable feature.

Further insights into the preferences of Italian respondents can be gained by considering the effect of the subject's covariates. Here we only comment on a specific situation as an example of the potential application of the proposed technique. The reader can refer to the project report (Piccolo, 2013) for a full and comprehensive illustration of results.

Figure 3 shows the CUB models for the level of agreement that respondents express on the statement: "I prefer EVO oil because I grew up in a family that used it". The numbers from 1 to 4 denotes increasing values of the selected covariate whereas in the first upper right panel the value 0/1 corresponds to the absence/presence of children in the family.

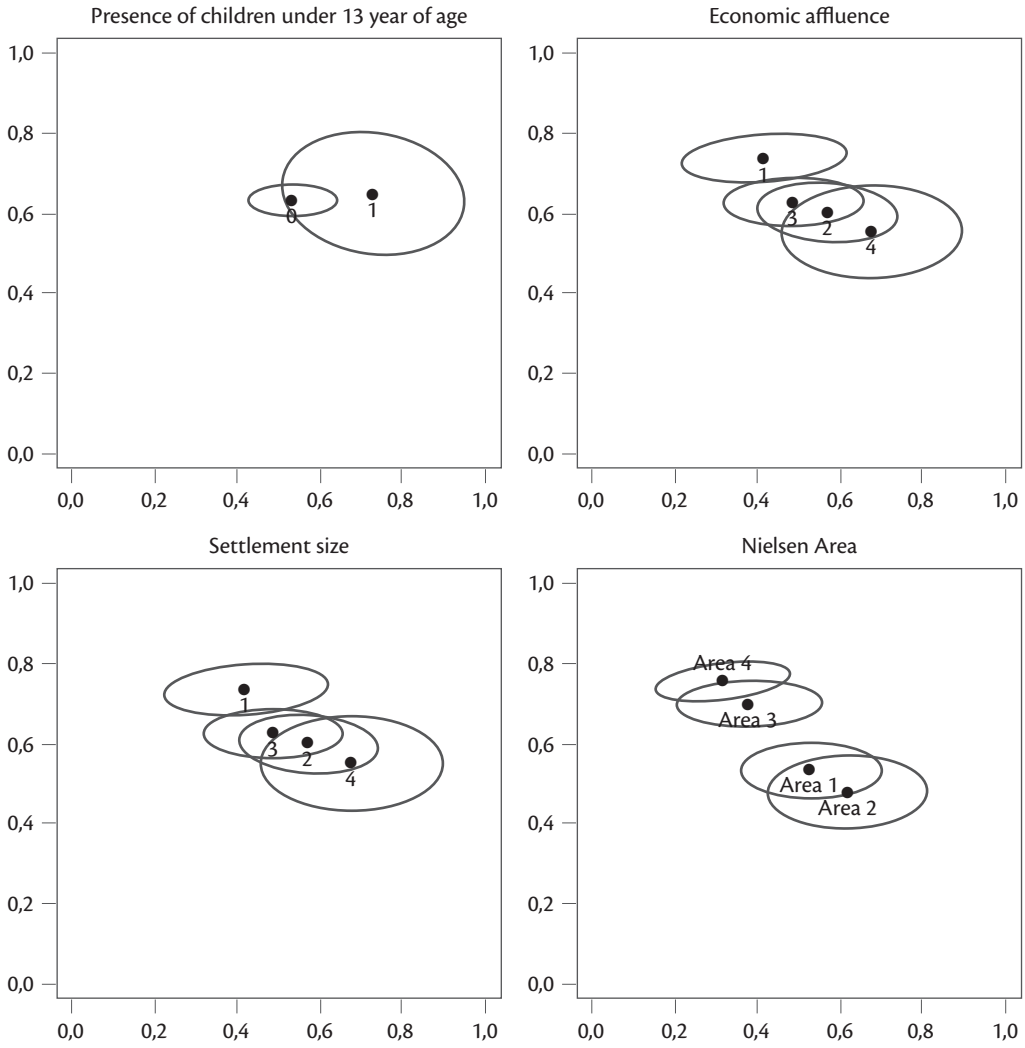
The graphs display the estimated coefficients and the related confidence regions of the models including as subject's covariate: the Nielsen Areas, the level of income, the settlement size and the number of family members below 13 years old. The fitted model changes according to the different level of the covariate. When the confidence regions are well separated this implies that the rating distributions associated with the corresponding consumer profiles are different. In particular, the relevance that consumers assign to tradition increases as far as the consumer lives in the Southern areas of the country, he/she has a lower/ middle level of income, the dimension of settlement where he/she lives decreases.

Finally, the presence of children in the family affects the consumers judgements, leaving feeling unchanged and considerably increasing uncertainty This is probably motivated by the fact that the presence of children makes other drivers important, such as health benefits or economic

factors, so that consumers do not recognize for certain their family traditions as one of the main purchase drivers.

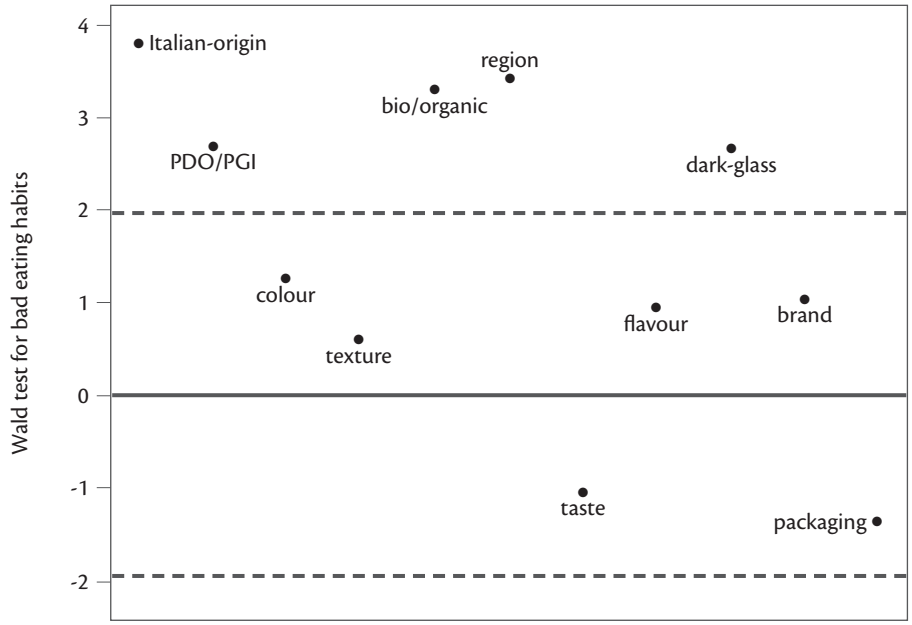
These findings highlight that eating and cooking habits experienced by consumers in their childhood certainly influence the behaviour they have when they grow up. This consideration is relevant for marketing activities of producers, on one hand, and of public authorities, on the other. In fact, the relevance of family traditions implies the need for a serious and continuous education of new generations to connect the fundamental rules for healthy food and eating to what was traditionally taught and which originated the success of the Mediterranean diet.

Fig. 3 - Confidence regions and estimated parameters of CUB models of the level of agreement with the statement: "I prefer EVO oil because I grew up in a family that used it"



Further information can be inferred from the graph displaying the Wald test for the model of some intrinsic and extrinsic attributes including the dependency of the characterizing parameters on the covariate "bad eating habits' (Figure 4). This is one of the dimensions summarized by the 38 variables from the A. C. Nielsen survey on the Home Scan Panel concerning food and eating habits.

Fig. 4 - Wald test for the CUB models including the covariate: "bad eating habits"



Tab. 3 - Relationships between 'dimensions' and product cues

Dimension											
Bad eating habits	–	–			–	–			–		
Pleasure							+				+
Health		+		+	+		+			+	+
Information		+	+	+	+	+	+	+	+	+	+
Trends	+	+			+	+			+	+	+
Social occasions								+		+	+
Number of courses in a meal				+							
Brands and pre-cooked food										+	+
Cues	**Origin**	**Certification PDO/PGI**	**Colour**	**Texture**	**Bio/Organic agriculture**	**Italian region.**	**Pungency /bitterness**	**Flavour**	**Dark glass**	**Brand**	**Packaging**

The points above the dotted line denote the significance of the coefficient, in other words a positive value of the Wald test implies a negative effect of the covariate on the level of agreement expressed by respondents. In particular, the "bad eating habits" induce consumers to pay less attention to quality. Thus, they express a low level of agreement with those product features that are generally related to the perception of quality: the Italian origin of the raw material, the oil texture, the PDO/PGI certification, the dark glass bottle, the colour. Consumers that have unhealthy eating habits tend to underestimate the importance of these cues.

In Tables 3 and 4 we illustrate, in brief, the significant relationships between the items object of evaluation of the present study and all the dimensions identified from the food and eating profiles: the pleasure associated with eating, the health and dietary benefits, the attitude and attention to various sources of information, recent trends in terms of natural and organic food consumption, the connection between food and social occasions/family meetings, the number of courses in a meal, the attitude towards brands and pre-cooked food. The sign indicates whether the effect of the covariate determines an increase (+) or a decrease (–) in the level of agreement.

Tab. 4 - Relationships between the 'dimensions' and the level of agreement/disagreement

Dimension																			
Bad eating habits	–				+		+		–								–	–	
Pleasure			+	+			+									+			
Health	+		+	+	–		+				+	+	+			+		+	+
Information	+	+	+	+	–		+	+	+		+	+				+	+	+	+
Trends		+	+	+	–	–		+	+			+				+	+	+	+
Social occasions	+		+		–			+				+				+	+		+
Number of courses in a meal			+	+			+				+	+			+	+			+
Brand and pre-cooked food							+		–		+			+		+	–		
Features	**Label information**	**Neutral flavor/taste**	**Addingaftercooking**	**Genuinity at pressing mills**	**Lower price**	**Attention to special offers**	**Advertisement**	**Superiority of Italian olives**	**Health benefits**	**Deep frying**	**Green colour**	**Natural extraction process**	**Brand and olives' origins**	**Growing-transformation process**	**Brand disloyalty**	**Family traditions**	**No-mixing**	**Healthy use in cooking**	**Premium price**

5. Concluding remarks

The results discussed in the previous sections show the flexibility of CUB models in describing survey data measured by means of the Likert scale. In particular, a remarkable advantage of the proposed approach is given by the possibility of representing the estimated models in the parametric space. The presence of clusters of subjects, sharing common values of the covariates

but having different rating distributions, are, therefore, identified by well-separated points in such a space.

In the following we briefly summarize some of the findings which this technique has highlighted. Firstly, the Italian origin, the health benefits of EVO oil and the need for not mixing it with other fatty substances are items that uniformly attract the positive ratings of the respondents. Thus, no clusters of consumers with varying behaviour are identified. The organic EVO oil is more appreciated by women, younger respondents and people that live in Central and Southern Italy. As mentioned above, family traditions influence purchasing behaviour and the effect increases when the respondent lives in a small community, in the South of Italy and has a low income. The use of EVO oil for non-traditional preparations (such as deep frying) produces great uncertainty among respondents that differentiates their degree of agreement to the proposed statement depending on age, level of education and presence of children in the family. The main quality cues are not perceived by consumers that have bad eating habits. This behaviour induces respondents to disregard the positive qualities of EVO oil which are generally recognized by more alert consumers and by food experts. Moreover, food pleasure is an important driver for the appreciation of the bitterness/pungency taste. Consumers who enjoy meals pay more attention to high quality attributes. The level of product knowledge that consumers can acquire from label information, specialized journals or advertisements increases the appreciation of the product: attentive consumers tend to judge positively all the product attributes. Finally, low price is not a widespread priority. It is favourably considered only by those who have bad eating habits whereas more discerning consumers (having a high level of product knowledge, attentive to healthy food and recent food trends) are willing to pay a premium price in order to be sure that the EVO oil they are purchasing is of good quality.

CUB models are useful tools for policy planners and marketing managers since they allow the limits of traditional and widely applied analyses of ratings based on summary statistics (such as averages or mode) to be overcome. From a methodological point of view, recent attention has been paid to further developments including the modeling of bivariate correlated data (Corduas, 2011) and the treatment of data characterized by overdispersion (Iannario, 2013).

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AGING AND SUCCESSION ON ITALIAN FARMS

JEL classification: Q12; Q18; D22

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Abstract. *The survival and competitiveness of the agricultural sector is increasingly threatened by the aging process of farmers and farms. In this perspective, the European Union has launched a number of initiatives directed towards favoring the entry of a new generation of young entrepreneurs in the agricultural sector. However, the way in which this transition occurs, whether via intra-family succession or via market transactions, may also have an influence on the economic performance of farms. In this paper, we test the influence of the age of the person who manages the farm and of intra-family succession on the economic performance of Italian farms. Our results indicate that younger farmers overperform and that inherited farms tend to underperform.*

Keywords: *farmers' aging; farms' succession; intra-family transmission.*

1. Introduction

The inter-generational turnover in agriculture is a fundamental issue on the political agenda of the European Union (EU). According to Eurostat data, only 6% of European farmers are thirty-five years old or less, while more than half of them are fifty-five or older (European Commission, 2011). The situation in Italy is even worse: according to the 6th Agricultural Census, only 5% of people under thirty-five choose to invest in agriculture, while farmers beyond sixty-five are more than 37% (Istat, 2010). The shortage of young entrepreneurs may create serious problems to the productivity and survival of the agricultural sector. It is a widespread opinion, in fact, that a larger proportion of young entrepreneurs in the sector would contribute to improving the productivity of agricultural enterprises by increasing human capital and encouraging adoption of innovation. and long-term investment. Starting from such considerations, the European Union has introduced a number of new initiatives to promote the establishment of young farmers in the Rural Development Program 2007-2013. However, the rejuvenation of the class of farm managers may have different effects on the productivity of agricultural enterprises, depending on the way young entrepreneurs enter the sector, whether by inheriting the farm from their family or by acquiring it on the market.

There is a large body of literature focusing on costs and benefits of family firms (Bertrand and Schoar, 2006). On the one hand, transmitting farms within the family promotes the accumula-

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tion of farm-specific knowledge related to the weather, the quality of soil and the type of crops and breeding that best fits them. On the other hand, the ability to follow scientific, technological and organizational progress successfully relates more to knowledge acquired through a formal education than to farm-specific learning by doing. In addition, the inter-generational transmission of the farm within the family might not ensure the selection of the most talented entrepreneurs, and the prevalence of emotional issues might be in conflict with the objectives of business efficiency. Since both positive and negative effects may occur simultaneously, it is an empirical matter to establish which prevails and whether the development of a sector characterized by a large proportion of family businesses is a signal of strength or of weakness. This issue seems to be particularly relevant for Italian agriculture, where the existence of strong barriers to entry, such as the high investment required to start the business, the difficulty of access to bank credit and the low propensity to rent land (Corsi, Carbone and Sotte, 2005), discourage prospective young entrepreneurs from entering farm activity and the almost exclusive channel of entry into the agricultural sector is the intra-family transmission of farms.

In this paper, we test the influence of the farmer's age and intra-family succession on the economic performance of Italian farms. Using cross-section data collected by the Farm Accountancy Data Network (FADN) in 2009, we find that younger farmers tend to perform avove the average (overperform). This finding suggests that factors related to higher human capital accumulation and propensity for technological innovation prevail over their lack of field experience, while the poorer results achieved by the oldest farmers highlight their inability to seize market opportunities and to adopt innovations.

With regard to the mechanisms of ownership acquisition, we find that, on average, inherited farms tend to underperform. In particular, we show that the propensity to diversify the farm's activity in related businesses such as agritourism, and to enroll in the most innovative market niches, such as the organic industry, are higher for non-inherited farms than for inherited ones. At the same time, the percentage of farms that do not receive extra income from non-agricultural activities is greater for those not inherited[1]. Finally, we find that the different performance of inherited and non-inherited farms does not depend on the level of education of the farmer, suggesting that intra-family succession may select less talented farmers.

The rest of the paper is organized as follows. In Section 2 we briefly present the relevant literature. In Section 3 we describe our model of empirical analysis, the data we use and the results we obtain. In Section 4 we discuss some policy implications. Finally, in section 5 our conclusions are presented.

2. Review of the literature

The structure of the agricultural sector in Italy, and also in other European countries, is characterized by two major features: the dramatic aging of farmers and the large number of family farms. Although the literature has dealt with these two issues, the question of the impact they have on the economic and financial performance at farm level and, consequently, on the survival and productivity of the sector has not yet been fully explored.

[1] Typically, farms supplement their income by engaging in businesses other than agriculture when they are not able to survive through farming alone and this is a signal of likely exit from the sector (Weiss, 1999; Stiglbauer and Weiss, 2000; Simeone 2005)

2.1. Farmers' age and farm performance

To the best of our knowledge, there are only a few studies providing statistical evidence on the impact of farmers' age on farm performance. Weiss (1999) focuses on the determinants of farm growth and survival in Austria between 1985 and 1990, finding a non-monotonic, inverted U-shaped relationship with the age of the farmer. He argues that learning by field experience in years following the birth or transfer of the business causes the expansion of farms managed by younger entrepreneurs. By contrast, the shorter time horizon of old farmers reduces the prospective gains from growth, inducing a less intensive farm governance as their age increases, so justifying the negative slope of the curve. Kimura and Le Thi (2013) analyze the economic results of many types of farm businesses in nine OECD countries for the period 2004-2009 and find that, in addition to farm size, the younger age of the farm manager explains a great part of variability in performance.

With regard to Italian farms, the results do not clearly indicate the sign of the relationship. Russo and Sabbatini (2001) examine the performance of over 58,000 farms of the Istat sample in 1998, and find a negative relationship between farmers' age and the average standard gross margin per hectare of utilized agricultural area (UAA). Similarly, Corsi (2009), using Istat census data on farm businesses operating in the Piedmont region in 2000, shows that the standard gross margin is negatively correlated with the age of the farmer. In the same vein is the paper of Mazzieri and Esposti (2005) on 786 commercial farms of the Marche region, included in the FADN sample in 2003: according to the authors, entrepreneurs aged under 35 manage firms that have the largest economic dimension; furthermore, they invest more in their businesses than their elder competitors. While Giarè and Vagnozzi (2012), exploiting the same FADN dataset but on a national scale and for the period 2008-2010, find that farms run by farmers over 40, on average, have a higher value added, with respect to farmers who are under 40. This difference in the results can be explained by the existence, also in the case of Italy, of a non linear relationship between the farmer's age and the performance of the firm. In this case the difference could not emerge clearly since results change according to which is the threshold age used to define young and old entrepreneurs. In a recent paper on the influence of the farmer's age on farm performance, Carillo (2012) finds an inverted-U shaped relationship between the farm's gross production value and the age of farmers, by confirming the existence of a non linear relationship between age and farm performance also in the case of Italy.

2.2. Succession in family farms

The second issue we face refers to the predominance of family farms usually observed in agriculture. The literature underlines that farm survival depends on inter-generational business transfer within the family (Weiss, 1999; Kimhi and Nachlieli, 2001; Glauben, Tietje and Weiss, 2002; Mishra, El-Osta and Johnson, 2004; Breustedt and Glauben, 2007; Lobley, 2010).In addition to contributing to the survival of the farm, the existence of successors within the family also contributes to the growth of the farm sector. Wherever heirs exist, founders are stimulated to invest extensively in new technologies, products and activities, and in improving organization (Perrier-Cornet *et al.,* 1991; Kimhi, Kislev and Arbel, 1995; Potter and Lobley, 1996; Calus *et al.*, 2008), while farms without successors tend to be managed less intensively, with production in decline. to the level that merely ensures the farmer's subsistence when he retires (Symes, 1973). Some other studies also show that succession encourages the purchase of agricultural land (Harrison, 1981; Hutson, 1987), reduces farmers' risk aversion (Stiglbauer and Weiss, 2000; Viaggi *et al.* 2011), and favors expansion into new business (Sottomayor, Tranter and Costa, 2011).

Agricultural economists explain the development of family farms on the basis of the greater return through "farm-specific knowledge" that farmers acquire by experience in the field, and transmission of technical and tacit expertise within the family. However, there are only a few studies in the literature analyzing the effects of accumulated experience on the economic performance of farms. Laband and Lentz (1983), for example, find evidence of a significant and positive difference between profit on inherited and on non-inherited farms in the U.S. Rosenzweing and Wolpin (1985) empirically test the hypothesis of family farms overperforming in developing countries and find that the accumulation of land-specific knowledge becomes particularly important in periods of more adverse weather conditions.

The study realized by McNally (2001) relative to 24 European regions, confirms the higher performance of inherited farms. However, the advantage enjoyed by heirs in the first years following the take-over is cancelled out after 15 years. This suggests a hypothesis of diminishing returns to experience, a question that seems to matter more in recent years. According to Huffman (2001), in most advanced economies, where business success depends on factors such as the professional and management capacities of the entrepreneur, her/his propensity to adopt innovation and ability readily to exploit market opportunities, the benefits from accumulated experience are uncertain, while the selection of entrepreneurs with the highest skills becomes crucial.

A large number of studies on this topic, however, has been carried out in the literature on family firms operating in manufacturing industry. A common result that emerges from these studies points to the lower performance of family firms where the successor succeeds the founder in the management and control of the firm than in those in which external CEOs are hired (Villalonga and Amit, 2006; Perez-Gonzales, 2006; Bennedsen *et al.*, 2007; Barth, Gulbrandes and Schone, 2005). Some of these papers find that successors are have a lower level of education than managers from outside the family, others, that the performance gap increases when firms operate in the most innovative sectors. In sectors where innovation matters more, the selection of the best talents becomes a fundamental tool for achieving better results. Finally, a large proportion of studies questions the family firm's organization itself, regardless of the inter-generational transmission of the business within the family. According to this line of literature, factors such as respect for family values and obligations may interfere with economic objectives; as a consequence family utility maximization might not correspond with the firm's profit maximization (Demsetz and Lehn, 1985; Burkart, Panunzi and Shleifer, 2003, Bertrand and Schoar, 2006). For example, some authors find that family firms are generally excessively risk averse (Agrawal and Nagarajan, 1990; Gallo and Vilaseca, 1996); whenever the leading goal consists in providing a legacy to heirs, the level of investment might be lowered to avoid jeopardizing business stability, thus compromising the firm's expansion path.

So taking into account that results shown in the literature are mixed and that different and opposite effects may follow from the family business organization and succession process, in the next section, after the age-performance analysis, we present our findings from a study in which we analyze the effect that inter-generational turnover within the family has had on farm performance in Italy.

3. Empirical analysis

The objective of this study is to investigate the influence of farmers' age and intra-family succession on the economic performance of farms in Italy. In particular, we test two hypotheses:

1. the "young" status of farmers is positively related to the farm's business performance;
2. the intra-family business transfer is negatively related to the farm's economic results.

In order to find confirmation of the above hypotheses, we first examine the performance-age relationship and the performance-intra-family succession relationship, using the Student's t-test analysis on mean differences between the economic results realized by younger and by older farmers and between those achieved by inherited and by non-inherited farms. We make this comparison by using different proxies of farm performance. This analysis gives us a first indication on the existence of differences in performance among different groups of entrepreneurs. In order to investigate what are the factors that are responsible for this result, we make a Student's t-test analysis, where the two groups of farms, inherited and non-inherited, are compared according to the different dimensions of managerial ability, such as the human capital of entrepreneurs, their ability to innovate and to put high effort into farming. Then we proceed with an OLS regression model analysis, in which we investigate both the impact of age and of succession on farm value-added per work unit -the measure of farm productivity that we have chosen-, by considering also the effect of other characteristics of entrepreneurs' abilities and other factors that determine the firm's performance.

The study is carried out using data collected by FADN in 2009 on a sample of over 11,000 Italian "commercial farms[2]", i.e. farms exceeding an economic size[3] of €4,800. Excluding the smallest firms, the FADN sample is not completely representative of the entire universe of farms over the country, but it allows us to analyze those that operate in the most effective and efficient ways. Moreover, the dataset includes a considerable amount of information relative to the farms' characteristics – such as the physical and economic size, the type of farming, the altimetry, the geographic location, diversification into related agricultural businesses-, relative to the features of farmers and family members – such as gender, age, education, category of labor, total farm working days, extra-income from non-agricultural activities-, relative to the production process – such as work units, physical capital use, machinery and hours of work, types of process, types of production – and, finally, relative to the public subsidies that farms receive – such as the type of subsidy and amount received. So it is very useful in exploring the effects of the variables of interest to us, i.e., the age of entrepreneurs and the channel of succession, on farm performance, since it allows control for a high number of other relevant variables.

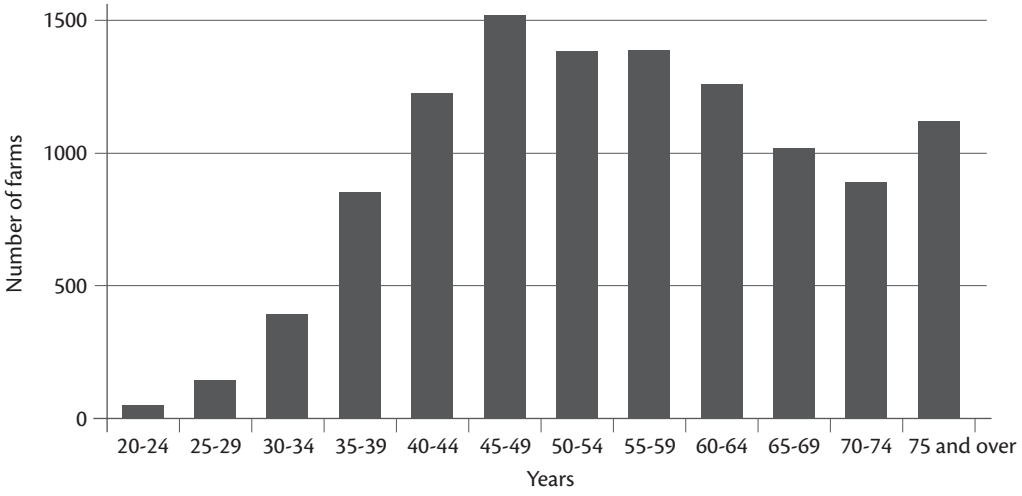
3.1. The performance-age relationship

Looking at the distribution of the FADN sample, the average age of farmers is 55 years, 14.4% of them are younger than 40, only 5.1% are aged less than 35, about 48.5% are over 55 and more than 25% are over 65. Thus, the data confirms the progressive aging of farmers in Italy as a cause for concern, due to a strong bias towards the oldest age groups, as we can see from Figure 1.

[2] According to Council Regulation (EC) No 1217/2009 of 30 November 2009 and subsequent amendments "A commercial farm is defined as a farm which is large enough to provide a main activity for the farmer and a level of income sufficient to support his or her family. In practical terms, in order to be classified as commercial, a farm must exceed a minimum economic size. However, because of the different farm structures across the European Union, a different threshold is set for each Member State. Consequently, the set of farms which constitute the FADN field of observation in a given country is represented by those agricultural holdings with an economic size exceeding the threshold set for that country".

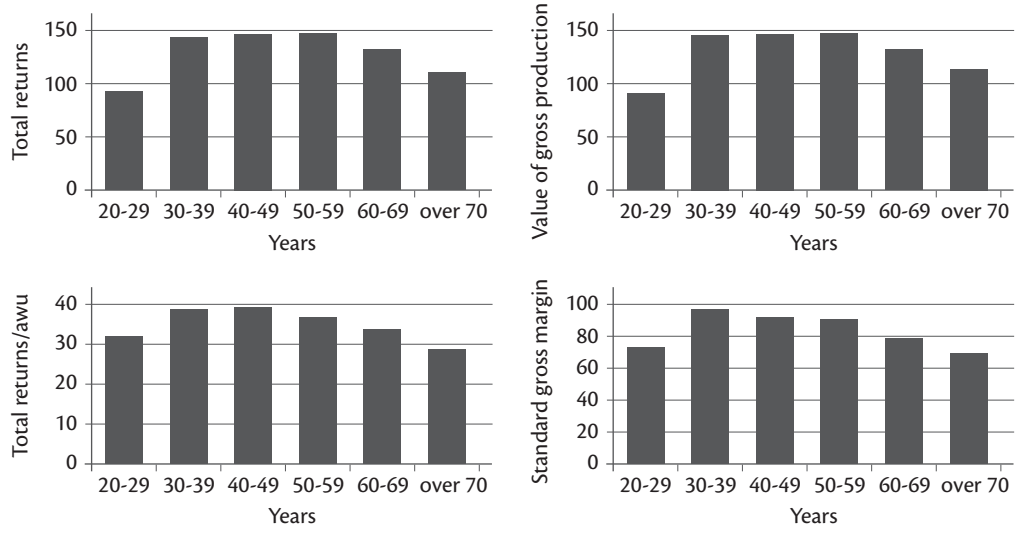
[3] The economic size of the holding is expressed in terms of European Size Units (ESU). The value of one ESU is defined as a fixed number of EUR/ECU of Farm Standard Gross Margin. Over time, the number of EUR/ECU per ESU has changed to reflect inflation.

Fig. 1 - Farm distribution by age class



As we have underlined in the previous section, the results on the relationship between age and performance are not clear, since some authors find a negative relationship, while others find no evidence of such a relationship, or even a positive one. Hence, first of all we search for evidence of the type of age-performance relationship in Italy, by using a Student's t-test analysis and other descriptive statistics. In this regard, we found that, as can be seen from Figure 2, which shows the average value of the measures per age class, the relationship between farm performance and entrepreneurial age in Italy is non-linear.

Fig. 2 - Farm performance by age class (value in thousands of euro)



In particular, it is first increasing and then decreasing, reaching a sort of stability in middle size classes starting from that of "30-39 years". Hence, we can say that before the threshold of 40 years, farmers' age increases performance, probably because of the increasing experience and learning by doing, while after that threshold, the positive effects due to the learning activity do not compensate for the negative ones due to other characteristics, such as higher risk aversion and the lower propensity to innovate and seize market opportunities, typical of the oldest entrepreneurs. In any case, even if the type of age-performance relationship is radically different between the group of entrepreneurs aged below 40 years and that above 40 years, it is not clear which group shows the highest average performance. For this reason we split the data between entrepreneurs aged under 40 and those over 40, and compare them according to different measures of performance in order to detect which class has the larger average productivity. Results are reported in Table 1 and show that farms where farmers are aged 40 years or less overperform on average compared with those with farmers aged over 40, in terms of all the measures we use, i.e. value of. gross production (column 1), standard gross margin (column 2), total returns per annual work unit -awu- (column 3), total returns (column 4), and value added (column 5).

Tab. 1 - Test on Mean Differences (t-test)§ Farm performance by farmers' age

	Value of gross production[a]	Standard gross margin[a]	Total Returns / awu[a]	Total Returns[a]	Value added[a]
Farmers aged <=40	161115.8	107201.5	40404.48	157273.7	92039.73
Farmers aged >40	131894.9	80379.65	34206.37	132163.7	76670.71
Difference§§	29220.89**	26821.88***	6198.111***	25109.99*	15369.01**
Observations	Farmers aged <=40	Farmers aged >40	All farms		
	1588	9618	11206		

§ The t-test assesses whether the means of two groups are statistically different from each other
§§ Significance: *** p<0.01, ** p<0.05, * p<0.1
[a] Values in euros

In order to find some indication of why the first group shows a higher performance compared with the second one, we analyze whether some particular characteristics of entrepreneurs may explain the result. Table 2 summarizes our results.

Tab. 2 - Test on Mean Differences (t-test)§ Farm characteristics by farmer's age

	Education[a]	Diversification[b]	Organic[b]	Rented land[c]	Extra income[b]	II Pillar subsidies[b]
Farmers aged <=40	10.53904	.0711587	.0384131	20.48569	.1366499	.2978589
Farmers aged >40	8.235888	.0536494	.025577	13.33889	.3256394	.1889166
Difference§§	2.303154***	.0175093***	.0128361***	7.146802***	-.1889896***	.1089423***
Observations	Farmers aged <=40	Farmers aged >40	All farms			
	1588	9618	11206			

§ The t-test assesses whether the means of two groups are statistically different from each other
§§ Significance : *** p<0.01, ** p<0.05, * p<0.1
[a] Completed years of schooling [b] Percentage of farms [c] Values in hectares

As expected, we find that younger farmers on average have a higher level of education, a higher propensity to diversify agricultural activities in related business and to invest in highly innovative sectors, such as organic farming. In addition, they use a higher amount of rented land, that could be interpreted as a signal of a greater effort employed in the activity of the farmer. In fact, when farmers utilize rented land for agricultural purposes, because of the higher cost implied, they are incentivated to employ more effort in entrepreneurial activities (CNEL, 2004). The results show also that younger farmers are less inclined to receive extra income from non-agricultural activities; we interpret this result as an evidence of a greater propensity of the younger farmers to invest in effort and a lower propensity to exit from the sector. In fact, according to many agrarian economists (Weiss, 1999; Stiglbauer and Weiss, 2000; Simeone, 2005), the farms that supplement their income by engaging in businesses other than agriculture demonstrate a lesser intention to sustain themselves through farming alone, and a high probability to leave the sector. Finally, from the t-test we can see that younger farmers better respond to public policies that encourage farm growth, as they are more capable of receiving public support for investments. Hence, due to their higher human capital accumulation, to their higher propensity for technological innovation and higher propensity to dedicate more effort to farming activity, as appears to emerge from our t-test analysis, younger entrepreneurs contribute to the competitiveness and growth of the agricultural sector. In this respect, the European policies that support young people's entry into the market are justified.

3.2. The performance-family succession relationship

While the study carried out so far highlights the fundamental role assumed by younger farmers in enhancing productivity and growth in the agricultural sector, we emphasize that different entry mechanisms to the sector, via the market or by intra-family succession, are non-neutral to farm performance. According to leading research on this topic, inter-generational transmission within the family could be detrimental to businesses, by failing to ensure that farms are managed in the most efficient way and that incumbents are succeeded by the most talented entrepreneurs. Table 3.a shows that on average "inherited" farms, i.e. enterprises transferred by family transmission[4], acheive lesser economic results than non-inherited, according to all the variables we use as proxy of performance. We compare inherited and non-inherited farms in the subgroups of those whose farmers are aged 40 or less and those managed by farmers over 40. We do not find differences between inherited and non-inherited farms in the class of age "under or equal 40" (Table 3.b), while when we consider the older class, we find that the inherited farms have lower performance (Table 3.c) -the entire distribution by class of age and by type of access is reported in Figure 3. This evidence can be explained by the fact that the young successor gains an advantage over competitors who do not inherit their farms, in terms of initial investment, of farm-specific experience and of a network of relationships that the parent/founder has set up and transferred, that compensate the heirs' lesser ability in managing the farm. After the early years of setting-up, however, non-inheriting farmers acquire field experience, set up their own network of relationships and improve productivity, so that, after some time, the initial gap is cancelled out and factors related to their higher skills prevail. This can justify the lack of difference in performance for entrepreneurs aged 40 or less, and the better performance achieved at a later age by farmers that did not inherit the farm.

[4] To identify inherited and non-inherited farms we use a dummy variable equal to one if the accession occurs by intra-family succession and zero otherwise.

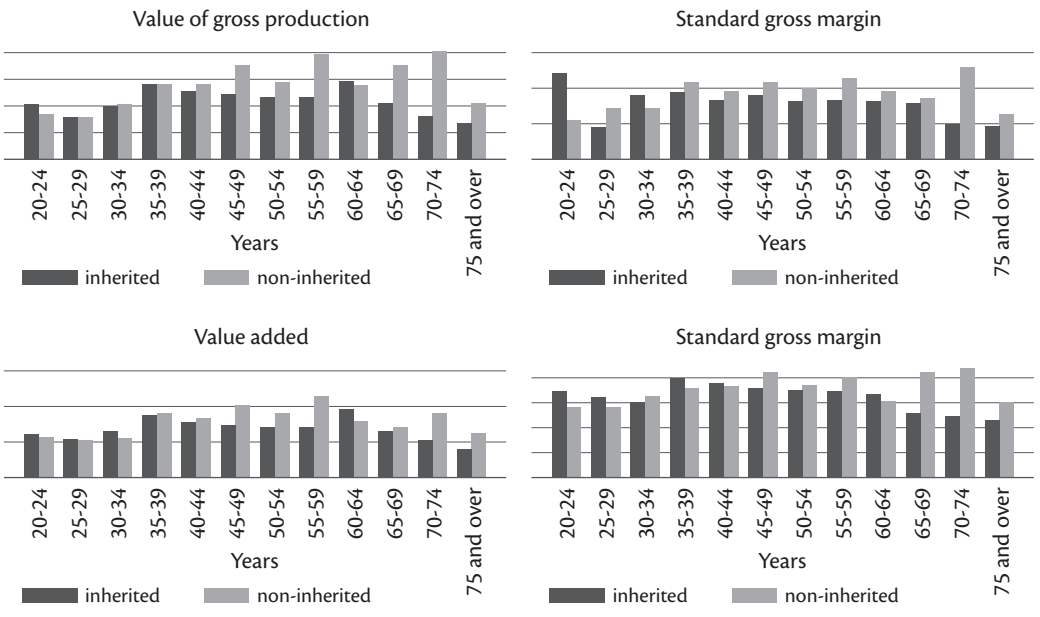
Tab. 3a - Test on Mean Differences (t-test)§ Farm performance by type of access					
	Value of gross production[a]	**Standard gross margin[a]**	**Total Returns / awu[a]**	**Total Returns[a]**	**Value added[a]**
Inherited	114657.8	77485.91	32577.35	115098.2	72666.91
Non- Inherited	152303	95990.47	37021.38	148886.4	87370.1
Difference§§	-37645.24***	-18504.56***	-4444.032***	-33788.27***	-14703.19***
Observations	Inherited	Non-Inherited	All farms		
	3672	2700	6372		

Tab. 3b - T-test§ Farm performance by type of access: farmers aged <=40					
	Value of gross production[a]	**Standard gross margin[a]**	**Total Returns / awu[a]**	**Total Returns[a]**	**Value added[a]**
Inherited	128860.8	89518.38	37559.26	127254.3	78313.44
Non- Inherited	126754.2	94690.63	33570.64	124108.5	76691.19
Difference§§	2106.61	-5172.245	3988623	3145.817	1622243
Observations	Inherited	Non-Inherited	All farms		
	519	467	986		

Tab. 3c - T-test§ Farm performance by type of access: farmers aged >40					
	Value of gross production[a]	**Standard gross margin[a]**	**Total Returns / awu[a]**	**Total Returns[a]**	**Value added[a]**
Inherited	111952.2	75505.3	31754.43	113097.2	70038.9
Non- Inherited	157421.1	96262.31	37743.05	154068.4	87192.34
Difference§§	-45468.89***	-20757.01***	-5988.625***	-40971.19***	-17153.45***
Observations	Inherited	Non-Inherited	All farms		
	3153	2233	5386		

§ The t-test assesses whether the means of two groups are statistically different from each other
§§ Significance: *** p<0.01, ** p<0.05, * p<0.1
[a] Values in euros

Fig. 3 - Farm performance by class of age and by type of access



In order to detect whether entrepreneurial ability is one of the major factors that can explain the difference in performance between the inherited and non-inherited farms, or whether other family characteristics are more responsible for the result, we examine whether the two groups differ according to different dimensions of entrepreneurial ability. One of the most important dimensions of managerial skills is the human capital of the entrepreneur. In this respect, we have that, on average, there are no significant differences in a statistical sense between successors and entrepreneurs that do not inherit businesses, relative to the years of schooling completed (Table 4, column 1). However, since we believe that scientific and technological progress might have changed the value of human capital over time, providing greater incentives to invest in education to the most recent successors than to those who inherited farms in the past, we distinguish the more recent from the older intra-family business transfer, by splitting the sample into those aged 40 or less and those over 40, in order to see if differences in educational levels emerge. Results in column 2 and 3 confirm the previous findings: differences between farmers who inherited and those who did not in the past and today are negligible. Hence even if the human capital of entrepreneurs is an important dimension of managerial ability, factors other than education explain the lower performance of heirs. Another important characteristic that we analyse is the ability to innovate captured by the diversification of production and the investment in the organic sector. In this regard, as Table 4 shows, the propensity to diversify agricultural activities into related business or to enroll in the most innovative sectors, such as organic, are higher for non-inherited farms, whether farmers are young or old (as we can see from columns 2 and 3).

Tab. 4 - Test on Mean Differences (t-test)§ Farm characteristics by type of access			
Education[a]	**All farms**	**<=40 years**	**>40 years**
Inherited	9.026151	11.0289	8.696383
Non- Inherited	8.969596	11.43041	8.45426
Difference§§	.0565551	-.4015051*	.2421232**
Diversification[b]	**All farms**	**<=40 years**	**>40 years**
Inherited	.0487473	.0558767	.0475737
Non- Inherited	.0759259	.0899358	.072996
Difference§§	-.0271786***	-.0340591**	-.0254222***
Organic[b]	**All farms**	**<=40 years**	**>40 years**
Inherited	.0261438	.0231214	.0266413
Non- Inherited	.0411111	.0620985	.0367219
Difference§§	-.0149673***	-.0389771***	-.0100806**
Extra income[b]	**All farms**	**<=40 years**	**>40 years**
Inherited	.3050109	.1233141	.3349191
Non- Inherited	.2807407	.1156317	.3152709
Difference§§	.0242702**	.0076824	.0196482
Rented land[c]	**All farms**	**<=40 years**	**>40 years**
Inherited	10.42661	17.73541	9.223546
Non- Inherited	19.7435	21.66304	19.34206
Difference§§	-9.316892**	-3.927626	-10.11851***

§ The t-test assesses whether the means of two groups are statistically different from each other
§§ Significance: *** p<0.01, ** p<0.05, * p<0.1
[a] Completed years of schooling [b] Percentage of farms [c] Values in hectares

We also consider factors indicating the entrepreneurs' effort in farming, like the use of rented land, which is higher for non-inherited farms, and the percentage of farmers engaged in extra-agricultural activities, which is lower for non-inherited farms. The differences in both characteristics indicate that non-inherited farms have a higher propensity to invest in effort. Hence, by interpreting all these variables as different dimensions of entrepreneurial abilities of farmers, the study has provided some evidence of less talented heirs as compared with farmers who enter the sector via the market, a finding that causes concern about the state of health of Italian agriculture if we consider that over 60% of the farms in the sample are inherited. Furthermore, because of a large number of missing values in the variable describing the kind of access, we suspect that the percentage of intra-family successors in Italy could be higher. In these circumstances public policies to support the entry of younger and more skilled people in the sector appear crucial.

3.3. The regression model

The above descriptive analysis has given strong indications in favor of the hypothesis that entrepreneurs under 40 years old are more productive and that the most efficient channel through which the new generations enter the agricultural sector is the market. In order to have a more complete test of this hypothesis we use an OLS regression model through which we estimate the impact of farmers' age and intra-family transmission on the economic performance of farms in Italy, by controlling for other characteristics of entrepreneurial abilities that, as we have seen in the previous section, are relevant in explaining, at least in part, the age-performance relationship

and the effects of the different channels of inter-generational transmission of farms. As measure of firms' performance, we use the value added per work unit. In particular we estimate the following model equation:

$$V\textit{alue added /awu} = \alpha + \beta\ \textit{farmers aged<=40} + \gamma\ \textit{inherited farms} + \delta X + \varepsilon$$

the *value added/awu* is reported in log terms. To distinguish younger and older farmers we use a dummy variable (*farmers aged<=40)* equal to one if the entrepreneur is 40 years old or younger and zero otherwise. The inherited status of farm is represented by a dummy variable (*inherited farms*) equal to one if the mode of accession is by gift or intra-family succession and zero if it occurs by purchase, lease or free loan[5]. In general, we have information on the kind of access to the farm available for only 6,372 sample units and about 60% of them (3,672 observations) consists of inherited farms. *X* indicates the vector of the other variables that affect the farm's performance. It includes measures of inputs that farms employ in their production process, such as total *physical capital value* and total *annual work units*, that are expressed in log terms. Adopting the hypothesis of diminishing returns to work units, we introduce the square of the labour variable in the regression. The amount of utilized agricultural area that farms have rented (*utilized agricultural area rented*) is used as another measure of size of enterprise. Moreover, we insert the number of family members on the farm (*family members working on the farm*) since this variable captures the strong connection between families and the businesses they run and gives indications about the probability of intra-family farm transfers in the future. We use this variable as an additional check of the impact of family organization on farm performance. The other variables in our model are a proxy for farmers' human capital, represented by their completed *years of schooling*, and dummies that account for farms' involvement in related businesses, such as agro-tourism (*diversification*), or operating in the most innovative sectors, such as the organic sector (*organic*), or that receive income from extra-farming activities (*extra-farming income*). The inclusion of these variables allows us to see whether these dimensions of managerial skills are relevant in explaining the farm's performance and if, after controlling for them, the variable *inherited farms* is still significant. If this were to be the case it would imply that they do not exhaust and do not explain all of the effect of the intra-family succession channel.

As further control variables, we have included the type of public subsidies that farms receive, since it gives information about the status of their economic health. We believe that farms that receive income support (*Pillar 1 subsidies*) might be less efficient, while enterprises that receive investment supports *(Pillar 2 subsidies*) might show better ability in creating more stable and self-sustaining firms. So we expect an opposite influence of the two variables on farm performance. Finally, we include types of farming, altimetry and region where farms are located, to take account of the particular sub-sector of production to which farms belong and of their geographical location.

3.3.1. Results

According to the results in column 1 of Table 5 (model 1), the age of farmers negatively affects the performance of Italian farms: entrepreneurs aged 40 or less overperform by about 13.3 % compared with their competitors over 40. As we can see, the coefficients of the other included

[5] We exclude farms which are classified by the FADN questionnaire under code "98" and "99" (4,834 sample units) because we were not able to identify them with certainty.

variables have the expected signs. For some of them the impact is very strong. Apart from the physical capital value and the total annual work units, whose positive effect is straightforward, we emphasize the negative influences deriving from receiving extra-farming income and income subsidies that both reduce farms value added per work unit, respectively by about 20% and 15%. The human capital coefficient is significant and shows a positive sign, as do the coefficients of variables that indicate the propensity for innovation.

Tab. 5 - Ols Estimation (Dependent variables: *Value added over total annual work units)*

Variables	**(1) Model**	**(2) Model**
Physical capital value	0.451*** (0.00741)	0.438*** (0.00992)
Annual work units	0.621*** (0.0542)	0.693*** (0.0701)
Annual work units squared	-0.170*** (0.0181)	-0.190*** (0.0231)
Utilized agricultural area rented	0.00370*** (0.000180)	0.00379*** (0.000245)
Farmers aged <=40 years	0.133*** (0.0221)	0.154*** (0.0281)
Farmer's years of schooling	0.0152*** (0.00211)	0.0143*** (0.00277)
Inherited farms		-0.113*** (0.0214)
Family members working on the farm	-0.0488*** (0.00887)	-0.0502*** (0.0114)
Extra-farming income	-0.206*** (0.0176)	-0.194*** (0.0231)
Diversification	0.0724** (0.0338)	0.0474 (0.0428)
Organic	0.0739 (0.0487)	0.102* (0.0592)
I Pillar subsidies	-0.148*** (0.0225)	-0.164*** (0.0300)
II Pillar subsidies	0.00335 (0.0219)	-0.0185 (0.0289)
Farming type	Yes	Yes
Altimetry	Yes	Yes
Regions	Yes	Yes
Constant	1.919***	3.754***
	(0.460)	(0.772)
Observations	11,009	6,260
R-squared	0.471	0.465
Adj. R-squared	0.469	0.462

Dependent variable: Value added per work unit in log terms.
Standard errors in parenthesis. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

The relationship between farm performance and intra-family business transmission is estimated with the model 2, where we have added to the previous model our variable of interest *inherited farms* (see column 2 of Table 5). Results show that farms that are inherited underperform by about 11.3% compared with non-inherited farms. Moreover, we find that increasing the number of family members enrolled in the family business reduces farm performance. This strengthens the results we obtained in the previous section and gives alarming warnings about the negative consequences that intra-family business transmission will cause for future productivity and growth in the agricultural sector[6]. We note that also in the more complete model (model 2), the variables that capture the particular dimensions of entrepreneurial ability are still significant and with the expected signs. Hence we can conclude that, even if the particular dimensions of entrepreneurial abilities that we have considered have the expected effects on the performance, they do not exhaust the negative effect of the intra-family succession channel. This means that our variable *inherited farms* captures other family characteristics and other dimensions of heirs' ability that can explain the result, but which constitute a still unexplored issue.

4. Policy implications

The results of our study permit us to remark on the suitability of public policies supporting younger people's entry into agriculture (measure 112).

Many reports on the evaluation of rural policy in recent years have pointed to several drawbacks arising from the previous regulations defined within the European Rural Development Policy 2000-2006. According to these, the main result achieved by the measure that stimulated younger farmers' entry into the sector was the early replacement of the incumbent by his children in the management of those family farms which were seeking funds to solve their liquidity problems. On the other side, the insufficiency of funds to cover start-up costs and/or to make the necessary investment that the business required, prevented new younger entrepreneurs from entering.

The study we have put forward in this paper highlights how the persistence of these mechanisms may be detrimental for growth and productivity in the agricultural sector. Indeed, the current European Program for Rural Development 2007-2013 has provided more effective tools for overcoming such problems, not only by promoting young people's investments in agriculture, but also by ensuring the growth of the farm over time. In this respect, the current plan involves a considerable increase in the amount of the premium for the initial setting-up of young farmers in the sector (measure 112). Submission of a business plan describing the essential stages of growth of the farm and underlining strengths and weaknesses due to the context in which the farm is located is obligatory, and finally it provides for the use of other measures of the rural program, such as advisory services, vocational training and information, diversification into non-agricultural activities, and investment for the modernization of the holding. So far, however, the effects of policy seem to be below expectations. In this respect, a recent study (Carillo *et al.*, 2013) shows that the progressive aging process of farms in Italy between the last two Agricultural Censuses has not yet stopped: as in 2000, the percentage of younger farmers in Italy is stabilized at around 10% in 2010. We believe that the new regulations should remove

[6] We exclude farms which are classified by the FADN questionnaire under code "98" and "99" (4,834 sample units) because we were not able to identify them with certainty.

some obstacles to the proper functioning of the market and the barriers to entry for new young entrepreneurs. The difficult access to bank credit and the low propensity to rent land represent some examples of entry barriers still persisting in the agricultural sector. Under these circumstances, it is quite likely that the survival of farms and their inter-generational transmission remain firmly entrenched in traditional forms of family business, implying all the risks which have been discussed in this paper.

5. Conclusions

The dramatic aging of Italian farmers calls for and justifies the development of public actions such as those supported under the Rural Development Program 2007-2013, to promote market entry of younger entrepreneurs in the agricultural sector. In this regard, the analysis that we have carried out on the relationship between farm performance and farmers' age has shown that younger farmers would enable farms to achieve better economic results. However, the ways in which this replacement occurs affect farm performance differently. An interesting result of our research indicates that inherited farms have a lower value of performance, measured in different manners, than non-inherited farms. According to the literature regarding family firms, intra-family business transmission does not guarantee the best selection of talent; from our study it emerges that inherited farms are less capable than non-inherited ones of diversifying agricultural activities, of operating in the most innovative businesses, and, finally, of creating stable, efficient and self-sustaining companies.

The results we found cause concern about the possible consequences at macroeconomic level, especially in view of the insufficient support from the Rural Development Policy so far in increasing the setting-up of young farmers. The persistent prevalence of family farms is compromising the development of a stronger and more productive sector that could compete in the present international scenario.

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THE MANY FACES OF FOOD SUSTAINABILITY: THE OBESITY ISSUE

JEL classification: D18; I18; M31

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Abstract. *The paper focuses on the issue of obesity, which has become one of the most insidious world epidemics and a serious threat to global health. The aim is to highlight the relationships between obesity and the sustainability of the food system and to discuss the effectiveness of different policies that could be implemented to address the problem. An empirical analysis has been carried out, aimed at assessing the relationship between price and energy density of foods and price premium for low-calorie foods. The main conclusion of the paper is that the aim of reducing obesity, which is a priority for food sustainability policies, cannot be achieved without regulatory intervention designed to reverse relative prices between obesogenic and healthy foods.*

Keywords: *obesity, energy density, diet cost, state intervention.*

1. Introduction

A very general definition of sustainable food is a food which is healthy for people and the planet, with reference to both the present and the future (Reisch, 2010). The concept of sustainable food brings to the fore various health, environmental, social and ethical concerns in the food chain. The non-sustainability of the present food system is documented by many data, among which: the high contribution of the food system to global warming (the global food system is accountable for nearly 50% of total world GHG emissions, according to Grain (2009); the enormous food waste and loss, i.e. food that is discarded or lost uneaten, which annually accounts for 1.3 billion tons of food, namely about one third of global food production; the health emergency related to hunger and obesity, with over a billion people in the world who go hungry and about the same number who are overweight (the WHO calls this "the double burden" of world food insecurity).

The paper focuses on the issue of obesity, which has become one of the most insidious world epidemics and a serious threat to global health. The aim is to highlight the relationships between obesity and the sustainability of the food system and to discuss the effectiveness of different policies that could be implemented to address the problem.

The paper is organized into two sections. In the first section, obesity is framed as a problem of food consumption sustainability and the different policies designed to prevent and control obesity are assessed accordingly. In the second section, the case of low calorie food price is addressed. Through the results of an empirical research recently carried out at the University of Naples, it

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is shown that the price differential between obesogenic and healthy foods is an important factor which may offset public efforts to tackle obesity.

The main conclusion of the paper is that the aim of reducing obesity, which is a priority for food sustainability policies, cannot be achieved without regulatory measure designed to reverse relative prices between obesogenic and healthy foods.

2. Obesity and food consumption sustainability: a policy agenda

In a broad perspective to be sustainable must be safe and healthy in amount and quality; and has to be carried out through means that are economically, socially, culturally and environmentally sustainable – minimizing waste and pollution and not jeopardizing the needs of others (Reisch *et al.*, 2010). According to this definition, obesity is clearly at odds with food consumption sustainability. Obesity is highly correlated with many non-communicable diseases, and therefore provides evidence of unhealthy food consumption. Moreover, it has been proven that obesity has a negative impact on the environment. Fatter populations need 19 percent more calories to survive and an obese person produces one ton more of carbon emissions than a thin person. Edwards and Roberts (2009) estimated the impact on greenhouse gas emissions of increases in the population distribution of body mass index (BMI). They found that, compared with a normal population distribution of BMI, a population with 40% of obese persons requires 19% more food energy for its total energy expenditure. They estimated that greenhouse gas emissions from food production and car travel due to increases in adiposity in a population of 1 billion are between 0.4 Giga tonnes (GT) and 1.0 GT of carbon dioxide equivalent per year.

While obesity is a multidimensional phenomenon, affected by many factors (socio-cultural, individual-psychological, economic, political, structural, and so on), nonetheless it arises directly from consumption decisions; therefore policies aimed at tackling obesity must modify consumption behavior, either directly or indirectly.

As shown in figure 1, obesity policies are generally targeted towards consumers, trying to change consumer preferences and habits with at least four types of intervention: communication campaigns and food education; market incentives, directly to consumers and indirectly to producers; regulations, in the field of labeling, advertising and junk food sales; infrastructure measures to promote physical activities and the availability of healthy foods.

Fig. 1 - Policies to counteract obesity

Communication policies	Market incentives	Regulations	Others
Communication, social marketing, public information campaigns	Market incentives for consumers (taxes and subsidies)	Mandatory labeling (nutrition facts and menu labels)	Improving infrastructures to increase physical activity
Education (mainly as school food education programs)	Farmers market incentive programs for increasing fruit and vegetable consumption	Regulation of junk food sales (mainly in school and hospitals)	Regulating retail food establishments for improving the availability of full-service supermarkets
Point of purchase, marketing, and advertising policies		Advertising regulation (targeted mainly at children)	

Policies so far experienced in the United States (see figure 2) have focused on consumer information and on children's food education. Other tools, -such as economic incentives, infrastructure support and regulation- relate to a small number of measures (Gostin *et al.*, 2009; European Commission, 2007; Faulkner *et al.* 2011; Sacks *et al.*, 2008). In the European Union also -where interest in obesity policy is, however, small compared to the USA-, the attention has been directed mainly to children, including measures such as: nutritional education campaigns, promotion of physical activity and proposed regulations for unhealthy food advertising aimed at children (EU Platform on Diet, Physical Activity & Health).

Obesity policies so far implemented have given scant results. Over the last twenty years, a period in which many obesity policies have been implemented, the obesity rate in US has continued to grow. Such a failure may be interpreted in several ways. Two main sets of problems can be identified: the first related to the predominance of communication policies with respect to regulation and market based instruments; the second related to some important mechanisms which prevent communication policies from giving the expected results.

2.1. The predominance of communication policies with respect to regulation and market based instruments

There is wide consensus that in order to tackle the public health burden of obesity effectively it is necessary to combine a large array of measures. Therefore, together with information and educational campaigns, regulatory and market-based instruments should be used. Even if the existing literature is quite limited in quantity and scope, studies carried out so far have shown the positive effects of regulatory and market intervention (Sacks *et al.*, 2009). There is broad agreement on the deleterious impact of agricultural policy on the prevalence of obesity in North America (Schaffer *et al.*, 2007). As a consequence, an important priority for obesity policy should be to modify agricultural support policies and food subsidies so as both to lower the prices, and to increase the availability of fruit and vegetables. There is also consensus on the effectiveness of the imposition of a tax on high calorie sweetened beverages and subsidies for fruit and vegetable consumption for children and low-income households. In general there is evidence that lower prices of fruit and vegetables are associated with lower child weight. In general, imposing substantial taxes on fattening foods may improve health outcomes such as body weight and chronic disease risk (Thow *et al.*, 2010). Notwithstanding the positive expected effects of regulations, taxes and subsidies, these measures have been applied very rarely and to a limited extent, due principally to the following reasons: 1- these forms of intervention directly interfere with the functioning of markets, and this is at odds with the neoliberal ideology which has been dictating food policy over the last 25 years (Sodano, 2012); 2- even supporting a more interventionist state, some measures, such as taxes on fats and sweet beverages, may be opposed because of their regressive effects; 3- producers' lobbies, at farm, manufacturer and retail level, strongly try to block any form of regulation and tax; 4- consumers may also disagree, when they perceive the state as paternalistic and their freedom of choice at risk.

2.2. Mechanisms which prevent communication policies from producing the expected result

When designing consumer communication policies, it is generally taken for granted that the more information consumers have on the negative impact on health of their current consumption and on healthier alternatives, the more they will switch to healthy diets. Instead, it has been documented that this is often not the case. The failure of consumer communication

policies is due to the same three arguments generally used for explaining the failure of sustainable consumption policies: the knowledge-to-action gap; the behaviour-impact gap problem; the rebound effect;

A knowledge-to-action gap exists to the extent that the knowledge and the awareness of health problems is not sufficient to change consumer behavior and lifestyles. This gap depends mainly on four factors. Firstly, there may not be adequate alternative consumption options; these might be unattractive, due to dominant tastes and social norms, too expensive, or requiring a high "purchasing effort" (i.e. hard to find). Secondly, consumers might not be adequately motivated to change their habits. Consumption decisions are influenced by a multitude of values and criteria competing with health goals. Consumption is strongly influenced by socio-economic conditions, leading to a conflict between different personal attitudes and values (Gastersleben *et al*., 2002). Furthermore, business communication strategies often confuse consumers, soliciting purchasing motivations which contrast with healthy and sustainable diets. Thirdly, the knowledge-to-action gap may be due to the discursive confusion faced by consumers when striving for better consumption practices (Markkula, Moisander, 2012). When the informative and socio-cultural frameworks become too complex and imbued with contrasting opinions and value judgments, consumers tend to stick to dominant habits, unable to make radical changes. Finally there is the phenomenon of akrasia, i.e. a weakness of will that prevents consumers from "not eating the wrong food", even if this is at odds with their utility function (Mann, 2008).

The behaviour-impact gap is confronted whenever the required behavioral change is achieved, but the observed effect on weight and health is minor or missing. In other words: "even when the required behavior changes do happen, the results may lag far behind what was originally expected; inconsistencies can be found between the behavior of consumers and the outcomes observed" (Csutora, 2012). The gap can be due to a miscalculation of the effective weight reduction resulting from diet-improving behaviors because of bounded rationality or external unexpected interference (for example a reduction of physical activity consequent on job and/or family constraints).

Finally, the rebound effect refers to a behavioral or other systemic response to a measure taken to reduce environmental impact (in the case of obesity the weight or health impact) that offsets the effect of the measure (Hertwich, 2005).[1] In the case of food education and communication policies to contrast obesity a rebound-type of effect is related to the strategic response of food companies to the new consumer preferences and cognitive attitudes created by these policies. Companies can take advantage of the induced higher preference for "healthy food" by launching new lines of low-calorie (light) products, thereby carrying out differentiation and price discrimination strategies, with consequent increase in market power and social welfare losses. The same companies will continue to sell low price high-calorie foods to low-income consumers (and to the same rich consumers buying the expensive light products, but affected by akrasia) and will use their higher profits and power to oppose other obesity policies such as regulations and taxes. The net final outcome might be higher average food prices and higher average weight among the population.

[1] The typical example is the case of energy-saving devices which, while reducing the marginal cost of energy, determine an increase in the demand for services such as heating, lighting or transport. Moreover, the economic growth promoted by energy-efficiency may entail a further increase in energy demand. Thus efficient devices may lead to a net increase in energy use (Greening at al., 2000).

Concluding, obesity is part of the general problem of food consumption sustainability, either because a healthy diet is part of the very definition of food consumption sustainability, or because the same diet which allows for sustainability, namely the Mediterranean diet (MD), helps to prevent obesity. As a matter of fact, literature on food consumption sustainability has demonstrated that the most sustainable diet (including environmental, economic and health dimensions) seems to be the Mediterranean diet, defined as a diet rich in fresh fruit and vegetables and low in meat, added sugar, salt and saturated fatty acids (Duchin, 2005). MD sharply contrasts with the current food habits of most developed countries, with the prevailing consumption of processed, ready to eat and animal-derived foods. While shifting to a MD would be the most simple and affordable solution for contrasting obesity, nonetheless it is not viable because of the strong resistance of the most powerful food companies which would see their demand reduced (just think of the meat sector and all the activities involved) together with the possibility of taking advantage of the market for light food and products and services targeted to people who want lose weight. Also consumers are likely to show a strong resistance to drastically changing their food habits, because of the many "pleasures" (food variety, strong tastes, convenience, and so on) which the current food model entails[2].

The previous considerations support the idea that as consumer communication policies alone are not sufficient to stop the obesity epidemic and that regulatory and market-based instruments need to be used as well. As long as prices for low-calorie foods are higher than prices of high-calorie food, consumers encounter further obstacles in their effort to shift towards a healthier and more sustainable diet (Drewnowski, Darmon, 2005; Monsivais, Drewnowski, 2007). Moreover, as long as food companies are able to segment the market in order to make extra-profits on the market for light foods, they will not have the incentive to change their supply in such a way as to satisfy the general need for healthier foods. The next section presents the results of a study which tries to estimate the relationship between price and energy density of foods and price premium for low-calorie foods, in order to highlight cost obstacles hindering the affordability of a better diet on the part of consumers.

3. Obesogenic and healthy foods: a price comparison

The survey was carried out in April 2012 in the Naples area at Italy's three main food retailers (Auchan, Carrefour and IperCoop). It considered food products belonging to the following categories: yogurt, frozen vegetables, savoury snacks, sweet snacks, breakfast biscuits, fresh-cut vegetables, fresh-cooked vegetables, ready-to-eat dishes. For each of the above categories, prices and label information were recorded for all the items found on the shelf. Only those products not being promoted were considered eligible for the survey. Data were collected on a total of 967 items (tab. 1)

[2] A shift to the sustainable MD meets the same problem documented by scholars in the case of the general shift towards more sustainable consumption and named the "double dividend" issue, i.e. the opposition between weak and strong sustainable consumption. Scholars endorsing this argument suggest that a kind of "double dividend" is inherent in sustainable consumption: the ability to live better by consuming less while reducing the impact on the environment of all consumption activities (Jackson, 2005). Accordingly, what is needed is a strong sustainable consumption perspective (Fuchs, Lorek, 2005), questioning the level of material consumption as a meaningful measure of well-being and calling for a radical change in levels and quality of consumption. The weak sustainable consumption approach instead, endorsed by policy makers and environmentalists so far, focuses on eco-efficiency and product "green innovation" assuming a business as usual and a continuous economic growth scenario.

Tab. 1 - Number of products by food categories					
	No. of items	**No. of producers**	**Items/ producers**	**PL**	**PL/items**
Yogurt	236	25	9.4	56	23.7
Frozen vegetables	204	11	18.5	101	49.5
Fresh-cut vegetables	91	8	11.4	62	68.1
Fresh-cooked vegetables	13	4	3.3	3	23.1
Savoury snacks	75	12	6.3	14	18.7
Biscuits	167	23	7.3	57	34.1
Sweet snacks	146	23	6.3	55	37.7
Ready-to-eat	35	6	5.8	22	62.9
Total	**967**	**82**		**370**	**38.3**

As observed in table 1, the product category with the most items was that of yogurt with over 230 products and 25 producers. The product category of fresh-cooked vegetables is still under-represented on the shelves of the large distributors, and at the retail outlets in question only 13 items were found.

Tab. 2 - Energy content by food categories				
	Kcal/100g	**Standard deviation**	**P/100g**	**P/100 Kcal**
Fresh-cut vegetables	30.2	24.2	1.00	4.36
Frozen vegetables	50.4	36.1	0.54	1.52
Fresh-cooked vegetables	55.9	31.2	0.63	1.47
Yogurt	82.9	23.6	0.58	0.61
Ready-to-eat	145.2	27.6	1.20	0.88
Sweet snacks	410.0	36.2	0.67	0.17
Biscuits	457.4	25.5	0.47	0.10
Savoury snacks	522.7	28.0	1.16	0.19

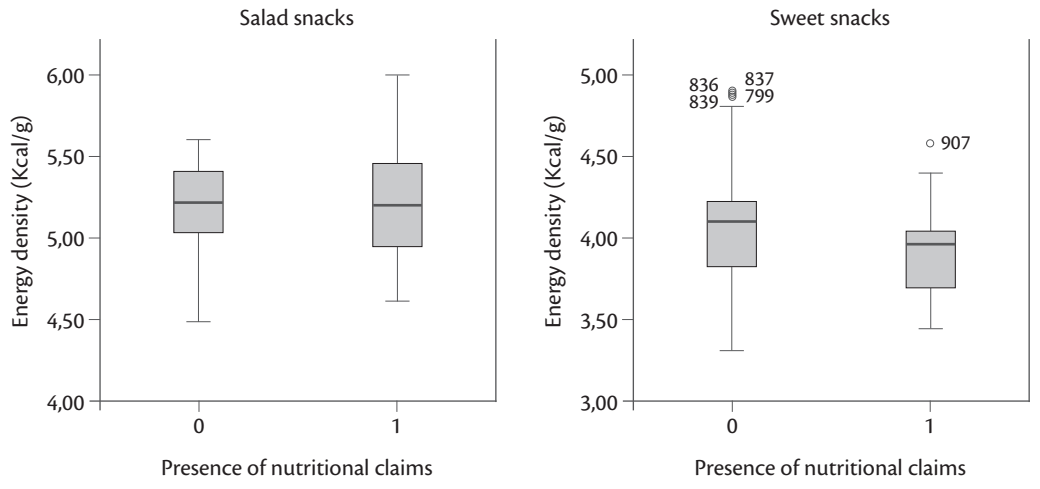
The information regarding some indicators is reported in table 2. In particular, the calorie content per 100g represents the energy value index. A glance at the index shows that the eight product categories may be distinguished into two sets. The first, which may be termed *low energy density,* comprises fresh-cut vegetables and frozen vegetables, pre-cooked vegetables, yogurt and ready dishes. The second set may be termed *high energy density*, and consists of sweet snacks, biscuits and savoury snacks.

With reference to the six product categories, we initially ascertained the relation between mean energy density and the presence of nutritional claims which explicitly or implicitly refer to the concept of "lightness" and low energy density. As may be observed, only in the case of yogurts and biscuits is it possible to reject the null hypothesis of the same energy density with a p-value < 1%. Importantly, in the case of the two categories of sweet and savoury snacks, no statistically significant difference is found in the energy content with respect to the presence of nutritional claims, as shown by the relative box plots in Figure 2.

Tab. 3 - Mean energy density and presence of nutritional claims

Product category	Presence of nutritional claims	Kcal/100g Means	Standard deviation	t	df	sig (2-code)
Yogurt	Yes	75.79	22.91	-5.431	234	0.000
	No	91.66	21.49			
Frozen vegetables	Yes	49	28.64	-0.152	202	0.879
	No	50.53	36.61			
Fresh-cut vegetables	Yes	44.37	41.65	1.75	89	0.083
	No	28.83	21.74			
Savoury snacks	Yes	530	43.98	1.124	73	0.265
	No	520.93	22.54			
Biscuits	Yes	440	25.71	-6.424	165	0.000
	No	464.8	21.53			
Sweet snacks	Yes	397.57	30.18	-1.709	144	0.090
	No	412.07	36.83			

Fig. 2 - Savoury and sweet snacks: Box Plot (energy density vs presence of nutritional claims)



4. The empirical model

To further assess the existence of a relationship between food price and energy value, we used a hedonic econometric model of price. As shown, this model determines the selling price of a commodity as a function of the material and non-material attributes that comprise it.

The first pioneering studies concerning products understood as sets of characteristics date back to 1929. In that year Waugh noted "There is a distinct tendency for market prices of many commodities to vary with certain physical characteristics which a consumer identifies with qual-

ity, and the relationship of these characteristics with prices may in many cases be accurately determined by statistical analysis" (Waugh, 1928, p.187).

In subsequent years, Hauthakker's model (Hauthakker, 1952) and then Lancaster's new approach to consumer theory were to ensure that the hedonic technique had a theoretical framework which would be the basis for future studies. In 1974, Rosen directly tackled the issue of hedonic models, proposing, under the hypothesis of perfect competition, the conditions required to estimate the demand curves of characteristics identified by econometric analysis (Rosen, 1974).

The many empirical applications developed since the 1960s have concerned many classes of commodities. In agriculture and food sectors some of the most recent applications have dealt with wine, fruit juices and genetic properties (Combris *et al.* 1997, Nerlove 1995, Neibergs 2001, Weemaes and Riethmuller 2001).

The hedonic technique entails two separate, conceptually different steps: 1) using the hedonic price equation implicit marginal prices of the properties may be estimated; 2) using such implicit prices we may estimate the inverse demand functions or the functions of marginal willingness to pay for distinct groups of consumers.

More formally, let *Q* be a class of products. Each unit of *Q*, say *qi*, may be completely described by an *n*-dimensional vector of its characteristics *xi*. Hence the price of the generic product *qi* is also a function of the level of such characteristics:

$$P_{qi} = P_q\left(x_{i1}, \ldots, x_{ij}, \ldots x_{in}\right) \tag{1}$$

The function *Pq* is the hedonic or implicit function for *Q*. If *Pq* may be estimated by starting from observations of prices and characteristics of the different products belonging to a class, then the price of each possible product variety may be calculated from knowledge of its characteristics. The implicit marginal price of a characteristic may be found by differentiating the implicit price function of that characteristic. For the generic characteristic *xj* we obtain:

$$\partial P_q \Big/ \partial x_j = P_{xj}\left(x_j\right) \tag{2}$$

This supplies the increase in spending on *Q* which is required to obtain a product with one unit more than *xj*, clearly *ceteris paribus*. If equation (2) is linear in characteristics, then implicit prices are constant. When the equation is not linear, then the implicit price of an additional unit of a characteristic depends: a) on the chosen quantity of the characteristic in question; b) on the quantity of the other characteristics; c) on the functional form chosen.

In this study we use only the first stage of the hedonic technique insofar as estimation of willingness to pay for each attribute; the second step, requires knowledge of the socio-demographic characteristics of the purchasers, which is very difficult to acquire and not available for this empirical study. However, the first stage allows the prime objective to be achieved, namely to measure the relative impact of an attribute on the dependent variable, *ceteris paribus*, through an implicit price function for the different characteristics concerning the food products in question.

The general theoretical model may be represented as follows:

$$P_{qi} = P_q\left(x, y\right) \tag{3}$$

where x and y represent respectively the vectors of intrinsic and extrinsic quality indicators.This

means that price is a function of intrinsic and extrinsic attributes, provided that the latter can be easily verified by the consumer prior to purchase.

Starting from the complete dataset of 967 observations concerning eight distinct retail categories, our empirical survey selected the 367 observations relative to all the products in the dataset sold with the retailer's brand. Analysis was thus limited to private label products. The choice was dictated by the need to arrive at a more homogeneous set of items with respect to the large number of variables (presence of organic products, products belonging to the main brand leaders on the market with specific price strategies) which could mask the relation between food price and calorie content. Starting from the set of available data, we obtained the matrix of potential independent variables, each of which contains information on a characteristic of the commodity which may be directly obtained from the label or from observation of the product (nutritional information, format, presence of nutritional claims, etc.)

In the hedonic model proposed, the dependent variable P_{100g} is defined as the mean price in Euros per 100 grams for each product. The independent variables which proved statistically significant are as follows:

- TW = overall product weight in 100 g of each item
- NutClaim = dichotomous variable which identifies whether the product makes claims explicitly or implicitly connected with the idea of well-being, lightness and physical shape:
  1 = claim
  0 = no claim
- D_{Funz} = dichotomous variable which identifies whether the product has added nutritional elements that might be termed *functional*, such as vitamins, mineral salts, fibre or probiotics, given the value 1, and 0 otherwise
- Kcal/g = indicates the content in kilocalories per 100 gram of product

The hedonic model, estimated with the ordinary least squares (OLS) method, may be expressed as follows:

$$P_{100g} = \beta_0 + \beta_1 \, TW + \beta_2 \, Kcal/g + \beta_3 \, Func + \beta_4 \, NutClaim + \varepsilon$$

The model was initially estimated by using Box-Cox transformation to test alternative functional forms. As the likelihood test ratios led us to reject both the double-logarithmic and semi-logarithmic form, we opted for a linear functional form. The latter also displayed some problems which were highlighted by White's test, discussed below. However, it allows, amongst other things, to interpret the coefficients directly as implicit prices and obtain information concerning the influence of each individual characteristic.

Tab. 4 - Implicit price estimates through hedonic model (OLS) Robust standard errors for heteroskedasticity

	Coefficients	Std. error	t-ratio	p-value
Const	0.8603	0.0624	13.7946	<0.01
TW	-0.0475	0.0285	-13.7924	<0.01
NutClaim	0.1145	0.0393	2.9179	<0.01
Kcal/100g	-0.0310	0.0693	-4.4814	<0.01
Func	0.1120	0.0500	2.2373	0.026

Mean dependent var.	0.5434	SQM dependent var.	0.0037
Sum of squared residuals	0.3135	SE regression	0.0029
NutClaim	0.1145	NutClaim	<0.01
R^2-	0.3778	Corrected R^2	0.3709
F(4, 363)	48.88795	P-value(F)	<0.001

The model explains overall about 37% of total variance (corrected R^2 = 0.3709) and the signs of the coefficients are consistent with expectations. Submitted to the White test, the model showed the persistence of inherent heteroskedasticity in the data. The statistic produced by the test is distributed asymptotically as a χ^2 equal to 4.80. The test was clearly run in the unknown variance mode, and to reach a consistent estimate of the coefficient values and the standard errors we proposed White's corrected matrix of variance and covariance. The model presented was thus estimated with standard errors robust to heteroskedasticity.

The dummy associated with the presence of functional elements has a positive coefficient, and thus the functional nature of food results in a price increase. The impact on the sale price, about 0.11€/100g, suggests that the functional choice represents successful strategy for firms, able to guarantee a significant price premium.

The Kcal/100g data represents a variable whose coefficient has a negative sign. This result was obtained by considering overall the items belonging to the eight categories in question. Although the coefficient is very low, the result confirms the inverse relation between food energy value and cost per unit of kilocalorie.

The coefficient of the product format also has a negative sign. In other words, the greater the weight of the package sold, the lower is the unit price of the product. This result, which might appear self-evident, should nonetheless be interpreted in the light of the overall analytical design. One of the factors which contribute to defining the so-called obesogenic environment is indeed represented by the progressive increase in the sales portions and formats. If this trend is combined with the price discount offered on the larger formats, the negative effects in terms of nutritional health become considerable and may be summarised in the slogan: the more you eat the less you pay.

The dummy associated with the presence of nutritional claims that evoke well-being and lightness has a positive coefficient. Hence the products which have such claims receive a price premium from the market. However, in the above analysis there emerged a weak, uncertain – or even non-existent – relationship between the presence of nutritional claims and mean energy value of food (tab. 3 and Figure 2). Our econometric model confirms the presence of an inverse relation between food product prices and energy value, and hence represents further confirma-

tion of the importance of factors of strict economic relevance in leading to the emergence and progressive increase in obesity worldwide.

5. Conclusion

Globally, 1.4bn people are overweight and 500 million obese. Obesity is the fifth-highest global risk for death, accounting for at least 2.8mn adult deaths a year (WHO, 2007; Merrill Lynch, 2012).

Obesity is an important aspect of the current unsustainable model of food production and consumption. Designing policies to fight obesity is a challenging task because obesity has multiple causes -ranging from individual lifestyle factors to general socioeconomic and environmental conditions- which occur in conjunction (Faulkner *et al.*, 2011; Sacks *et al.*, 2008). The debate on government's role in fighting the obesity epidemic sets the supporters of state intervention against the advocates of consumers' freedom of choice and the autonomy of the individual.

So far, the most popular measures have been targeted at stimulating consumer responsibility through communication policies aimed at raising consumers' awareness of the costs of obesity. This research has pointed to the ineffectiveness of such policies when economic incentives are not aligned with the consumer's best nutritional choices. In particular, it has focused on the necessity of removing some important constraints which hinder healthy food consumption choice, such as the lower price of high energy food compared to that of low energy. The survey carried out in Southern Italy was aimed at testing the relationship between price, food energy density and nutritional claims for a selected group of food items. The econometric model confirmed the presence of an inverse relationship between food product prices and energy value, and hence represents confirmation of the importance of factors of strict economic relevance in leading to the emergence and progressive increase in obesity worldwide. Results bring evidence of socio-economic causes of obesity, with the poorest section of society at higher risk, and add arguments in favour of a stronger state intervention.

The main conclusion of the paper is that the consumer communication policies alone are not sufficient to stop the obesity epidemic and that regulatory and market-based instruments need to be used as well. In particular, there is a need for regulatory measures aimed at reversing relative prices between obesogenic and healthy foods.

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ECONOMIC PROFITABILITY AND LONG-TERM VIABILITY IN ITALIAN AGRICULTURE

JEL classification: Q18, Q12

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Abstract. *The EU direct payments system is about to change and Italian agriculture will face a scenario of decreasing aid. The present work is an attempt to estimate the types of farm at risk in such a scenario by analyzing Italian FADN data. We have estimated a profitability index relating real net income to a reference revenue that takes into account the opportunity cost of resources. This has allowed us to highlight situations where farms are unable to remunerate fairly the factors employed and to identify areas of Italian agriculture at risk. By comparing profitability indices with and without public aid and by analyzing demographic factors and production characteristics, it is possible to investigate how EU payments affect the persistence of non-profitable farms.*

Keywords: *farms' profitability, CAP reform, FADN sample*

1. Introduction

In the last ten years the Common Agricultural Policy (CAP) has changed considerably. The single payment scheme, introduced by the 2003 Fischler reform for arable crops, beef, lamb, and the dairy sector, has been gradually extended to most agricultural products. Thus, with the exception of suckler cow, goat and sheep premia, the coupled support has been removed and the bases for more radical changes in CAP have been laid. Today, in fact, an agreement on a new CAP reform has been reached that should enter into effect from January 2014, except for new direct payments that will apply from 2015 onwards. This reform aims at a redistribution of aid between regions and Member States and proposes the "segmentation" of direct payments into several components, each of which meets one of the goals that the CAP has been adding over time: income support, environmental sustainability, maintaining the population in the less favored areas, increasing the number of young farmers. On the other side, a single CMO is foreseen that should simply maintain the function of market intervention: a safety-net mechanism with a set of exceptional/emergency measures that should help farmers to manage situations of market crisis.

The convergence of direct payments and their distinction into different components will inevitably lead to two consequences:

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1. the level of aid per farm will be lower than in the past, both because of redistribution, and because not all farms will be eligible for all components of the support;
2. historical references for direct payments will come to an end and that will bring about a redistribution of support between holdings and sectors.

To understand how the reform will affect Italian agriculture it is important to know the role that aid has played so far and to assess the economic viability of farms, namely whether the profitability of a farm "holds" in the absence of aid.

To achieve this objective we used 2010 Italian FADN data, which contain information on structural and production characteristics, as well as economic and financial data. Based on these data, we first estimated a profitability index that relates real net income to a reference income. The latter makes assumptions about the opportunity cost of all internal resources and has been calculated taking into account the value of production with or without European aid. Secondly, the comparison of indices with and without aid was carried out with reference to different areas, sectors, and farm types. This allowed us to point to situations where economic sustainability is at greater risk and to assess the impact in terms of number of holdings and of abandonment of land in a scenario of lower European aid.

2. A farm profitability index

The literature and current practice dealing with farm performance and assessment of profitability have always underlined the difference between agriculture and other sectors. In fact, while for firms in the industrial and service sectors the net income/profit and return ratios, such as ROI and ROE, give useful information on the profitability of capital invested and allow comparison between performance of different firms, in agriculture the use of these indicators can be rather misleading. Farm profitability analysis should take into account at least two distinctive features that characterize the agricultural sector. First, the entrepreneur generally provides several factors to the farm, labor and land in addition to capital, and the estimated net income rewards them as a whole. Second, the objectives can vary across holdings and the return on capital may not be the only indicator that explains the farmer's choices. Moreover, the term profit by itself is not used with the same meaning in business and in agricultural economics studies. While in business analysis the profit is assumed as capital remuneration, in agricultural economics the term profit is used as "compensation for the entrepreneurial factor".

Taking account of that, and following similar analyses carried out on the Italian FADN data (Tosco, 2010, Scardera and Tosco, 2012), we estimated a farm profitability index, PI, given by the ratio of the real Net Income (NI) obtained from official data and a Reference Net Income (RNI), calculated as the sum of opportunity costs of the implicit factors the farmer contributes to production. Such an index expresses the overall profitability of the factors used in the agricultural activity and allows comparison between situations that are different in terms of the amount and features of factors the farmer and his family contribute. It can give information on the higher/lower ability of the farm to remunerate family resources and can help to understand whether the farm is economically sustainable.

It can, moreover, be useful in addressing several analytical objectives, depending on the way it is estimated. If income is calculated before depreciation and amortization, the PI allows assessment of the farm's viability in a short-term perspective. By considering income with or without aid it is possible to highlight the role of public intervention in maintaining a specific farm

structure. The Reference Net Income can be estimated with reference to opportunity costs that differ among regions or farmers (e.g. full time vs part time, retired vs active farmers) in order to consider the real alternative possibilities for the factors and farmer's aims.

In this study three main indices have been estimated:

1. a standard Profitability Index (PI) where the opportunity costs used to calculate the Reference Net Income are the same for all farms in the FADN sample. In particular, for family work we used data published annually by the Ministry of Labor, that refer to average daily wages of agricultural workers; the average yield of government bonds was assumed as reference value for the working capital; for land and buildings, the opportunity cost was based on the average ratio between the rent and the land value resulting from FADN data;
2. a Profitability Index net of public aid (PIna), where the net income is calculated excluding the value of EU and State aids;
3. a "Sustainable Profitability Index" (PIsu) where the Reference Net Income is estimated by considering only the labor. The PIsu can help to assess whether the farm is able to remunerate labor, at least at opportunity cost. Moreover, the PIsu was determined using opportunity costs that differ with respect to the economic size of the farm (higher the larger is the economic size), in order to take into account different farmers' expectations. In this case, the PIsu assumes short-term perspective where the farmer can accept to keep on farming without any return for the capital invested provided that the labor can be fairly paid[1].

3. Profitability in the Italian FADN sample

The Profitability Indices have been estimated using the 2010 Italian FADN accounting data. The analysis has been carried out on a sample consisting of 10,566 farms[2], of which 45% are in Northern Italy, with Southern and Central Italy representing 37% and 18%, respectively.

Distribution of farms and land by PI classes is reported in table 1. While almost half the holdings and 29% of the Utilized Agricultural Area (UAA) have a profitability index lower than 0.66, 36.4% of farms, with 56.8% of the UAA, is able to guarantee factor remuneration equal

Tab. 1 - Distribution of holdings and Utilized Agricultural Area (UAA) by class of Profitability index

	Holdings		UAA	
	Number	%	Hectares	%
PI lower than 0,33	2959	28.0%	51212.41	14.5%
PI between 0.33 and 0.66	2213	20.9%	51718.23	14.7%
PI between 0.66 and 1	1554	14.7%	49492.73	14.0%
PI equal or higher than 1	3850	36.4%	200267.04	56.8%
Total	10576	100.0%	352690.41	100.0%

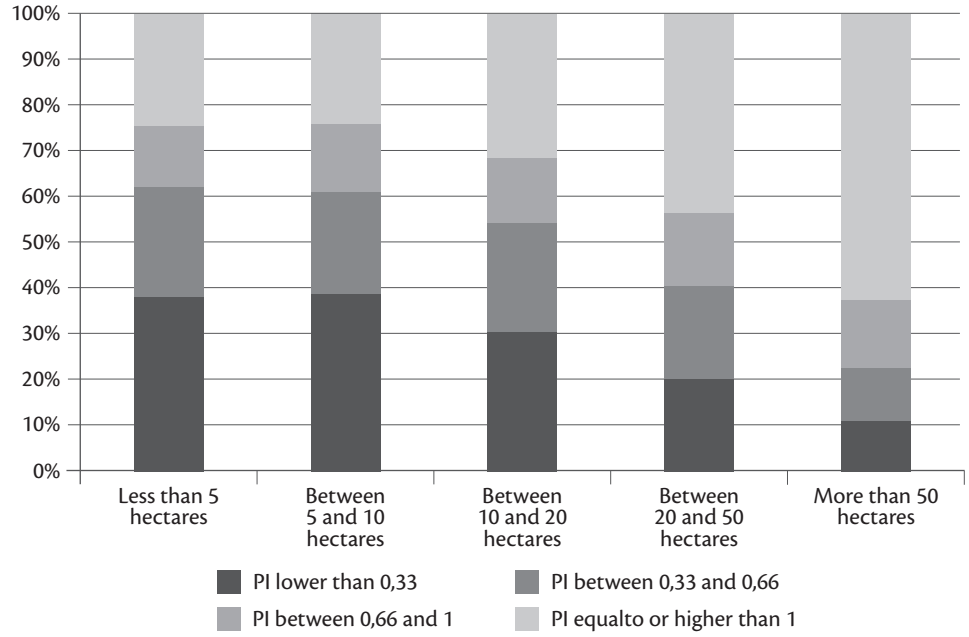
Source: our processing on FADN – INEA data

[1] When capital is the prevailing factor (capitalist farms) the PIsu is estimated by the ratio between the Net Income and the opportunity cost of the capital. That occurs in less than 5% of the sample. In these cases the PIsu still gives information on the short-term viability of the farm.

[2] This number is net of some cases with anomalous data.

or higher than opportunity cost. The comparison of data in terms of holdings and UAA clearly highlights how profitability is closely related to the physical size of farms. That is demonstrated in graph 1 where distribution of farms by PI has been distinguished by UAA size. While no difference exists between the two lower classes of size, the percentage of farms with PI equal to or higher than 1 accounts for 30% of the farms between 10-20 hectares and increases to 60% in the class with more than 50 hectares.

Graph. 1 - Distribution of holdings by class of Profitability index and by physical size



Source: our processing on FADN – INEA data

Data by geographical areas show levels of profitability that are not statistically different when Central and Southern Italy are compared (average PI value equal to 0.99 and 1.02, respectively), while in Northern Italy they are significantly higher (average PI value equal to 1.28)[3]. In fact, the number of farms and the UAA in the highest PI classes (PI higher than 0.66 and equal to or higher than 1) represent respectively 55% and 74% in the North, while moving to the Center and South of Italy these percentages decrease to 46%-48%, in terms of farm numbers, and to 68%, in terms of UAA.

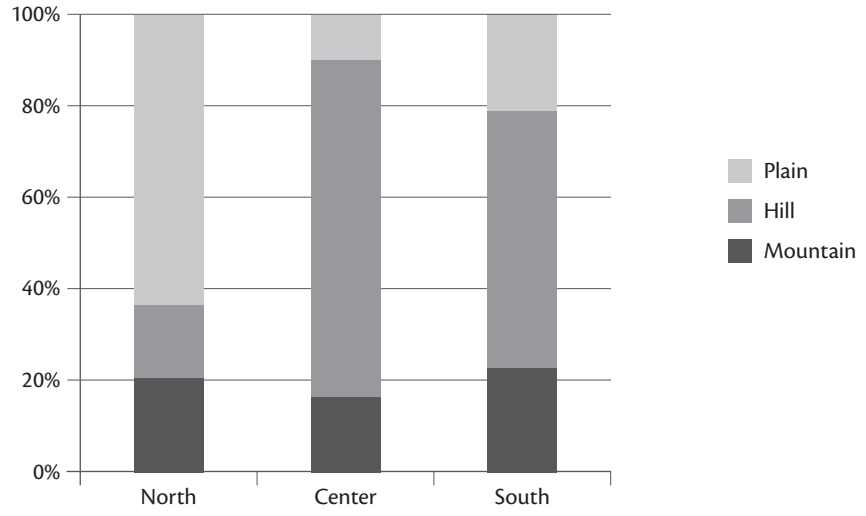
Geographical differences can be linked to two factors that appear to act strongly on profitability: the quality of the land and the type of farming.

The mean value of PI is statistically different according to altitude and, in particular, is higher in the areas of plains (average PI equal to 1.31) than in mountains and hills (average

[3] A univariate analysis of variance and a multiple comparison T2 Tamhane's test were used to determine whether PI means are statistically different by geographical areas and which means differ from each other.

values equal to 1.06 and 1.03 respectively). The role played by land quality in geographical differences can be detected roughly by comparing the incidence of UAA localized at different altitudes in each geographical region (graph 2). In Northern Italy 63% of UAA of FADN sample is localized in the plains; these percentages are significantly lower in Central (10.7%) and Southern Italy (22%).

Graph. 2 - Distribution of UAA by altitude and by geographical regions

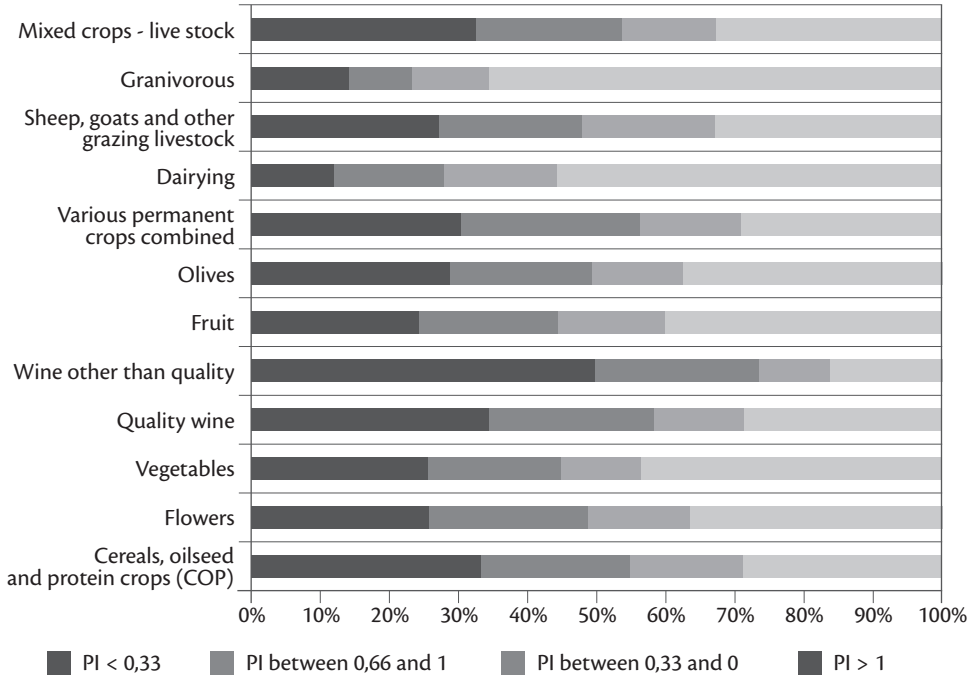


Source: our processing on FADN – INEA data

Type of farming is relevant, too (graph 3). The granivorous, dairy and vegetable sectors show values of PI above the average, while values for wine other than quality wines and for mixed farms stay below it. In particular, two-thirds of granivorous farms are in the highest PI class; the percentage is 55% in the dairy sector and 44% in horticulture. On the other hand, the Profitability Index remains under the value of 0.66 for 50% to 78% of wine and mixed farms.

The distribution of types of farming varies across geographical regions, thus affecting the territorial average PI. For instance, the dairy sector accounts for 15% in North Italy and only 4.7% and 7.4% in Central and Southern Italy, while wine other than quality wines or mixed farm types have a higher weight in the South of Italy than in other areas.

Graph. 3 - Distribution of PI by types of farming



Source: our processing on FADN – INEA data

The PI index can give an idea of the ability of the farm to guarantee sufficient revenue for rural households and that represents a starting point for assessing the long term viability. This can be compared with the "Sustainable Profitability Index" (PIsu) that assesses the profitability of the farm in a short-term perspective on the assumption that, given the low mobility of capital invested in agriculture, the probability that the agricultural activity continues in the short term is higher if at least the labour receives adequate remuneration.

Taking 0.66 as a limit to discriminate critical from viable situations, a small group (6% of the total sample) emerges where the PIsu is higher than 0.66, while PI is lower. Almost 40% of these farms are located in plains and two-thirds are less than 10 hectares. Without a policy aimed at improving their efficiency, in the medium-long term these farms are likely to leave the sector and that risk is higher in areas of plains where the competition in land use is higher. More uncertain is the case of farms with values of both PI and PIsu below the limit. These represent 42% of the total sample and are equally distributed in all size classes and altitudinal areas.

4. Public support and profitability

4.1. Public aid and territory

In 2010, the amount of public aid received by farms included in the FADN sample was € 160.8 million, an average of € 18,900 per farm (table 2). More than 77% of payments came from

the first pillar that still represents the largest part of EU support. In fact, in the same year the second pillar contributed only € 15 million (about 20% of the total support).

At territorial level, significant differences exist in the average amounts received per farm (graph 4). This difference is mainly related to the first pillar, as in Northern and Central Italy each farm received € 14 thousand of decoupled payments, while in the South the average amount per farm was €9.1 thousand. The non-decoupled aid within the first pillar shows a larger difference. In this case, the average aid per farm amounts to €3.7 and €2 thousand, respectively in Northern and Central Italy, and to €0.9 thousand in the South. Differences are less relevant in the case of agri-environmental payments and payments for areas facing natural or other specific constraints, while other aid within the second pillar is higher for southern farms than in other areas. Considering financial support as a whole, including State aid, northern farms receive €23 thousand on average, an amount that is 65% higher than the payment assessed in South Italy (€14 thousand).

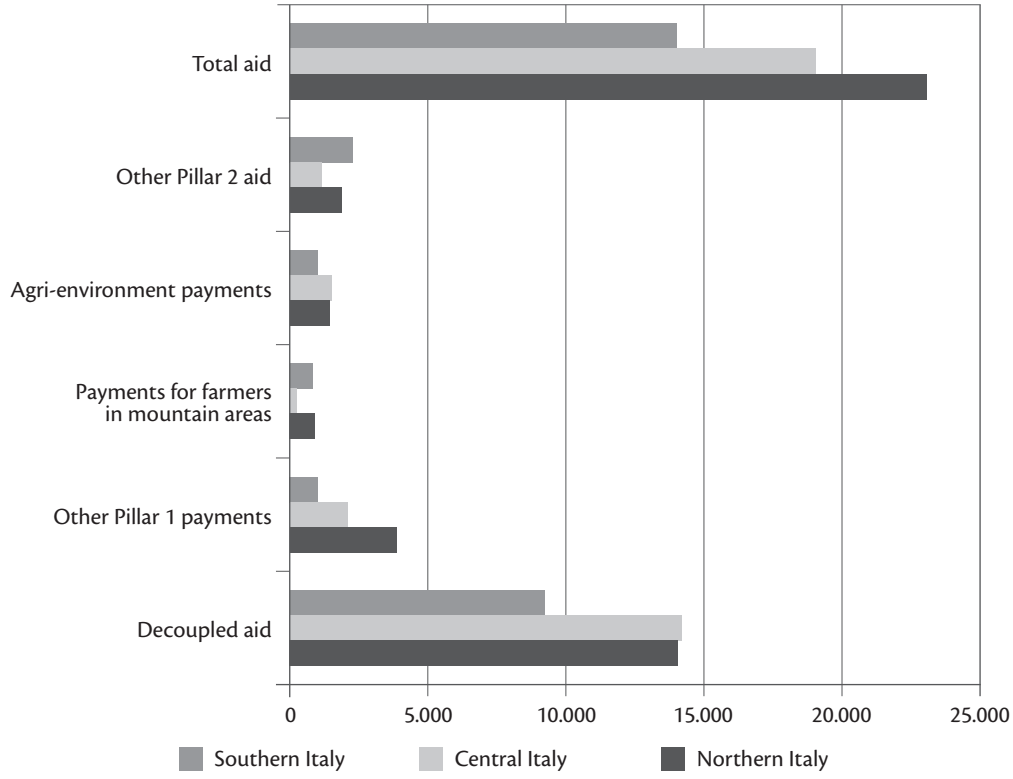
Thus farms in North Italy are able to "intercept" the policies to a greater extent than those in other areas. This is especially true with regard to the first pillar (53.8% of the total amount goes to Northern Italy), but is even more evident for state aid. With regard to the second pillar, data show that farms in Central Italy are less able to attract funds than others, but these figures should be read with some caution, as these types of payments are part of a multi-annual programming and thus annual amounts could be misleading. At the same time, however, it is true that funds for rural development plans are mainly allocated to two measures, agri-environmental measures and payments to farmers in mountain areas, which are granted annually and represent a fairly constant support over time.

Tab. 2 - Number of Italian FADN farms and amount of payments by type of aid and geographical area

	Number of Italian FADN farms	Number of farms that receive payments	First pillar aid (euro)	Second pillar aid (euro)	State aid (euro)	Total payments (euro)
North	4,768	3,766	€ 67,092,669	€ 14,945,325	€ 4,488,839	€ 86,526,833
Centre	1,929	1,607	€ 25,999,364	€ 4,530,611	€ -	€ 30,529,975
South	3,879	3,138	€ 31,729,568	€ 12,046,900	€ -	€ 43,776,468
Italy	10,576	8,511	€ 124,821,601	€ 31,522,836	€ 4,488,839	€ 160,833,276
Percentages						
North	45,1	44,2	53,8	47,4	100,0	53,8
Centre	18,2	18,9	20,8	14,4	0,0	19,0
South	36,7	36,9	25,4	38,2	0,0	27,2
Italy	100,0	100,0	100,0	100,0	100,0	100,0

Source: our processing on FADN – INEA data

Graph. 4 - Average aid per farm by geographical area and type of support (data in euro)



Source: our processing on FADN – INEA data

4.2. Public aid and types of farming

Because of the high incidence of the first pillar on the whole of CAP support, the difference in the average amount of aid at territorial level can be directly linked to the different types of farming.

Table 3 shows how 60% of the first pillar aid is directed to three types of farming, that is fieldcrops (Cereals, oilseed and protein crops, COP; 33.6%), dairy production (13.6%) and farming with mixed crops-livestock (12.7% of the total). Data on the geographical distribution of these types of farming show a clear predominance of northern regions: the latter account for 47%-48% of fieldcrops and mixed crops-livestock farms and for 69% of the dairy farms, much more than the share of Northern Italy in the total number of holdings.

The public support plays a very important role in all situations, but it is strategic for the survival of some sectors. First pillar payments account for 61% of the net farm income on average, but in some farming systems the profitability is only guaranteed by the support to production: this is the case, as is well known, of the tobacco sector where aid exceeds 110% of the average net income, but it is also true of cattle-rearing farms, where the average incidence of aid at the farm level reaches 120%. Very high levels of protection characterize fieldcrops (the average ratio

aid/net income is 84.3), grazing livestock (73.9%), mixed crops - livestock farming (82.6%) and mixed permanent crops (73.8%).

For other sectors, the first pillar aid ranges between 40% and 60% of net income. These are farming systems specialized in wine, citrus fruit, mixed vegetable and permanent crops which, however, represent a small share in terms of total net income. Special cases are those of quality wine and dairy farms in which support, equal to 47% and 44.9% of net income respectively, is associated with a significant share in economic terms (9.7% and 23.1%).

Data on first pillar payments confirm the lower level of protection given to farms specialized in sectors such as horticulture and floriculture (ratio aid/net income between 1.5% and 8.2%), but also fruit and olives where the aid is around 20% of the net income.

The relationship between aid and net income is an indicator of the degree of dependence of farms on policies and, therefore, provides important information about the economic sustainability of different types of farming. In particular, the relevance of aid for a large sector, such as that of fieldcrops, makes the production of COP one of the weakest, that could fall into a very critical situation when the new CAP rules are implemented.

The degree of dependence on public support is an indicator of higher/lower economic viability. However, this indicator should be related to the overall farm profitability, which in turn depends on the type of farming, but also on structural characteristics and, in particular, on farm size.

As first pillar aid is historically linked to the quantity produced and, therefore, to land area, it is not surprising that the support is highly polarized according to size classes. Table 4 shows how farms below 10 ha of UAA, which correspond to 30% of the FADN sample, receive less than 5% of first-pillar aid, as opposed to 22.7% of holdings, those above 50 hectares, that receive two-thirds of total funds.

Average data on the ratio between first pillar payments and net income point out strong differences among size classes. In particular, farms between 10 and 20 hectares are the ones with the highest levels of support (88%); on the contrary, the weight of the aid is much lower the case of small farms (31.7%).

Tab. 3 - Italian FADN sample: amount of First pillar aid , Net Income (NI) and Aid/Net Income ratio (average level per farm) by types of farming

Type farming	First pillar aid (euro)	%	Net Income (euro)	%	Aid/Net income (%)
Cereals, oilseeds and protein crops - COP	41,984,624	33.6	€ 71,553,881	15.2	85.2
Tobacco	6,733,708	5.4	6,993,681	1.5	111.1
Vegetables under glass	139,737	0.1	1,438,216	0.3	16.2
Flowers	98,897	0.1	3,098,817	0.7	8.2
Flowers and vegetables	106,317	0.1	3,763,164	0.8	1.5
Specialist vegetables	6,510,405	5.2	20,089,683	4.3	63.6
Quality wine	3,747,678	3.0	45,445,779	9.7	47.0
Wine other than quality	1,013,530	0.8	5,056,910	1.1	37.0
Table grapes	84,685	0.1	1,485,585	0.3	42.6
Mixed vineyards	192,912	0.2	671,499	0.1	45.6
Citrus fruit	1,351,017	1.1	4,885,069	1.0	53.0
Fruit	1,677,430	1.3	14,804,457	3.1	23.1
Fruit & citrus fruit	404,766	0.3	3,084,596	0.7	16.5
Olives	4,987,338	4.0	10,569,567	2.2	18.2
Permanent crops combined	2,370,318	1.9	8,579,171	1.8	73.8
Dairying	16,956,883	13.6	108,427,752	23.1	44.9
Cattle rearing	2,048,596	1.6	8,417,755	1.8	120.6
Sheep and goats	6,795,867	5.4	23,027,535	4.9	73.9
Granivorous	4,454,085	3.6	62,994,524	13.4	23.6
Mixed crops	6,389,693	5.1	19,019,102	4.0	52.3
Mixed livestocks	866,413	0.7	3,307,929	0.7	9.1
Mixed crops and livestocks	15,906,702	12.7	43,609,803	9.3	82.6
Total	124,821,601	100.0	470,324,475	100.0	61.1

Source: our processing on FADN – INEA data

Tab. 4 - Italian FADN sample – First pillar aid, Net Income (NI) and Aid/Net Income ratio (average level per farm) by size class

Class of UAA	Holdings (number)	%	First pillar aid (euro)	%	Net Income (euro)	%	First pillar aid/NI (%)
Less than 5 ha	1,043	12.7	1,664,257	1.3	18,093,405	3.8	31.7
Between 5 and 10 ha	1,426	17.4	4,198,092	3.4	25,484,544	5.4	44.1
Between 10 and 20 ha	1,781	21.7	10,252,694	8.2	54,142,866	11.5	88.0
Between 20 and 50 ha	2,090	25.5	26,031,300	20.9	112,287,554	23.9	55.4
More than 50 ha	1,862	22.7	82,675,258	66.2	260,316,106	55.3	71.4
Total	8,202	100.0	124,821,601	100	470,324,475	100	61.1

Source: our processing on FADN – INEA data

4.3. Public aid and farm viability

The economic sustainability of Italian farms in a scenario of lower CAP payments can be assessed by means of the Profitability Index net of public aids (PIna). This index allows us to define the higher/lower degree of dependence of the farm on public support and can thus measure its ability to survive and develop in a context of agricultural policy change.

A first insight into this issue comes from the comparison between profitability indices with and without aid. Data on farms by classes of size and profitability (table 5) show that the weak area (farms with PI lower than 0.66) increases by 13% and by 25% in terms of farm number and UAA, respectively, when PIna is considered. Removal of aid mainly affects farms larger than 50 hectares: in this size class are included 41% of farms and 79% of UAA with PI higher than 0.66 that are no longer profitable in a scenario without public payments.

Tab. 5 - Italian FADN sample – Number of farms and UAA by size class and by PI with and without aid

Class of UAA	PI lower than 0.66	PI equal to or larger than 0.66	PIna lower than 0.66	PIna equal to or larger than 0.66	Total
Number of farms					
Less than 5 ha	1,558	934	1,615	877	2,492
Between 5 and 10 ha	1,179	743	1,313	609	1,922
Between 10 and 20 ha	1,094	923	1,313	704	2,017
Between 20 and 50 ha	906	1,320	1,310	916	2,226
More than 50 ha	435	1,484	1,009	910	1,919
Total	5,172	5,404	6,560	4,016	10,576
UAA					
Less than 5 ha	4,057.66	2,264.36	4,254.15	2,067.87	6,322.02
Between 5 and 10 ha	8,386.71	5,410.99	9,425.49	4,372.21	13,797.70
Between 10 and 20 ha	15,385.66	13,398.71	18,672.39	10,111.98	28,784.37
Between 20 and 50 ha	27,498.17	42,753.31	41,050.88	29,200.60	70,251.48
More than 50 ha	47,602.44	185,932.40	116,416.93	117,117.91	233,534.84
Total	102,931.00	249,760.00	189,820.00	162,871,00	352,690.00

Source: our processing on FADN – INEA data

The relationship between profitability and medium-long term viability, however, requires a deeper analysis, first, because several factors can play a role in influencing the farm's choice to stay in business or to exit and, secondly, because these factors can intervene in the short- rather than in the medium- or long-term and time matters in economic decisions.

Producing and staying in the market depends on the ability to remunerate farm resources at least at their opportunity cost. But economic issues are only one part of the story in Italian agriculture.

A first aspect to be considered concerns the farm-household system that characterizes most of Italian agriculture. This feature has two main consequences:

– business and family choices can overlap and income is not the only goal that guides farmers' behaviour. Other objectives can be equally valid: the possibility of employment for members of the family or the need to reconcile farm-working time with outside activities;

– the farm's life cycle is closely linked to the family life cycle. The aging process that characterizes part of Italian agriculture strongly influences continuance of agricultural activity, and that is especially true in some areas and where the farmer lacks a successor. But it also affects investment and farm development, as the age of the holder is relevant for long-term choices and for the time horizon to which they relate.

A second issue concerns the nature of land, which is a productive input but also a family asset. The decision on whether to use the land depends on the ability to remunerate this factor at its opportunity cost, but it is also related to the decision of maintaining the ownership of the land, on the one hand and to real possibilities of alienation, on the other.

Moreover, different production systems and organizational situations coexist and pluriactivity represents a structural element of Italian agriculture. Pluriactivity can integrate agricultural incomes when the farm size and the quality of the land are not able to guarantee satisfactory income levels and, therefore, represents a factor for equilibrium of the agricultural system, affecting farm survival.

Thus, to assess the risk of abandonment one must take into account the demographic characteristics of the farmer, the farm's level of employment and possible outside revenues.

Limiting the analysis to farms with PI lower than 0.66, the farmer is older than 65 years in 31% of cases. In these cases the intensity of production is low, more than 37% of farms are below 5 hectares, the value of capital investment is below the average and direct payments represent 59% of net income. All these factors might push the farm out of the sector in a medium-long term scenario of decreasing aid.

On the other hand, focusing on farmers less than 65 years old, in 28% of cases the holder is a woman and that frequency is statistically different with respect to farms where PI is higher than 0.66[4]. Women' farms are smaller (32% are less than 5 hectares whereas only 25% of farms fall into this size group when the holder is a man), are less capital- and labour-intensive, have a lower economic size. Many studies have underlined the feminization of Italian farming as a process of fairer gender opportunities. That is certainly true, but at the same time, when the economic performance of farming is lower than the average and the farm is not able to pay its resources adequately, there is room for thinking that the farm plays an accessory role in the family revenues. Thus, even situations of low farm profitability are likely to persist in the medium-long term and that could still be true when public payments are totally or partially removed.

When low profitability indices are associated with young farmers (males), high employment levels and high intensity of capital and labour, the situation is seemingly different and long-term perspectives could be very critical. This is the case of 2,461 farms (23% of the FADN sample) that become 3,295 (31% of the sample) when public support is removed. This corresponds to a third of the sample's UAA and represents the more risky area where stronger structural intervention is needed.

5. Concluding remarks

The analysis of profitability indices in the Italian FADN sample has highlighted a large share of non-profitable farms. In fact 49% of the sample is not able to remunerate the resources employed at their opportunity cost and that percentage increases to 62% in a scenario of removal

[4] That was tested by means of the chi-square test.

of public support. Profitability is closely related to the physical size of farms, the quality of land and the type of farming: values of PI above the average are more likely to occur the larger the farm is, when it is located in plain areas and when it operates in the granivorous, dairy and vegetable sectors.

When the farm has low values of profitability indices, two questions arise. First, what makes these farms continue, even in the short term? Secondly, what will happen to them in the medium-long term?

The first question recalls the role farm and agricultural activities play for rural families' incomes. The segmentation of the sample by holders' age, by gender and by labor time showed that more than 30% of the low profitability farms is held by older farmers, and another 19% is conducted by women. In these cases the agricultural revenue could be considered additional for the family income, mainly based on pensions, on the one side, or external (husband's) incomes, on the other. When the holder is a man and the farm employs one unit of labor or more, the situation is more debateable, even more so with a very low Sustainable Profitability Index (PIsu), that estimates the reference income by considering only the opportunity cost of labor, thus adopting a short-term perspective.

Public support can play an important role in stabilizing agricultural incomes and data of first pillar payments on net income has shown that on average more than 60% of the farm net income is related to this aid. Direct payments are particularly strategic for the survival of some sectors, the tobacco sector first of all, but also in cattle rearing farms, fieldcrops, grazing livestock mixed crops-livestock farming. Moreover, the incidence of aid on net income is higher in farms that are larger than 10 hectares, that is, in those farms that should represent a stronger component of Italian agriculture. Thus, a reduction of European payments could be a critical factor for the survival of a large share of agricultural production, even in those areas such as the plains where the quality of land is higher.

The EU reform is pointing to innovation as a key factor for rural development. That certainly responds to the need for higher productive efficiency and thus to a more adequate remuneration of farm resources. Careful planning of the intervention should take into account two relevant issues. First, innovation should be focused on those farms where profitability potential can exist and a way to assess this potential should be carefully studied. Second, rural development plans cannot be separated from land policy. The latter is entirely lacking in Italy but it becomes essential in a context of long-term low profitability of agricultural production, both for preserving agricultural use in areas where competition for land use is more intense and for preventing the risk of abandonment of land in inland areas.

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IMPLEMENTING AGRICULTURAL POLICIES FOR SUSTAINABLE DEVELOPMENT AND THE INTEGRATION OF IMMIGRANT WORKERS: AN APPLICATION OF MCA TO THE CASE OF TWO SOUTHERN ITALIAN PROVINCES

JEL classification: Q18, Q56, C65

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Abstract. *The main purpose of this paper is to consider suitable instruments of agricultural policy and to identify optimal combinations of such measures to pursue the complex target of sustainable development in a context of binding public budget constraints. To this end, we carry out an application of Multi-Criteria Analysis (MCA). The results show that a relatively small (but by no means negligible) weight is ascribed to environmental protection with respect to other intermediate targets (farm competitiveness and integration of immigrants). High importance is given to the measures of "Technical and professional education" and "Subsidies to technological innovation" by all types of stakeholder in any of the aggregation procedures considered. Concerning the target of "Immigrants' integration", panelists indicate "Technical and professional education" first, and then "General education" and "Housing policies" as the most important instruments. Our investigation seems to confirm how important is the issue of immigrants' integration and employment for the present and the future of Italian agriculture: immigrants may constitute a unique option for development, provided that policy makers are able to design suitable actions to promote not only economic incentives for their participation but also acceptable living conditions, in order really to foster social and cultural inclusion of immigrants and their families. Indeed, in a rural context, only when the economic and social dimensions are strictly connected, is it possible to plan improvements in farm productivity, economic growth and sustainable development.*

Keywords: *agricultural policy, sustainability, migrant workers, MCA*

1. Introduction

The main purpose of this paper is to consider suitable agricultural policy instruments and identify optimal combinations of such instruments to pursue the complex target of *sustainable development* in the context of binding public budget constraints. To this end, we adopt an integrated definition of sustainable development, including a variety of economic, social and environmental dimensions, together with an inter-generational rule imposing compatibility and time-consistency of private and public agents' choices.

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Dealing with agricultural policies, we stress the meaning of sustainability, especially in terms of two specific aspects: socio-economic inclusion of immigrant workers and the competitiveness of the agricultural sector. In the case of Italian agriculture, an adequate deployment of the immigrant work-force appears a strategic factor for the future growth of the sector. In this perspective, it seems appropriate to consider the immigrant workforce more as an important resource to be drawn on than as a welfare or public security problem to be dealt with[1]. For example, considering that one of the main deficiencies of Italian agriculture concerns the average size of farms, relatively small because of the predominance of family-run businesses, it can be argued that the workforce supplied by qualified, motivated, and young immigrants may represent a solution for an upgrade in size and a reorganization of the production process. Another weakness is connected with the mean age of producers and managers: the prevalence of elderly agricultural entrepreneurs calls for a significant turnover, but this is hindered by the shortage of a (large enough) cohort of young native farmers. Again, immigrants may offer an interesting solution by filling these gaps, provided that policy makers are willing and able to design policy actions to promote economic incentives and good conditions for fostering social and cultural inclusion for immigrants and their families.

Policies in favour of migrant workers should firstly aim at promoting more stability in agricultural employment by introducing and encouraging less fragmentary contracts, and by combating the underestimation of immigrants' abilities and level of instruction which involve serious loss of skill. As regards incentives to encourage immigrant entrepreneurship in agriculture, credit facilities and public subsidies to support long-run investments appear to be strategic options to be carefully considered. But policy makers must also be aware that alongside strictly economic measures, social measures aimed at the integration of immigrants are also important. Education policies, housing policies and health assistance are among the main kinds of intervention suitable for combating social exclusion and discrimination. Public involvement in support of the social and psychological conditions of immigrants is not only related to the responsibility of modern welfare but has strong economic implications. Indeed, in a fragile context like the rural one, the integration of immigrants and social cohesion are essential requirements for an effective planning of economic growth.

Typically, when seeking to implement policy measures targeting different goals, with a restricted set of available tools and under strong budget constraints, policy makers face complex multidimensional problems with difficult solutions. In this paper, with reference to a specific case of two provinces of Southern Italy, we carry out an application of Multi-Criteria Analysis (MCA), a methodology possibly to be used to deal with these problems. MCA is a set of techniques developed for decision making, based on identification and comparison of possible solutions to a complex problem. Usually, the decision maker is called to make choices in the presence of multiple instances coming from economic agents, society, lobbies and other stakeholders, and scarcity of resources. In the attempt to find the best solution, MCA aggregates groups of variables generating aggregate indicators able to reduce the dimension of the original problem. Making use of MCA, a case study for two provinces of Southern Italy (Benevento and Salerno, in the Campania region) will be illustrated. The case study, starting from the stakeholders' preferences on possible goals and tools of policy action, will try to achieve an appropriate solution in terms of relative budget allocation among the possible policy actions (i.e. how much to use an instrument for any given target).

[1] This is the stance of many authoritative observers. See for example INEA (2009).

After this brief introduction, section 2 illustrates the aim and main features of the MCA approach used in the following sections. Section 3 analyses more deeply the structure of the problem and the solution proposed by the Analytical Hierarchy Process (AHP), a well known technique which uses the MCA approach. Section 4 gives an account of the presence of immigrants employed in agriculture in the two selected provinces and provides a short report on their conditions and degree of integration. Section 5 analyses responses to the interviews conducted within a sample of stakeholders, considering their preferences on policy goals and actions to foster sustainable development. Finally, section 6 summarizes the main conclusions of the paper.

2. Multi-Criteria Analysis (MCA) for economic policy

When considering the presence of migrant workers in agriculture, there are at least two different possible spheres for public intervention. The first concerns policy measures designed to foster immigrants' integration and advancement in skills; the second is relevant for the promotion of competition and growth of the agricultural sector, taking into account the positive externalities exerted on the whole economy, the environment and the rural world. As is well known, budget constraints on policies have become more and more binding in recent years. This has imposed a strong need for parsimonious policy measures, to be carried out by privileging the targets most preferred by stakeholders and choosing the most efficient set of instruments to achieve those targets. Economic theory supplies well known (but somehow disputable) solutions to both problems. To select the best instruments to reach the targets, economists build up econometric models to estimate the model parameters and forecast the effects of instruments on targets. As is known, the reliability of this approach is hampered by the so-called Lucas critique which questions the parameters' property of policy invariance. Secondly, the econometric approach is in any case weak when policies are implemented in novel contexts with little previous experience, which makes it impossible to obtain a sound estimate of the effect of public intervention on economic and social variables. The problem of target selection is even harsher. Since no objective evaluations can be made on the relevance to public interest of each selected target, the assessment is conducted through several different methods based on disclosure of stakeholders' preferences. The revelation of actual preferences by stakeholders and the definition of a ranking rule remain, however, serious problems for the application of these techniques.

These problems are faced in this paper by resorting to an alternative approach, Multi-Criteria Analysis (henceforth MCA), a tool for decision-making used initially in the 70's and significantly improved in the following decades[2]. MCA is based on the comparison of different possible solutions to a complex multidimensional problem taking into account stakeholders' preferences, benefits and costs. A remarkable advantage of MCA is that it forces researchers and policy makers to set up the problem within an explicit formal framework. This helps to understand and consider more carefully even minor aspects of the problem and thus to carry out better medium- and long-run planning. Another advantage of using the MCA approach consists in the possibility of adopting a truly interdisciplinary view, as MCA methodology allows economic, social and

[2] For an introduction to MCA, see for example Vincke (1992), Finlay (1994) and Roy and Mousseau (1996). A comprehensive review is in Figueira *et al.* (2005).

environmental aspects of the problem to be addressed to be dealt with simultaneously. Despite these considerable advantages, MCA techniques have not yet found widespread diffusion and application. Nowadays, in many countries, and in Italy as well, political decision-making is still anchored to different criteria, often unfortunately not grounded in a solid and fair evaluation discipline.

In agricultural policy planning, and in general for any kind of policy, MCA might be a good tool to foster communication among planners, politicians, administrators, civil society representatives and other actors involved in the decisional process[3]. The ideal output of MCA should be the best compromise between different needs of different stakeholders, minimizing the distance between the individual optimum and the general optimal solution. Agricultural policy planning should be a good field for application of MCA techniques because: a) several stakeholders are usually involved in the decision process, b) stakeholders have typically different needs and preferences, c) final decisions are negotiated among stakeholders, d) the discussion is explicitly defined around specific themes and objectives. The big challenge in the implementation of MCA resides in the assignment of a specific weight to the single policy tool considering the different intermediate targets and the general goal to be accomplished. This task is performed by reducing the dimension of the problem and aggregating all relevant indicators: MCA produces a vector of weights for each instrument used to achieve intermediate targets and a vector of weights for each intermediate target to define the general goal (in our case sustainable development) as a suitable combination of intermediate targets.

3. A policy for sustainable development: setting up the problem

In this section and the following ones, we focus on a specific case to which an MCA technique known as the Analytical Hierarchy Process (henceforth AHP) is applied. The AHP technique, elaborated by Thomas L. Saaty (1980, 1992), is aimed at establishing a hierarchy among alternatives which would otherwise be non-comparable, by exploiting stakeholders' quantitative and/or qualitative judgments and summarizing the composite information in a single indicator, obtained by weighting elementary indices connected to stakeholders' indications (Saaty e Vargas, 2001 e Figueira *et al.*, 2005). We apply the AHP procedure to a specific case regarding two provinces of Southern Italy: Benevento and Salerno. The interest in these provinces stems from the high relative importance of the agricultural sector in the local economy and the noteworthy presence of immigrant workers in the labor force[4].

The theoretical experiment of the paper lies in the attempt to design policy intervention aiming at the general purpose of promoting sustainable development of agriculture in the two selected areas based on three intermediate goals: a) farm competitiveness, b) environmental sustainability and c) social and economic integration of immigrant workers and their families. The application is carried out following the standard steps of the AHP procedure:

1. The first step consists in building the hierarchy process. The hierarchy is defined on three levels: General goal, Intermediate targets and Policy instruments, as shown in Figure 1.
2. The second step consists in the definition of the intermediate targets, which contribute to

[3] On MCA and agricultural policy, see van Mansvelt (1997), Roseland (2000) and von Wirèn-Lehr (2001). For a specific focus on land planning decisions in Italy, see Fusco Girard e Nijkamp (2005).

[4] See section 4 for a short description of agriculture in Benevento and Salerno provinces.

the general goal with (possibly) different weights. These latter are derived from stakeholders' judgments on their relative importance.

3. The third step consists in the assignment of weights to the policy instruments reflecting their perceived effectiveness on intermediate targets.
4. The last step consists in specifying the aggregation function needed to reach the best output, i.e., final decision (in our case the best combination of measures to reach intermediate targets and the choice of targets most representative of public interest).

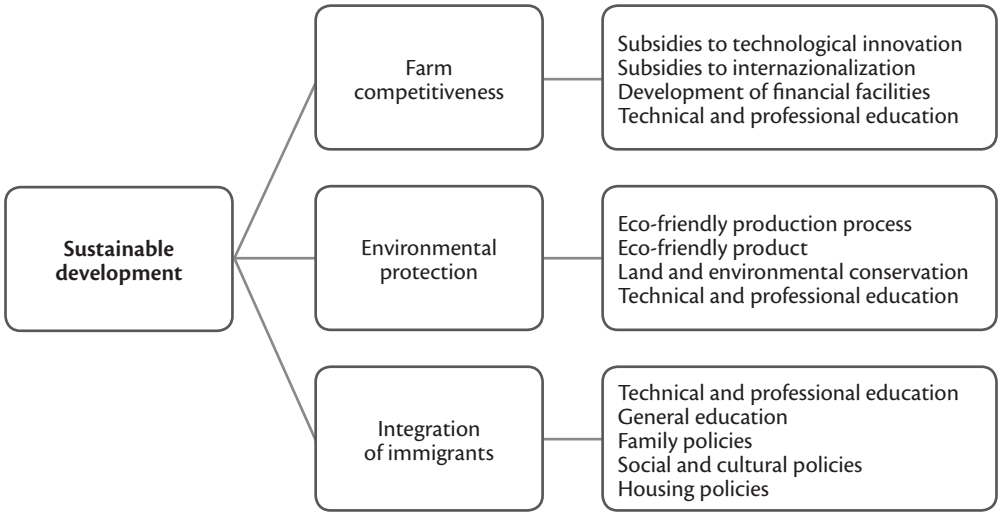
Figure 1 depicts the structure of the hierarchy i.e. the general goal, intermediate targets and a set of policy instruments for each target[5]. The notion of sustainable development is naturally articulated in three (non-exclusive) proposed targets, i.e. farm competitiveness, environmental protection and integration of immigrants. Farm competitiveness is a crucial factor for the development and growth of the agricultural sector. Environmental protection is critical for the well-being of the population, commercial penetration on agribusiness markets (considering the increasing demand for eco-friendly products), the process of integration of immigrants and land conservation. Finally, integration of immigrants is a major challenge for agriculture: integrated migrant workers are strictly needed for a valuable contribution to guarantee growth rates comparable to those of recent decades.

Likewise, for each of the intermediate targets, a set of policy instruments has been selected (again, these are to be taken as only some of all the potential actions that could be adopted). In greater detail, for farm competitiveness we consider the following instruments: i) subsidies to technological innovation; ii) subsidies to internationalization; iii) development of financial facilities; iv) support to technical and professional education. Regarding the target of environmental sustainability, the selected policy actions are: i) subsidies to the adoption of eco-friendly production processes, ii) subsidies to the production of eco-friendly goods and services; iii) measures for land and environmental conservation; iv) support to technical and professional education. Finally, concerning the social and economic integration of immigrant workers and their families, the selected measures are: i) support to technical and professional education; ii) support to general education of workers and their families; iii) family policies in favour of immigrants (such as access to the national health system, counselling, child care, etc.); iv) social and cultural policies (sport, culture, social activities); v) housing and anti-segregation policies.

Figure 1 is a representation of steps 1 and 2 above. Step 3 consists in the assignment of weights to intermediate targets and policy instruments. The procedure for the assignment of weights starts from the preferences as expressed by a selected panel group. Information collected from the interviews has enabled first of all the building of a vector of weights for each of the interviewed actors, secondly, thanks to an aggregation procedure, an overall vector of weights and finally a ranking for policy instruments. However, there are at least three preliminary issues to be addressed: 1) How to choose panelists? 2) How to determine individual weights? and 3) How to determine aggregate weights?

[5] In the MCA terminology, intermediate targets and policy instruments are indicated respectively as "choice criteria" and "alternatives".

Fig. 1 - MCA General goal, intermediate targets and policy instruments



Concerning the first question, we have chosen as members of the panel stakeholders and decision makers (farmers, immigrant farm workers, representatives of labor unions and trade associations, local politicians and researchers)[6]. Secondly, in order to determine individual weights we resort to the AHP technique. Following this procedure, each panelist assigns a value of importance to one policy instrument compared with another through a pairwise comparison expressed either as a verbal judgment (instruments A and B are considered indifferent; A is barely/appreciably/greatly preferred to B or vice versa) or a quantitative assessment. The answers are then elaborated to build up a frame like the one shown in Table 1, where preferences are alternatively expressed in terms of verbal judgments and values of importance (1 standing for indifference and 9 for absolute dominance).

Tab. 1 - Scale of pairwise comparisons

Definition	Intensity of importance	Explanation
Equal importance	1	Two elements contribute equally to the general objective
Moderate importance	3	Experience and judgment slightly favour one element over another
Strong importance	5	Experience and judgment strongly favour one element over another
Very strong importance	7	One element is favoured very strongly over another
Extreme importance	9	The evidence favouring one element over another is of the highest possible order of affirmation

Intensities of 2, 4, 6, and 8 can be used to express intermediate values. Intensities 1.1, 1.2, 1.3, etc. can be used for elements that are very close in importance.

[6] Precisely, the panel is formed by 7 farm owners, 1 agribusiness entrepreneur, 2 managers, 3 labor union representatives, 1 local politician, 2 researchers specialized in agricultural economics, 4 immigrant workers. The questionnaire and the list of the names of the 20 panelists are available on request.

To define individual weights, starting from panelists' judgments, it is possible to build the Pairwise Comparison Matrix (PCM), which, in our case, has a number of rows and columns equal to the number of policy instruments (or intermediate targets). For example, if the policy instrument 2 is strongly preferred to the instrument 3, in the cell (row 2, column 3) of the PCM the number 5 will appear; if the intermediate target 4 very strongly dominates target 1, in the cell (row 1, column 4) of the PCM the number 1/7 will appear and so forth.

Once the PCM has been obtained in this way, weights are determined by the values of the eigenvector associated with the maximum eigenvalue of the matrix. In the presence of many instruments (or intermediate targets), it is necessary to test the consistency of pairwise comparisons through the Saaty Consistency Index

$$CI = \frac{(\alpha_{max} - n)}{(n - 1)}$$

where α_{max} is the higher eigenvalue of PCM and n is the matrix dimension. By construction, the Consistency Index is such that:

$$0 \leq CI \leq 1$$

where higher values of ***CI*** indicate lower consistency. According to Saaty, $CI = 0.1$ is the threshold over which consistency is not sufficient.

Finally, once individual weights have been obtained, to achieve aggregate weights, an aggregation procedure has to be applied. In our case, the aggregation is carried out by computing a weighted average adjusted by individual weights. To this purpose, considering a single panelist, let us denote w_{ij} the weight given to instrument i to achieve the intermediate target j and W_j the weight given to the intermediate target j to reach the general goal (sustainable development). This implies that the products $w_{ij}W_j$ represent the weights that each panelist assigns to each policy instrument to achieve the general goal. Each policy instrument weight is therefore calculated as the average

$$\omega_i = \frac{1}{\mathrm{m}} \sum\nolimits_{\mathrm{k}} \rho^k w_{ij}^k W_j^k$$

where $\boldsymbol{m}$ is the number of panelists, $\boldsymbol{k}$ is the panelist indicator and ρ^k is a weight possibly to be assigned to any panelist on the basis of the individual ***CI*** or other factors, as in section 6. Notably, while forcefully $\sum w_{ij} = \sum W_j = \sum w_{ij}W_j = 1$, it may happen that $\sum \omega_i \equiv \omega \neq 1$. In this case the adjustment is made by assigning the value $\omega_i' = \frac{\omega_i}{\omega}$ to aggregate weights.

4. The case studies: the provinces of Benevento and Salerno

It is well known that in the last decade flows of migration have been non-homogeneous over the country as a whole. Even if in the last years before the financial crisis in 2007-2009 a small increase in migration inflows to Southern Italy was recorded, migrants continue to go mainly to the northern regions. Nevertheless, the southern region of Campania has become an important destination for many migrants in recent years. As shown in Table 2, between 2005 and 2010, Campania has registered an impressive increase (+77.4%) in the number of incoming migrants, i.e. from 92,619 to 164,268 persons, which amount to more than one quarter (26.5%) of the

entire number of immigrants located in Southern Italy. Arguably, this enormous increase has been boosted by the recent economic crisis, because of which many migrants who had lost their jobs in the North, have decided to move to alternative (and underpaid) occupations in Campania. This decision is motivated by the presence of a strong shadow economy in the region that, more so than in Northern Italy, may assure an irregular job in the agricultural or other non-manufacturing sectors.

Tab. 2 - Foreign residents in Southern Italy and Campania

Years	2005		2010	
	Units	%	Units	%
Benevento	2.917	3.1	6.202	3.8
Salerno	19.282	20.8	38.082	23.2
Avellino	7.177	7.7	11.257	6.9
Caserta	19.693	21.3	32.784	20.0
Napoli	43.550	47.0	75.943	46.2
Campania	92619	100.0	164.268	100.0
Southern Italy	321.900		618.990	

Source: ISTAT (2011)

The distribution of immigrants in Campania is shown in Table 2. For agriculture, Campania is one of the most important regions in Italy, as it contributes significantly to the total added value of agriculture. It is characterized by intensive farming, and small- and medium-sized farms with family management. The specialization is especially in fruit, vegetables and tobacco production but also livestock, especially buffaloes, and dairy production, labor intensive activities that, very often, resort to migrant workforce as the local labor supply is quantitatively not sufficient and often not motivated to accept a kind of job with unappealing features, i.e. seasonality, short-term and bad working conditions. For these reasons, in the provinces of Campania with a strong agricultural vocation (Caserta, Salerno and Benevento), the immigrant work force exceeds the 54%, as shown in Table 3.

The specialization of national groups in different activities is worthy noting: Indians and Pakistanis are usually employed on livestock farms, especially for buffaloes, concentrated on the coast (Litorale Domizio), Villa Literno in the province of Caserta and Battipaglia in the province of Salerno. Sub-Saharan migrants are frequently employed as day labor in the fruit and vegetable sector (strawberries and tomatoes for example) especially in the Piana del Sele and Agro Nocerino-Sarnese areas in Salerno province, while Moroccans and Albanians are often employed in the tobacco harvest between August and September in Aversa, Marcianise and Capua areas (province of Caserta). In Benevento, a significant presence of immigrants in agriculture is in the Valle Telesina and near the border of the province of Caserta, where a relatively large number of Romanian migrants is employed in oil and wine agribusiness (IOM, 2010). The working conditions, especially in small farms, are usually critical and sometimes totally unacceptable: migrants are required to work seven days per week, without definite working hours, protection and security, for monthly salaries ranging from €300 to €600 (Amnesty International, 2012).

Tab. 3 - Immigrants employed in agriculture with permanent contracts (2010)			
	Employed in agriculture	**Immigrants**	**%**
Benevento	905	124	13.7
Salerno	4.145	691	16.7
Avellino	1.648	76	4.6
Caserta	4.005	968	24.2
Napoli	3.998	268	6.7
Campania	14.701	2.127	14.5
South Italy	73.371	9.282	12.7
Source: ISTAT (2012)			

5. A policy for sustainable development: collection and elaboration of data

This section explains the procedure adopted for data elaboration. The first step has been accomplished by collecting our data through interviews with selected panelists. The proposed questionnaire asks the panelists about a) the estimated relative effectiveness of each policy instrument for reaching the target and b) the perceived relative importance of each intermediate target with respect to the general goal of sustainable development. To express their preferences on measures and targets, panelists are required to distribute a hypothetical budget among different policy instruments and targets[7]. Since preferences are expressed in terms of pairwise options, 22 questions are asked to each panelist. Moreover, to test the consistency of individual and aggregate weights, as a final control question, the interviewee is asked to assign a ranking between 1 and 5 to each policy instrument[8], in a multiple comparison which is subsequently turned into a pairwise comparison, as is later shown. The same procedure is applied to define weights of intermediate targets with respect to the general goal.

The second step consists in the conversion from preferences as expressed by answers to the questionnaire (e.g. A deserves 70% and B 30% of the budget or A has an assessment of 5 and B only 3) to Saaty values of importance (from 1 to 9) as shown in Table 1.

In the first case, we adopt this procedure: defining q as the budget share split between two rival policy instruments, so that $\frac{1}{2} \leq q \leq 1$, each answer has been expressed in values of importance considering alternatively the following transformations:

$$x_1 = \frac{q}{1-q}; \quad x_2 = 10 \log_{10} \frac{q}{1-q}; \quad x_3 = \mathrm{e} * \ln \frac{q}{1-q}; \quad x_4 = 10[q - (1-q)].$$

In this way we obtained Table 4 in which typical q values are reported from each x transformation. As Table 4 shows, the linear transformation x_4 seems to be preferable to the other alternatives because it is the only one a) for which no significant adjustment is required to convert original values into Saaty values (except for $q=0,50$ that is rounded up to 1); b) for which each Saaty value is matched by a typical and unique q (except for unit Saaty value) and c) which tends

[7] Questions are formulated as: "Having a total budget of 100, how would you allocate it among these instruments (targets)?".
[8] Figures between 1 and 5 correspond to items "extremely effective", "very effective", "sufficiently effective", "slightly effective" e "not effective".

to uniformly distribute preferences in Saaty values (for example, the value 8 is assigned to q values included in the interval $0{,}875 \leq q < 0{,}925$, while the value 7 in the interval $0{,}825 \leq q < 0{,}875$; intervals have equal size except for the extreme ones).

Tab. 4 - From budget shares q to Saaty values of importance x

q	x_1	x_2	x_3	x_4
0,95	19,00	12,79	8,00	9,00
0,90	9,00	9,54	5,97	8,00
0,85	5,67	7,53	4,71	7,00
0,80	4,00	6,02	3,77	6,00
0,75	3,00	4,77	2,99	5,00
0,70	2,33	3,68	2,30	4,00
0,65	1,86	2,69	1,68	3,00
0,60	1,50	1,76	1,10	2,00
0,55	1,22	0,87	0,55	1,00
0,50	1,00	0,00	0,00	0,00

Tab. 5.a - Numerical preferences and Saaty values

	5	4	3	2	1
5	1,00	2,25	3,67	5,50	9,00
4		1,00	2,33	4,00	7,00
3			1,00	2,50	5,00
2				1,00	3,00
1					1,00

Tab. 5.b - Numerical preferences and rounded Saaty values

	5	4	3	2	1
5	1,00	2,00	4,00	6,00	9,00
4		1,00	2,00	4,00	7,00
3			1,00	3,00	5,00
2				1,00	3,00
1					1,00

In the second case, the evaluation from 1 to 5 is converted into Saaty values of importance by using the following transformation:

$$\frac{y}{z} + y - z \quad \text{con } y \geq z$$

where y =1,2,3,4,5 and z =1,2,3,4,5 are the original values of preferences for each couple of instruments and targets. Table 5.a shows the Saaty importance values, for each combination of judgments on the relative effectiveness of the instruments. Since in some cases the Saaty values are not integer values, in table 5.b they are rounded to the closest integer. The same procedure is applied with respect to the intermediate targets and the general goal.

It is now possible to build up an individual PCM for each interviewee to work out vectors for weights of a) instruments to pursue intermediate targets and b) intermediate targets to pursue the general goal. Table 6.a gives an example of individual PCM (the one obtained by answers of panelist n.1). Considering in particular the intermediate target "Environmental protection", the panelist n.1 states to distribute the budget a) in two equal shares (50% each) between the instruments "Subsidies in favour of eco-friendly production" and "Subsidies in favour of eco-friendly products"; b) in shares of 60% and 40% between "Subsidies in favour of eco-friendly produc-

tion" and "Land and environment conservation"; in shares of 20% and 80% between "Subsidies in favour of eco-friendly production" and "Technical and professional education"; in shares of 60% and 40% between "Subsidies in favour of eco-friendly products" and "Land and environment conservation"; in shares of 20% and 80% between "Subsidies in favour of eco-friendly products" and "Technical and professional education" and finally in shares of 10% and 90% between "Land and environment conservation" and "Technical and professional education". Following the transformation x_4 (see Table 4), the first option corresponds to the value 1 appearing at first row and second column in Table 6.a; the second option to the value 2 (first row, third column), the third to 1/6 (first row, fourth column) and so on.

Tab. 6.a - Individual PCM from budget shares

1	1	2	1/6
	1	2	1/6
		1	1/8
			1

Tab. 6.b - Individual PCM from numerical evaluations

1	1	5	1/4
	1	5	1/4
		1	1/9
			1

Table 6.b is built up by a similar procedure, considering the evaluations expressed on a 1 to 5 scale. Considering again the answers of panelist n.1, the scores assigned to the instruments are respectively 3 for "Subsidies in favour of eco-friendly production", 3 for "Subsidies in favour of eco-friendly products", 1 for "Land and environment conservation", 5 for "Technical and professional education". From these evaluations, using Table 5.b, the individual PCM illustrated in Table 6.b is obtained.

The values of the eigenvectors associated with the highest eigenvalues for the PCMs reproduced in Tables 6 are reported in columns "Weights 1" and "Weights 2" of Table 7: therefore the first derives from pairwise comparisons expressed in terms of shares of budget to be assigned, while the second stems from a comparison among several alternatives evaluated on a 1 to 5 scale. As a result of the choices made by panelist n.1, he/she attaches weights respectively of 50% to the intermediate target "Farm competitiveness", 25% to "Environmental protection" and 25% to "Integration of immigrants". Likewise, to pursue the target "Farm competitiveness", she/he assigns the highest weight to the instrument "Technical and professional education", between 45.45% (first column) and 46.12% (second column); equal weights, ranging from 24.72% to 25.25%, to the instruments "Subsidies to technological innovation" and "Subsidies to internationalization" and a lower weight to "Development of financial facilities" (between 4.44% and 4.05%). Similarly, the weights given to different instruments to pursue the other intermediate targets "Environmental protection" and "Integration of immigrants" are shown in the lower parts of Table 7.

Finally, Table 7 also shows standard deviation (SD), the Saaty Consistency Index *CI* for the column Weights1 and the correlation index between the two sets of weights. SD gives a measure of the agent's attitude on discrimination among the different policy instruments to reach each target. In column Weights1, SD has an average value around 0.1415. Out of 60 cases, it assumes a value lower than 0.1 in 19 cases and values lower than 0.2 in 43 cases. In column Weights 2, SD takes an average value around 0.1364. Out of 60 cases, it assumes a value lower than 0.1 in 14 cases and values lower than 0.2 in 54 cases. For instruments connected with the intermediate target "Farm competitiveness", SD assumes an average value around 0.1654; out of 40 cases, it

assumes a value lower than 0.1 in 4 cases and values lower than 0.2 in 31 cases. For instruments connected to the intermediate target "Environmental sustainability", SD assumes an average value around 0.1310; out of 40 cases, it assumes a value lower than 0.1 in 15 cases and values lower than 0.2 in 30 cases. Finally, for instruments connected to the intermediate target "Integration of immigrants", SD takes an average value around 0.1204; out of 40 cases, it assumes a value lower than 0.1 in 14 cases and values lower than 0.2 in 36 cases.

The Consistency Index *CI* measures, as mentioned above, the internal consistency of each set of panelist's answers. For example, considering three instruments A, B and C and evaluating 2 the preference for A with respect to B, and 3 the preference for B with respect to C, the preference for A with respect to C should be consistently evaluated 6. In this case, *CI* would assume the lowest value 0, indicating maximal consistency. If instead, the preference for A with respect to C is evaluated 1/6, *CI* would assume the value 0.1. In this investigation, *CI* takes an average value around 0.0731. Out of 60 cases, it assumes values equal to 0 in 11 cases, values lower than 0.05 in 33 cases and lower than 0.1 in 48 cases.

Tab. 7 - Targets, instruments and individual weights (panelist n. 1)

	Intermediate targets and instruments	Weights 1	Weights 2
0.5000	Farm competitiveness		
	Subsidies to technological innovation	0.2472	0.2525
	Subsidies to internationalization	0.2472	0.2525
	Development of financial facilities	0.0444	0.0405
	Technical and professional education	0.4612	0.4545
	Standard Deviation (SD)	0.1702	0.1690
	Consistency Index (CI)	0.0035	
0.2500	Environmental protection		
	Subsidies in favour of eco-friendly production	0.1250	0.1793
	Subsidies in favour of eco-friendly products	0.1250	0.1793
	Land and environment conservation	0.0695	0.0448
	Technical and professional education	0.6806	0.5965
	Standard Deviation (SD)	0.2882	0.2396
	Consistency Index (CI)	0.0069	
0.2500	Integration of immigrants		
	Technical and professional education	0.1194	0.2000
	General education	0.4056	0.4000
	Family policies	0.2259	0.2000
	Social and cultural policies	0.1130	0.1000
	Housing policies	0.1361	0.1000
	Standard Deviation (SD)	0.1236	0.1225
	Consistency Index (CI)	0.0399	
	Linear correlation index (LC) = 0.9752		

Finally, to measure how similar and consistent are preferences coming from pairwise and multilateral comparisons, the correlation coefficient between Weights 1 and Weights 2 is computed. Its value equals 0.9752 for Panelist n. 1 (see Table 7) and is on average equal to 0.7496; out of 20 cases, it assumes values larger than 0.9 in 8 cases, values larger than 0.7 in 13 cases and larger than 0.5 in 19 cases. Thus, on the whole, panelists show a good ability to discriminate among policy instruments and answer in a consistent way. Furthermore, the weights obtained turn out to be robust with respect to the type of comparison adopted[9].

6. A policy for sustainable development: results and main conclusions

The last step of the procedure to determine the role and importance of each instrument for achieving intermediate targets and of each target for pursuing the general goal consists in finding an aggregation function able to synthesize all previous information to get a vector of aggregate preferences. For this purpose, we resort to a simple weighted mean of individual weights. Weighting is made with four different methods, i.e., by considering absolute values, *CI*s, *DS*s and correlation indexes.

The results are summarized in Table 8. In the upper frame, in each of the first four columns, the vector of aggregate weights is reported. This is the final aggregate ranking of targets with respect to the general goal of sustainable development. The last column shows the values of SD computed across rows to measure the variability of weights obtained through different procedures. As mentioned before, columns in Table 8 are derived by different methods of aggregation (i.e. by using different methods to weight individual preferences). In particular, the first two columns in Table 8 (upper frame) come from the column "Weights 1" of Table 7; the third and fourth columns from "Weights 2" in the same Table. The column "Weights 1 (CI)" is constructed by dividing each individual weight by the value *(1 + CI)*, so as to ascribe a greater importance to the answers with a higher degree of consistency[10]. A similar procedure is applied also to columns labeled "Weights 1 (SD)" and "Weights 2 (SD)" where weighting individual preferences is based on individual abilities to discriminate among instruments (those who discriminate more get a higher weight) and takes place by dividing by *(1-SD)*. Lastly, the column "Weights 2 (CL)" is obtained by multiplying weights in table 7 (column labeled "Weights 2") by the linear correlation coefficient so as to recognize a greater weight to panelists more internally consistent (i.e. with answers to pairwise comparisons more consistent with answers to multilateral comparisons).

Finally, in the lower frame of Table 8, the values of aggregate weights of the intermediate targets in fulfilling the general goal of sustainable development are displayed. The first column shows the simple average of individual weights; figures in the second column are averages of individual weights after being divided by *(1+CI);* figures in the third column are averages of individual weights after being divided by *(1-SD)*[11].

[9] The equivalent for other panelists of the data in Table 7 are available on request.

[10] Figures are then normalized by averaging over individuals, and re-proportioning so that the sum of weights amount to 1.

[11] It is worthwhile recalling that the weights of Table 8 are expressed so as to obtain aggregate weights of intermediate targets summing up to 1. From those figures, it is easy to compute the weight of each instrument with respect to any intermediate target by multiplying values in the upper frame by the ones in the lower. For example: the weight of the instrument "Subsidies to technological innovation" to achieve the target "Farm competitiveness" is obtained as the product of the suitable values in the upper and lower frames, according to the chosen weighting procedure.

Summarizing, Table 8 shows the importance assigned to policy instruments (to reach targets) and intermediate targets (to fulfill the general goal) by stakeholder panelists. Even if the panel is relatively small, our experiment may be considered significant, especially considering: a) the adoption of a rigorous method in the elaboration of individual and aggregate preferences; b) the internal consistency emerging from the analysis of Table 8, where weights obtained with different aggregation procedures come out to be definitely steady; c) the relevant policy implications.

Tab. 8 - Targets, instruments and aggregated weights

	Weights 1 CI	Weights 1 SD	Weights 2 LC	Weights 2 SD	SD
Farm competitiveness					
Subsidies to technological innovation	0,109762	0,113178	0,104672	0,104744	0,004146
Subsidies to internationalization	0,068305	0,068905	0,071328	0,072032	0,001815
Development of financial facilities	0,094211	0,097169	0,079924	0,079801	0,009218
Technical and professional education	0,125127	0,1291	0,132445	0,134768	0,004193
Environmental protection					
Subsidies in favour of eco-friendly production	0,050698	0,046767	0,064252	0,062596	0,008659
Subsidies in favour of eco-friendly products	0,043791	0,040408	0,043116	0,041244	0,001579
Land and environment conservation	0,058631	0,054419	0,046073	0,043896	0,006938
Technical and professional education	0,088137	0,088359	0,077218	0,078109	0,006122
Integration of immigrants					
Technical and professional education	0,093518	0,0935	0,095364	0,094554	0,000900
General education	0,076057	0,075171	0,082016	0,081345	0,003532
Family policies	0,074349	0,073417	0,073387	0,072874	0,000614
Social and cultural policies	0,044335	0,043047	0,044914	0,044063	0,000781
Housing policies	0,073083	0,076557	0,085293	0,089976	0,007772
	Simple	**CI**	**SD**		
Farm competitiveness	0,392120	0,397636	0,408564		
Environmental protection	0,231320	0,240824	0,229562		
Integration of immigrants	0,376535	0,361544	0,361872		

The latter point deserves some final comments. First, the intermediate targets we propose for panelists' evaluation receive a positive assessment by all the panelists. In particular, they ascribe a smaller (but by no means negligible) weight to environmental protection with respect to other intermediate targets. Concerning the different kinds of stakeholders included in the panel, one can verify that environmental protection is considered more important by researchers than by other groups, with migrants much less interested in it than in other targets. There is clear evidence of the strong weight granted to the instrument "Technical and professional education" by all kinds of stakeholders in any of the aggregation procedures considered. This instrument is judged to be the most important one for each of the three intermediate tar-

gets, and preferred to welfare policies by immigrants themselves[12]. Similar arguments may be applied to the measures favouring technological innovation. These are highly considered (especially by the entrepreneurs) together with development of financial facilities for farmers. Concerning the target of "Integration of immigrants", panelists indicate as the most important instrument "Technical and professional education", and then "General education" and "Housing policies".

In conclusion, the results of this investigation seem to confirm how important is the issue of immigrants' integration and employment for the present and the future of Italian agriculture. As pointed out in the introduction, immigrants may bring a unique opportunity to the entire agricultural system provided that policy makers are able to design suitable actions to promote not only economic incentives for immigrant participation but also acceptable living conditions truly to foster social and cultural inclusion of immigrants and their families. Beside economic measures, investments on the social side are just as important for immigrant inclusion and modernization of the agricultural system. Education, housing policies, social and cultural promotion, health assistance are only some of the several measures that could be implemented to combat social exclusion and discrimination. In a general perspective, these measures also have a "productive" meaning and are not merely linked to welfare. Indeed, in a rural context, only when the economic and social dimensions are strictly inter-connected is it possible to plan improvements in farm productivity, economic growth and sustainable development.

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[12] It is worth noting that while (as expected) different groups of stakeholders express different preferences on the importance of intermediate targets, they have very homogeneous opinions about the effectiveness of instruments in pursuing intermediate targets.

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