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ECONOMIC INCENTIVES FOR POLLUTION CONTROL IN DEVELOPING COUNTRIES: WHAT CAN WE LEARN FROM THE EMPIRICAL LITERATURE?

JEL classification: Q28, Q53

Salvatore Di Falco*

Abstract. *This review seeks to analyze the implementation of Market Based Instruments (MBIs) in developing countries. The focus is mostly (but not exclusively) on the empirical literature. The evidence is that MBIs have played a role in pollution reduction. However, this conclusion is mostly based on evidence from one country – China. Moreover, these tools seem to be used in conjunction with command and control instruments.*

Keywords: *Market based policies, economic-incentives, pollution taxes, permits*

1. Introduction

Some of the most challenging environmental problems are nowadays located in developing countries. Air and water pollution, for instance, have reached very high levels in these areas of the world. The reduction of pollution is therefore of paramount importance. Historically, this objective has been targeted by the implementation of Command and Control (CAC) approaches, such as limits and standards. The observed results, however, are in general not very encouraging (Eskeland and Jimenez, 1992; Russell and Vaughan; 2003; Blackman 2009). One possible alternative way to deal with enviromental problems is the implementation of market-based instruments. Market-based instruments are said to "harness market forces" (Stavins, 1991) so that they use market signals to affect behaviour (of both consumers and firms) towards pollution control. They are also called Economic Incentives for pollution control (EI) and include pollution charges or levies, taxes and tradable permits. This stresses the way in which MBIs achieve pollution control. They create an incentive for firms, by imposing an implicit or explicit price on emissions, so that it is beneficial to clean up more provided that a sufficiently low-cost method (technology or process) is available. From a theoretical standpoint, "when properly designed and implemented, market-based instruments allow any desired level of pollution clean-up to be realized at the lowest overall cost to society, by providing incentives for the greatest reductions in pollution by those firms that can achieve these reductions most cheaply" (Stavins, 2003 p. 359). These instruments equalize the incremental amount that firms spend to reduce pollution - their marginal cost [Montgomery (1972), Baumol and Oates (1988),

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Tietenberg (1995)]. In the literature, MBIs are traditionally opposed to the so-called Command and Control (CAC) instruments. This view is, however. somewhat inaccurate. In many circumstances these tools are complementary. Moreover, the success of MBIs depends upon a well-functioning monitoring and command and control system (including properly functioning institutions). Moreover there are situations in which a command and control action (through setting up standards) can be superior to MBI. This is particularly true when (the marginal) abatement cost of pollution is less responsive than environmental damage. It should be also noted that CAC approaches may be sensible as an initial approach. This is specially the case when there is limited information and the environmental damage is important. In addition, the costs of an MBI approach "are assumed to exceed the operating costs of a system of fixed standards" so for there to be cost savings "there must exist some heterogeneity among firms i.e. if options for reducing pollution are limited or potential trading pools are small, the gains from a more market-oriented approach may not justify the costs (Romstad, 1999, p52). A quintessential characteristic of the command and control methods is that they set a uniform standard (both in terms of performance and of technology standards[1]) and compel firms to share the pollution-control burden. Setting performance standards can limit emissions of some pollutants. However, this is achieved with no (or little) consideration of the possible cost heterogeneity involved. Holding all firms to the same target can be expensive and counterproductive (Stavins, 2003). Some technology, appropriate in one situation, may not be appropriate (or as mentioned cost-effective) in another. Thus, controlling costs differs enormously from one firm to another due to the firm's production characteristics. It is maintained that to achieve pollution control, CAC seems to impose a relatively high cost for firms (Pandey, 2005). The cost of controlling emissions may differ greatly among firms and even among sources within the same firm. An example is reported by Tietenberg (1985). In this survey of eight empirical studies of air pollution control it was found that the ratio of actual, aggregate costs of the conventional, command-and-control approach to the aggregate costs of least-cost benchmarks ranged from 1.07 for sulphate emissions in the Los Angeles area to 22.0 for hydrocarbon emissions at all domestic DuPont plants. In essence, there may be little financial incentive for businesses to exceed their control targets, and "both technology-based and performance-based standards may discourage adoption of new technologies" (Stavins 2003). Command-and-control approaches could, in theory, achieve this cost-effective solution, but this would require that different standards be set for *each* source of pollution. To achieve this target, policy makers or institutions need to find out information about the compliance costs *each* firm faces. This may be a very challenging goal. Market-based instruments provide for a cost-effective allocation of the burden of pollution control without having access to both these piece of information. For these reasons command and control methods seems to be rather complex to implement.

There are therefore some relevant theoretical reasons to consider MBIs "superior" to CAC. Successful implementation is a different thing though. For example, banning leaded petrol or banning hazardous waste is far superior to MBIs in dealing with those problems and often CAC and MBIs are best used together. In other words, in reality most of the time CAC and MBIs do co-exist. For instance, regulators establish a specific level of pollution (or standard) and apply a fee for the amount of pollution above that threshold. Moreover, MBIs can have considerable problems of implementation too. This can be particularly relevant in developing countries where institutional

[1] Technology-based standards specify the method and or equipment that firms can use. A performance standard, instead, sets a uniform control target for firms, while allowing some flexibility in how this target is met.

capabilities may be weak and markets imperfect. This review seeks to analyse the implementation of MBIs in developing countries. What do we know about the use of these tools for pollution control? What are the instruments that have been implemented more successfully and where? This paper attempts to answer these questions by screening the evidence on the use the MBIs. The focus is mostly on the empirical literature. Previous reviews have appeared in the literature.

In the last ten years we have observed a dramatic increase in available data and simultaneous blossoming of econometric analysis from developing countries. It therefore seems very appropriate to update the state of our knowledge with this information.

This paper proceeds as follows. The next section will provide a brief background on MBIs. Section 3 will present the quantitative evidence grouped for type of instrument (e.g. fees, charges and taxes). Section 4 will present evidence of the interaction with other instruments. Section 5 concludes the paper by offering some final remarks.

2. MBIs: implementation and issues

Both CAC and MBIs can be classified considering different criteria. Table 1 (adapted from Blackman and Harrington, 2001) provides a classification in two categories: direct and indirect instruments.

Tab. 1 - Classification of instruments

Regulatory Tool	Direct Instruments	Indirect Instruments
Economic Incentives	Emission fees Marketable permits	Taxes Subsidies
Command and Control	Emissions Standards	Technology Standards

The former require that the regulators will monitor the emission while the latter does not. As mentioned earlier, CAC instruments dictate how much to abate and what abatement technology to use instead of simply creating financial incentives for firms to abate. So for instance emissions standards are direct instruments that require both identification of the amount of pollution and monitoring from the regulator. The above classification is very useful. It identifies some of the general benefits of some MBIs (e.g. flexibility and efficiency) specially when we consider two of the most important dimensions of environmental regulations: *monitoring* and *enforcement*. Fees or levies can be grouped in one specific category: the charge system where. pollution charges, via either fees or taxes applied on the amount of pollution that a firm or source generate are, in essence, what economists would call *Pigovian*[2] taxes. Both a charge system and a tax system use financial instruments to persuade polluters to reduce pollution. In both situations, the regulator attempts to make pollution more costly to the polluter. Because of the charge, the firm has the incentive to reduce emissions to the point where its marginal abatement cost is equal to the fee (or tax) rate. The tax should be set equal to the marginal benefits of clean-up at the efficient level of clean-up. In the case of charges. the regulator sets up a standard for the pollutant and the plant pays a penalty charge for when they exceed the standard. The Chinese Pollution Levy

[2] Pigovian taxes are named after the economist Arthur Pigou; they are taxes levied on a market activity that generates pollution or negative externalities.

System is one of the most comprehensive emission charge systems in the developing world. The imposition of a fee requires the measurement of mass emissions or effluent. This can be more or less complex depending on the pollutant. For instance, some air pollutants are more difficult to monitor than water pollutants. The regulator, moreover, has to set the appropriate fee level and collect the amounts due. Charges on air emissions can be difficult to implement because of difficulties in measuring emissions. While emission standards in most nations are expressed in terms of concentrations, not mass, only fairly crude estimating techniques normally are used to calculate payments due (Anderson, 2002). Besides this, a charge system can be complex to coordinate when there are many different pollutants from different sources.

Deposit-refund systems require a monetary deposit at the time of sale of a product. This deposit is eventually returned when the item is returned. This scheme has been implemented successfully in many high income countries. For instance in the United States, deposit-refund systems have been applied to control the disposal of lead-acid batteries and products containing potential pollutants such as aluminium and glass cans, pesticide, containers, and tyres. The private sector often creates and manages a disposal system. This system helps to subsidize the return of recyclable products. Deposit refund systems thus appear to be most appropriate instruments for discrete, solid commodities. They, however, may have a high cost of implementation. For instance, collecting, refunding deposits on the sale of individual products, returning product for disposal can all be expensive activities. Among middle-income countries, South Korea has one of the most exhaustive deposit systems. This program affects a multitude of products (from packaged paper to televisions, and washing machines).

As mentioned above, taxes are very similar to charges. They, however, are indirect instruments. There is therefore no need for the regulator to determine the abatement level. This makes them easier to implement. Taxes seem appropriate in the context of fuel use and choice. The issue of air pollution control has been addressed in the context of policies aimed at discouraging the use of private transportation during peak hours.

This is because collection would be implemented via tax collection institutions (Blackman and Harrington, 2000). Moreover, consumption of fuel is usually much easier to monitor than emissions. Taxes generate revenues for governments. These revenues can be used to fund investment in projects. Nevertheless, taxes can be politically difficult to put in place. Taxes need to be, in fact, high enough to create a disincentive that then translates into environmental effects. Moreover, there is also the possibility that the taxes will be regressive, hence affecting particularly the poorer part of the population. Decision makers may find this not particularly appealing. if taxes are regressive, they would impose a larger burden on the poorest part of the population. Taxes should, therefore be rejected on distributional grounds. Using household survey data from Costa Rica, Alpizar and Carlsson (2003) tested the incidence of fuel tax. They found that the effect of a 10 percent fuel price rise through all types of direct and indirect spending would be slightly regressive, the magnitude of this combined effect would be modest. They conclude that distributional concerns need not rule out using fuel taxes to address pressing public health and safety problems, particularly if gasoline and diesel taxes can be differentiated.

Besides these points the successful implementation of taxes needs proper enforcement. An example is given by the "forestry tax" in use in Brazil and Colombia. This tax is charged for wood consumption when the extraction is not compensated by reforestation activities. This may be seen as an incentive to curb deforestation. Its enforcement however has been very weak. Therefore the tax did not seem to affect the deforestation rates nor provide important budgetary benefits.

Subsidies could also be used to induce reductions in pollution. Among the subsidies that are used at all levels of government to help manage environmental pollution are grants, low-interest loans, favourable tax treatment, and preferential procurement policies for products believed to pose relatively low environmental risks. Subsidies for environmental management are however sometimes criticized because of their welfare implications but also because they can be seen as a "prize" given to polluters. Thus the subsidy is helping to bear the costs that should be the responsibility of the polluter. Other environmentally related subsidies, such as federal support for timber harvesting in the national forests, also are criticized because they have proven harmful to the environment. Nonetheless, subsidies have become a fairly common tool for managing the environment at every level of government. Eliminating environmentally harmful subsidies can be even more effective when used to improve environmental quality. In the early 1990s, the World Bank made the phase-out of pesticide subsidies a condition for new lending to Egypt. The use of pesticides dropped by nearly 70% over the subsequent five years.

Among the direct instruments, tradeable permits have been attracting much attention. They basically thrive on the creation of a market for pollution. In theory, they can achieve the same cost-minimizing allocation of the control burden as a charge system, while avoiding the problem of uncertain responses by firms (Stavins, 2003). In a tradable permit system, an allowable overall level of pollution is established and subsequently allocated among firms in the form of permits. Firms that keep their emission levels below their allocated level may then sell their surplus permits to other firms or use them to offset excess emissions in other parts of their facilities (Stavins, 2003). As we will see in the next sections, quantitative evidence on the use of this tool is extremely scarce in developing countries. Permits require both a strong regulatory and enforcement capacity to be in place. This usually comes with administrative complexity that may not be at hand in the developing world. This, in fact, may be the key reason why these tools have not been adopted more widely in OECD countries. During the last 20 years OECD countries have experimented MBIs for pollution control. Charges and fees are the most popular tools (both emissions and product charges). For instance emission charges levied on air and water pollutants have been applied in more than 21 countries. Carbon taxes in Denmark, Norway, and Sweden are intended to have an incentive effect, in addition to a revenue-generating effect, but it has been difficult to determine their actual impacts (Blackman and Harrington 1999). Claims have been made that the Swedish and Norwegian taxes have reduced carbon emission (Larsen and Nesbakken 1997). Stronger evidence is on the reduction in water pollution. The Netherlands, for instance, has assessed that effluent fees on heavy metal discharges from large enterprises, and organic discharges from urban and farm households, and from small, medium, and large enterprises have reduced total organic discharges by one-half, and industrial organic emissions by 75 percent (World Bank, 2000). The most ambitious implementation of MBIs has been the control of sulphur dioxide (SO2) emissions in the context of acid rain reduction under Title IV of the *Clean Air Act* amendments of 1990 in the USA. In the first stage the allowance trading program was assigned to 263 most polluting units. Then in successive stages it was extended to other units. These units could emits SO_2 units in relation to the permits assigned by the US Environmental Protection Agency (EPA). Units were allowed to trade the permits or bank them in order to promote cost-effectiveness. The results of the program were satisfactory. Target emissions reductions were achieved. An estimated cost saving of $ 1 billion annually was also reported (Stavins, 2003). While the implementation of these tools has become very widespread, it should be noted that there is no tendency, however, towards replacing the basic regulatory approach with a purely economic one. 'Economic instru-

ments are complements mostly and substitutes only sometimes for other types of approaches' (OECD, 1994, p. 187).

Table 2 presents a success matrix for the implementation of MBIs. It summarizes the activities and requirements for implementing these instruments. It also highlights the conditions for success (e.g. how important is the possibility of monitoring data or enforcing compliance) and the strengths and weaknesses of these policies. Table 3 maps the application of the tool in relation to the type of pollution. It also lists the existing application in developing countries.

Tab. 2 - Success matrix for implementation of MBIs

MBIs	Activities and requirements for establishing and implementing the instrument	Conditions for success	Strengths	Weaknesses
Charge system	The regulator needs to set up the rules clearly Collection of the revenue	Monitoring - Data on pollutant must be available - Enforcing Compliance	Charges - proportional to Pollution	More complex to coordinate with different sources of pollution Monitoring and enforcing are costly activities Institutional integrity must be very high
Deposit Refund	The regulator needs to set up the rules clearly Collection of the revenue	Front end charge (deposit) combined with refund payable when quantities are turned in for recycling. Participation of households	Low legal, institutional and political barriers. No need for monitoring when voluntary	More difficult to enforce because of the voluntary nature of the scheme High cost of implementation
Taxes	The regulator needs to set up the rules clearly Collection of the revenue	Enforcing Compliance	Multiple sources of pollution No need to identify an abatement level No Monitoring data Available Easier to manage Generate Revenues	Do not always incentivate adoption of abatement technologies May affect non - targeted activities Institutional integrity must be very high Politically difficult to accept Distributional Impacts can be distortive
Subsidies	The regulator needs to set up the rules clearly	Monitoring data on pollutants must be available Enforcing Compliance	Incentive to actually change system	Tax payer gets part of the pollution burden
Tradable permits	The regulator needs to set up the rules clearly	Enforcing compliance Data needed for initial allocation Tracking system required Enforcing compliance	Flexibility in the application Cost savings for the regulator Less efficient units of production are likely to stop operating	Regulatory requirements are considerable Consistent legal framework -Political resistance

The reduction in market friction can serve as a market-based policy instrument to reduce pollution. In such cases, substantial gains can be made in environmental protection simply by reducing existing obstacles to market development and functioning. As indicated by Anderson (2002) and Stavins (2003) three main types of market friction can be identified:
(1) market creation for inputs/outputs associated with environmental quality,
(2) liability rules; and
(3) information programs, such as energy-efficiency product labelling requirements.

Market creation is a tool that aims to facilitate the voluntary exchange of rights (i.e. water rights). This is to promote more efficient allocation and use of scarce natural resources. Liability rules encourage firms to consider the potential environmental damage of their decisions. This can be a very effective tool for control in the context of very toxic or hazardous material. Firms have a strong incentive to consider the full implications (in terms of societal risks) of the use of some specific materials. The transactions costs associated with litigation, however, can be very high. Poorly informed markets are less likely to result in an efficient allocation of resources. Product labelling or certification is a way to address this issue and deliver relevant information to the consumer.

While in theory there is a very large set of instruments that can be used the adoption of these policies has been patchy. Most important – for the scope of this survey – the evidence based on econometric analysis is not particularly substantial. We therefore extend the scope by including also some selected case studies.

3. Evidence based on quantitative studies

As mentioned earlier, while command and control approach may work reasonably well for large and highly visible sources of pollution, high costs may affect its implementation. MBI approaches also seem to address small sources of pollution (i.e. households that are not easily controlled by traditional forms) and provide a stimulus for technological change and innovation in pollution control. In general, MBIs may differ from traditional command and control requirements in terms of their information and enforcement requirements, as well as of institutional, political, and other demands. Among incentive-based instruments, there is tremendous variation in the prerequisites necessary for successful implementation (Anderson, 2002). These initiatives aim to improve the environmental effectiveness of regulatory strategies as well as to reduce compliance costs. Environmental fees, charges, and taxes are largely interchangeable in terms of their effects. Pollution reduction can be achieved through environmental levies on inputs, outputs, or on pollution generated by sources. Developing countries have imposed a great variety of such levies. Levies on inputs and products generally are the most easy to collect but are more removed from the actual decision to pollute, weakening the incentive. We follow Anderson (2002) in presenting the requirements imposed by fees on regulators and communities:

- Measurement of mass emissions or effluent
- Setting appropriate fee level
- Collecting amounts due, and
- Disposition of the amounts collected

The Chinese Pollution Levy System is one of the most comprehensive emission charge systems in the developing world. It requires the availability of data monitoring. It is one of the oldest schemes in place and it has been criticized from different angles. For instance, it has been

argued that charges are too low to directly affect polluting behaviour. About three-fourths of levy payments were returned to sources for pollution-control investments and those investments are believed to have had an impact on emissions. The remainder pays for environmental management at the local and regional level. Thus, the Chinese levy can be thought of as "a hybrid policy" with a substantial subsidy component (Anderson 2002). This system has been studied widely in the empirical literature. The paragraph below summarizes the empirical finding related to it.

Tab. 3 - Tool, pollution type and existing application*

MBIs	Issue or source of pollution	Application in Developing Countries
Charge system	Industrial air and water pollution from mostly large units of production.	**China** Colombia Philippines Malaysia Ecuador Mexico
Deposit Refund	Waste management households (glass and plastic, car batteries)	Sri Lanka Mexico Colombia Ecuador Jamaica Venezuela Taiwan Korea
Taxes	Air pollution mostly from large units Fuel use Traffic congestion Halting deforestation via a "Forestry tax"	**Chile** Thailand Kenya Mexico Brazil
Subsidies	Air pollution from both large and small units -Used to incentivate reforestation and adoption of cleaner technolologies	**Chile** **Brazil** Colombia Ecuador Kenya Mexico Tanzania
Tradable permits	Air pollution from both large and small units Water use by large and small farmers -Car use/ congestion in megacities	Chile Singapore Mexico

* in **bold** evidence based on quantitative studies. Details of these studies are reported in sections 3.1, 3.2 and 3.3.

3.1. Evidence based on pollution levy and pollution fees or charges

David Wheeler and his associates provide an assessment of the Chinese levy system in a set of papers. The first paper considered in this survey was published in 1996 as a World Bank Policy Research Working Paper. This is the first attempt to study the levy system systematically. The authors begin by considering most of the criticisms of the system (i.e. it is arbitrarily administered and ineffective). The charge system covers hundreds of thousands of factories. They also observe that strictness of enforcement may vary widely, so factories in different regions face very different penalties for polluting. The paper provides an empirical test of the levy system using a provincial level panel database for the period 1987 - 1993. It analyses the water pollution levy

(so no conclusions may be drawn for air pollution, solid waste, or emissions from facilities). The database is very rich as it incorporates information from many thousands of factories over a seven-year period. This is a period in which we witnessed great changes in China's economy.

The econometric analysis focuses on two measures of environmental performance: intensity of industrial emissions (provincial emissions/output) for organic water pollution, and the effective water pollution levy rate (provincial levy collections per unit of above-standard wastewater discharge). The analysis considers that in each region and period, the effective levy rate and pollutant discharge are jointly determined by the intersection of environmental demand (ED) and supply (ES) functions. The ED function relates industrial pollution intensity to the local price of pollution. It reflects the economics of cost-minimizing abatement by industry, and is formally equivalent to the marginal abatement cost (MAC) function. The ES function specifies the pollution price imposed by the community as damage rises. The equilibrium pollution is reached at the intersection of ED and ES is therefore not necessarily optimal pollution (at the intersection of ED and MSD). The results suggest that the water pollution levy system is neither arbitrary nor ineffective. Across provinces and over time, variations in the effective levy rate are well-explained by proxies for local valuation of environmental damage and community capacity to enforce local norms. Results also suggest that the emissions intensity of Chinese industry was highly responsive to these increases. From 1987 to 1993, provincial pollution intensities fell at a median rate of 50% and total discharges declined at a median rate of 22%. These results are, however, based upon a province level database. As reported by the authors the effective levy also serves as a proxy for enforcement of quantity-based standards. It is possible that a province with a higher levy enforcement rate is also enforcing command-and-control regulation more effectively. This would result in a coefficient estimate that is possibly biased upward. Moreover, the lack of individual data may mask time-invariant firm level heterogeneity. This would again result in biased coefficient estimates.

The same authors addressed a similar research question in a second working paper in 1999. In this paper, the authors expand and deepen the analysis in the following ways. First, they decompose industry's response to the levy into two components: pollution intensity of process production and degree of end-of-pipe (EOP) abatement. Second, they used a new database for 3,000 polluting plants. They find that the elasticity of TSP intensity with respect to the air levy is about -0.65, while the elasticity of COD intensity with respect to the water charge is about -0.2. The decomposition of effects suggests that most of the air levy's impact is through process adjustment, while the water levy has most of its impact at the end-of-pipe. This paper presents a clear improvement with respect to that of 1996. mostly, because of the larger database at the lower lever of aggregation. However, should be noted that TSP is only one specific type of air pollutant (not SO2 or CO2). However, the cross-sectional nature of the analysis does not allow a control for time- invariant unobserved heterogeneity. The estimated parameters must be therefore interpreted with some degree of caution.

Wang (2002) used the same database to understand what is the response to pollution regulations. The focus again is on the pollution charge instrument. The impacts of pollution regulation on abatement expenditures are thus examined for one thousand large and medium Chinese industrial polluters. This paper stress the issue of endogeneity of the wastewater generated, the tonnes of chemical oxygen demand generated, and the pollution charge rate. These endogenous variables are combuned with exogenous variables in each of the models. Additional variables included income, education, industrial share of total GDP, population density, per capita complaints on pollution, and average COD discharge concentration.

The results show that plant-level expenditures on end-of-pipe wastewater treatment are strongly responsive to the pollution charges. The estimated elasticities of operation cost and new investment with respect to pollution price are 65 and 27%, respectively. Other command-and-control regulatory approaches, however, are not found to have systematic and significant impacts on abatement expenditures. While the endogeneity treatment provides a better alternative to the estimation exercise presented in the earlier paper, the lack of reported testing on the validity of the instruments makes the assessment of the analysis difficult.

In another follow up paper (using again the same data from 3000 Chinese factories) Wang and Wheeler (2005) estimate an econometric model of endogenous enforcement in which factories' levy rates and emissions are jointly determined by the interaction of local and national enforcement factors, abatement costs and regulator–manager negotiations that are sensitive to plant characteristics. Their findings stress the significant deterrent impact of a system that combines progressive financial penalties and self-reporting with few options for contesting regulatory decisions - this despite the prevalence of state enterprises and developing-country conditions. Interestingly, they also find that pollution control through financial incentives has a much greater impact on production processes than on end-of-pipe abatement. More specifically, they estimated a noticeable elasticity (-1.08) for water pollution. For air pollution, the estimated elasticity of -0.65 implies that emissions decline by about 0.65% for each 1% increase in the effective levy rate. For SO2 emissions alone, the estimated elasticity is again noticeable (-1.03). Therefore, firms' response to the water pollution levy is focused on process change, rather than end-of-pipe removal.

A similar water pollution scheme was adopted in Colombia. The Colombia discharge fee program, despite a set of serious problems that limited its success in some regions, (i.e. widespread non-compliance by municipal sewerage authorities, and a confused relationship between discharge fees and emissions standards) seem to have achieved its targets. Indeed, in some watersheds, pollution loads dropped significantly after the program was introduced (Blackman, 2009). For instance, in the ecologically sensitive area of the Rio Negro watershed, water pollution from industrial sources was reduced by 28 % (Sterner, 2003).

Water effluent charges have also been experienced in Central European and Eastern countries. In Poland, a revenue raising charge to provide funds for environmental protection and water management on a national, provincial and municipal scale was implemented. Pollutants targeted include BOD, COD,[3] suspended solids, chloride and sulphate ions, heavy metal and volatile compounds. In 1996 BOD decreased by 11,000 tons and insoluble substance by 71,000 tons (OECD 1999, p.92). Similar actions were taken in Latvia and Estonia. In Latvia the water effluent charge referred to 36 pollutants. Rates can differ and are based on two criteria: the level of hazardousness of the category and the type of recipient. For instance, BOD, phosphorus and nitrogen are classified as moderately hazardous and are charged 30 LVL (0.047 euro) per kg. Non-compliance is penalized with a three-fold rate. (Speck et al., 2006).The revenues from the wastewater charges are then shared between national environmental funds and municipal funds/budgets and are used to finance environmental improvements. The results in terms of reduction of pollution do not seem very strong though. A similar situation appears in Estonia, where the water charge system has been in place for much longer. Over the 18 years that they have been used, the environmental fees have contributed 4.3 billion *kroons* to the state budget, which has

[3] BOD and COD are acronyms for Biochemical oxygen demand and Chemical oxygen demand. They inform on the physico-chemical properties of water samples.

been invested in the environmental protection of Estonia. A range of projects have been supported. These include the construction of a large number of waste water treatment plants and utilities, drinking water pipelines, waste disposal sites and more. Existing fees however have had lower environmental effects than expected.

Malaysia was one of the first countries to use effluent charges (paired with licensing) to control pollution from the palm oil industry (World Bank, 1997). The Philippines instituted environmental fees for wastewater discharge from industrial sources in 1997 (World Bank 1997). Evidence from one area (Laguna Lake) shows that BOD discharges from affected plants dropped 88 percent between 1997 and 1999 (World Bank 2000).

Evidence that MBIs matter in determining firms' environmental performance was found in a study on the Brazilian industrial sector (Seroa da Motta, 2006). This paper uses data drawn from a survey of the Brazilian National Confederation of Industries (CNI) undertaken in the period August–September 1998. The survey inquired into the situation of respondents related to the year 1997 and, for some financial variables, to 1996. The survey target was to generate insights that would allow governmental and development agencies to evaluate strategies, policies and instruments to enhance environmental management (captured by a set of proxies). It is found that besides the characteristics of the firm (e.g. size, sector and foreign ties, demands from communities) market incentives are also very important determinants of environmental performance. Cost savings on inputs and subsidized credit are also found to be important. However, data are, again, from a cross section database. This implies that the coefficient estimates can be biased because of unobserved time-invariant firm level heterogeneity. Moreover, important information regarding the survey are missing in the paper. Nor is endogeneity addressed. Therefore, these coefficient estimates should be interpreted very carefully.

A better data collection is offered by Pandey (2005). The basic premise of this paper is that the lack of reliable information on the nature and magnitude of emissions/discharges from various industrial sources may flaw the ability of regulators to formulate cost-effective strategies for industrial pollution control. This article, therefore, uses the Industrial Pollution Projection System database to estimate the industrial pollution load and the associated abatement cost, which can be used to design cost-effective strategies for pollution control. The article also illustrates the cost-effectiveness of market based instruments such as effluent charge vis-a`-vis regulation.

Xu et al. (2010) use production data from 34 paper mills in two representative provinces to examine the abatement efficiency and effectiveness of the levies. It uses a distance function to determine individual output-based and revenue-based shadow prices for each mill during the years that the levies were the main environmental incentive. The output-based shadow prices for pollutants display no recognizable trends over time and they are very different for firms in different locations. The revenue-based shadow prices are widely variable between mills and locations as well. These findings indicate that the marginal opportunity costs of abatement were also widely divergent and that there was no trend toward improved abatement efficiency. It should be stressed that this method did not use econometric methods to estimate the coefficients.

It is important to mention the work by Bhat and Bhatta (2004). This paper focuses on the externalities deriving from aquaculture and formulates an interactive model of non-renewable and renewable resources to characterize land allocations between aquaculture and agriculture in an ecologically and economically sustainable fashion. Through an empirical application, various economic and policy circumstances that affect the optimal land allocation mix are evaluated. The aquaculture industry must address two economic effects: off-site negative effects on renewable food and other coastal resources, and on-site self-pollution of shrimp ponds. Current regulatory

and land-use policies are inadequate to address these effects. Water effluent discharge is different in that sampling and flow measurement are relatively inexpensive. At Laguna Lake in the Philippines, a sophisticated effluent discharge fee system with high fee levels has proven effective in limiting BOD discharge.

Blackman (2009) analyzed the implications of Columbia's discharge fees programme. Again it should be noted that these results are not based upon econometric models. This paper is actually based on a variety of primary and secondary data. It finds that in its first 5 years, the Colombia discharge fee program was beset by a number of serious problems including limited implementation in many regions, widespread non-compliance by municipal sewerage authorities, and a confused relationship between discharge fees and emissions standards. The key finding is that in some watersheds, pollution loads dropped significantly after the program was introduced.

3.2. Evidence based on taxes

Taxes are very important MBIs. They have less monitoring involvement and create an important incentive that could indeed affect behaviour.They can, moreover, provide government with important opportunities of revenue generation. However, taxes may also have some negative feedback in terms of regulators' or governments' popularity. Another reason why taxes are seen as inappropriate is that they are potentially regressive. For instance a tax on fuel: a common argument against raising fuel taxes is that poor households would bear most of the burden - it would therefore be unfair on the poorest part of the population. This question is addressed directly by Blackman et al (2009). The study analyses the incidence of a fuel tax in Costa Rica. It uses household survey data and income-outcome coefficients to analyse fuel tax incidence. It finds that the effect of a 10 percent fuel price rise through direct spending on gasoline would be progressive, its effect through spending on diesel – both directly and via bus transportation – would be regressive (mainly because poorer households rely heavily on buses), and its effect through spending on goods other than fuel and bus transportation would be relatively small, albeit regressive. It concludes that distributional concerns need not rule out using fuel taxes to address pressing public health and safety problems, particularly if gasoline and diesel taxes can be differentiated.

Another analysis by Alpizar and Carlsson (2003) focuses on transport choices by commuters in Costa Rica. The paper analyze a group of policies aimed at discouraging the use of private transportation during peak hours, both directly and indirectly, by increasing the attractiveness of the only available substitute, the bus. A choice experiment is constructed to analyse by how much is the choice of travel mode for commuters to work sensitive to changes in travel time, changes in costs for each mode and other service attributes. This information is then used to identify the most suitable combination of policies dealing with air pollution and congestion in the typical developing country context of metropolitan Costa Rica. The analysis is implemented through a choice experiment. Fuel taxes can also be useful to incentivate technological change. This is the case if firms are quite responsive to changes in relative prices.. In 1990, a study by USAID, estimated that by the age of seven, Bangkok children collectively suffer a loss of up to 700,000 IQ points as a result of elevated blood-lead levels (O'Connor, 1998). This research prompted the Thai Government to introduce unleaded petrol at a slight discount relative to leaded petrol, subsidizing the former from a surtax on the latter (O'Connor, 1998). Moreover, from September 1993, the Thai Government introduced a regulation requiring that all cars sold in Thailand, from that date forward, should be equipped with a catalytic converter. Both these measures resulted in the market share of unleaded petrol rising to almost 50% of the market for petrol in the following few years" (O'Connor, 1998: 98).

Coria (2009) brings some evidence from Santiago, Chile. The paper presents an analysis of technology choice tested via a Hazard model. The findings stress that indirect regulations might stand a better chance of being effective in promoting environmental targets. A large response of the rate of switching to the lower price of natural gas in Santiago was found. This supports the use of taxes on non-clean fuels. Even if they do not create incentives to abate emissions per se they might create incentives to use cleaner fuels and to reduce emissions. This also promotes ease of administration (Blackman and Harrington, 2000). Indeed, consumption of fuel is usually much easier to monitor than emissions. And the existing government tax collection institutions can be used. The authors argue that "these two aspects seem quite correlated to the success of the implicit tax on "non-natural gas fuels" and to the failure of quantity policies in Santiago.

4. Interaction with other methods

While the focus of this survey is assessing the empirical evidence on the effectiveness of MBIs, it seems appropriate to devote some space to the alternative methods for pollution control. The interested reader may refer to Blackman 2009. These methods have in fact been screened widely by the empirical literature. After the seminal paper by Pargal and Wheeler (1996) much attention has been devoted to the so called *informal*, *voluntary* or *informational* polices. In some way they can provide an alternative or a complement to the more traditional approaches to environmental performance (via adoption of better technologies and/or environmental standards). Attention to these method has been stimulated by the World Bank. As Blackman (2009) put it: "the World Bank has probably been the most visible and vocal advocate of environmental policy innovation in developing countries."

In fact, during the 1990s, the Development Research Group at the World Bank conducted a series of studies of the impact of non-regulatory pressures on environmental performance. This process is also called informal regulation. The work of the group originated a flow of data collection and papers. The book,published in 2000 and entitled *Greening Industry: New Roles for Communities, Markets, and Governments* (World Bank 2000) encapsulates this effort. The authors concluded: "Overall, the proliferation of innovative channels for reducing emissions has created a new model for pollution control in developing countries. In this model, regulation is information-intensive and transparent. As environmental agencies exert influence through formal and informal channels, they become more like mediators and less like dictators. Community representatives take their place at the negotiating table, along with regulators and factory managers. Market agents make their presence felt through the decisions of consumers, bankers, and stockholders."

A1996 paper by Hettige et al. reviewed evidence drawn from three empirical studies of plant-level abatement practices conducted 1992–1994. The analyses test the importance of plant characteristics, economic considerations and external pressure in determining environmental performance. The results consistently show that pollution intensity is negatively associated with scale, productive efficiency, and the use of new process technology. It is strongly and positively associated with public ownership, but foreign ownership has no significant effect once other plant characteristics are taken into account. Among external sources of pressure, community action, or informal regulation, emerges as a clear source of inter-plant differences in all three studies. The results suggest that local income and education are powerful predictors of the effec-

tiveness of informal regulation. They also show that existing formal regulation has measurably beneficial effects, even when it is quite weakly developed. Dasgupta and associates addressed these issues in a series of papers. They used new survey evidence from Mexico (Dasgupta et al. 2000) to analyse the effects of regulation, plant-level management policies, and other factors on the environmental compliance of Mexican manufacturers. A two-stage least squares method for econometric estimation was used. and consistent parameter estimates in presence of endogeneity were provided. Results suggest that environmental management has a strong, independent effect on compliance, even after we control for simultaneity and take many other determinants of emissions intensity into account. It concludes that in developing countries with weak regulation, the carrot of subsidized environmental management training may provide a useful complement to the uncertain stick of conventional enforcement.

Dasgupta et al. (2001) investigated the role of inspection on environmental performance in China. They present an empirical analysis of the impact of monitoring and enforcement activities on the environmental performance of polluters. The paper explores the impact of both inspections and pollution charges on the environmental performance of polluters in China. Results indicate that inspections dominate and better explain the environmental performance of industrial polluters. The role of capital markets was investigated in another 2001 paper. This paper shows that capital markets in Argentina, Chile, Mexico, and the Philippines do react to announcements of environmental events, such as those of superior environmental performance or citizens' complaints. Public disclosure mechanisms in developing countries may be a useful model to consider, given limited government enforcement resources.

Foulon et al. 2002 provided an empirical analysis of the impact of both traditional enforcement and information strategies within the context of a single program. It provides insights on the relative impact of the traditional (fines and penalties) and emerging (public disclosure) enforcement strategies. It presents evidence that the public disclosure of environmental performance does create additional and strong incentives for pollution control.

Managi and Kaneko 2008 analysed how the performance of environmental management has changed over time using province level data for 1992–2003. Mixed results for environmental performance are shown using non-parametric estimation techniques. It is found that the environmental performance index, abatement effort, and increasing returns to pollution abatement play important roles in determining the pollution level over the period of the study.

While the role of public disclosure was analysed by Garcia et al. by studying the differences in firms' responsiveness to PROPER, Indonesia's public disclosure program for industrial pollution control. They use plant-level data to relate short- and longer-term environmental responses to facility characteristics. The results revealed that foreign-owned firms were consistently more likely to respond to the environmental rating scheme, compared to private domestic firms. The role of press is analysed by Kathuria (2007). He offers a test of the hypothesis that the press can act as an informal agent of pollution control. This hypothesis is tested using monthly water pollution data from four hot spots in the state of Gujarat, India for the period 1996 to 2000.[5] The results show that the press can function as an informal regulator if there is sustained interest in news about pollution. However, the attention and treatment of endogeneity seems not very robust.

[5] A comprehensive review of alternative pollution control policies is Blackman (2010).

5. Conclusion

The purpose of this paper is to provide a survey of Market Based Instruments (MBIs) for pollution control and draw some conclusions on their successful implementation in developing countries. This review has mostly focused on papers that present econometrics analyses from developing countries. Screening the existing literature, it is found that pollution charges and fees have had an impact on curbing both air and water pollution. Interestingly, the reductions that have been found for both water and air pollutants seem to be of a similar size. In addition, charges seem to work for pollution that is generated by both small and by large units. This indicates that these MBIs can offer a valuable means of reducing pollution.. The charge system, however, requires means for monitoring data and institutional capacity to enforce compliance. The regulator has to set an appropriate level of fee and collect the amounts due. Moreover, charges on air emissions can be difficult to implement because of problems of measurement. They also can be difficult to administer when facing a large set of different pollutants from different sources. It should be stressed that most of this empirical evidence relies on evidence from one single country: China. Because of the specificity of the Chinese context, it is, therefore, difficult to generalize these findings. We therefore expanded the scope of the review by including evidence based on case studies from both developing and developed countries. Again, the evidence (mostly on effluent charge) indicates that water pollution has been declining in a range of different countries including Colombia, Philippines, Estonia and Latvia.

Empirical evidence highlight that taxes, also, can be very useful in reduction of air pollution. The reduction seems to work through substitution and incentives in switching to cleaner energy. As for the charge system, to be effective it is necessary to enforce compliance. However, taxes seem to have a larger set of benefits. They generate revenues and they may be easier to manage. Their collection could be implemented via the tax or finance department rather than the environmental regulator. The key question, though, is their suitability in a development context and their implications in terms of distributional equity. It is important that the most vulnerable component of the population would not be adversely affected by it. Alongside fees and taxes, subsidies are also found to be an important tool to achieve reductions in pollution. These include grants, low-interest loans, favourable tax treatment, and preferential procurement policies for products believed to pose relatively low environmental risks. These, of course, still require monitoring capability and enforcement of compliance. Subsidies for environmental management are, however, costly and can be criticized because of their welfare implications. They can, indeed, be seen as a "prize" given to polluters. The subsidy is helping to bear the costs that should be the responsibility of the polluter. Eliminating environmentally harmful subsidies can be even more effective when used to improve environmental quality. Prime examples are the removal of subsidies on fertilizers, and leaded petrol.

There are grounds to suggest that successful implementation of MBIs can play a key role in reducing pollution. However, this does not mean that regulatory efforts are not useful. It should be noted that MBIs very rarely work in isolation. In reality, CAC and MBIs co-exist. Thus, regulators establish a specific level of pollution (or standard) and apply a fee for the amount of pollution that is above that threshold. It is, in general, complex to disentangle the implications of different tools. The positive results of MBIs can, therefore, be biased upwards. A balanced mix of regulatory measures and MBIs will effectively achieve pollution reduction targets. From the standpoint of the implementation in developing countries, the effectiveness of both MBIs and CAC can be undermined. Monitoring environmental performance and enforcing compliance

are crucial stages for the success of the policy. The successful achievement of these stages can be affected by a host of problems. Regulatory institutions in can be weak, understaffed and with lack of resources. This can impair both monitoring and enforcement phases. Moreover, developing countries often have a large set of very small firms that are more difficult to monitor. Firms' location may also be spatially dispersed. Recent findings on the relevance of *informa*l, *voluntary* or *informational* polices, however, seem to indicate that these can both lower the regulator's burden on monitoring and compliance and increase the extent of pollution control. We need, therefore, to analyse all polices in conjunction rather than in isolation. Some technical caveats should be raised. Most of the empirical evidence relies on cross sectional evidence from China. Some caution should be exerted when one aims to generalize the results. Also, given that most of these analyses lack a time-dimension we cannot draw the dynamic implications of MBIs. The availability, in the future, of larger databases with time-dimensions and from different countries will be critical for assessing the role of these tools.

It should also be stressed that while, in theory, there is a very large set of potential instruments, policies have focused on a few specific instruments. This may be due both to lack of administrative capacity and to the level of development of markets. It may also be due to the fact that more sophisticated MBIs (i.e. permits) still require both a strong regulatory and enforcement capacity. . This stresses again the necessary coordination of regulatory process and market -based instruments. The lessons learned from the experience of developed and OECD countries can be valuable in this process.

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THE FUTURE OF THE QUALITY POLICY IN THE LIGHT OF THE CAP POST-2013

JEL classification: Q10, Q13, Q18

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Abstract. *Quality policy is an integral part of the CAP and represents a useful instrument for promoting both the competitiveness of the agricultural system and the vitality of rural areas. With the "quality package", changes are introduced in the normative framework of the PDO, PGI and TSG products, with the objective of answering to the needs of both producers, for sustainable profitability, and consumers, for a higher level of information and guarantees on the origin of products. Nevertheless, considering the magnitude of structural and socio-economic differences that mark quality production systems across Europe, the possibility of making the system capable of answering to the different needs still seems to be open*

Keywords: *Quality package; CAP; PDO, PGI, TSG; TRIPS Agreement*

1. Introduction

Quality is a concept with many implications, and therefore hard to analyse and to define. Following an economic approach two dimensions can be identified: horizontal and vertical (Grunert, 2005). The first is temporal and distinguishes the perception of quality before (quality expectation) and after (experience of quality) the purchase; the vertical dimension studies how the consumer: 1) infers the quality from a variety of signals, 2) binds the properties of food products to his behaviour and to his values.

The quality signals about the characteristics of the product can be intrinsic, if related to the physical characteristics (colour, shape), or extrinsic, if not related to tangible aspects of the product: the brand, the price, the geographical origin are examples of quality signs that may constitute real marketing instruments (Nelson, 1970).

The quality of food products has always represented a priority for consumers, companies and institutions. Over the years, the European citizen has asked himself what the quality of food products actually is, coming to identify the quality of a nourishment mainly with the intrinsic characteristics: a nourishment is a quality product if it is considered good, tasty and with a delicious look (Eurobarometre, 1999).

But in the current food system, quality must also comply with specific technological and production rules; moreover, quality is bound up with the ways and the characteristics of the production system, with food safety and with correct information to the consumer (Adinolfi et al., 2011).

However, with the globalisation process, quality has assumed another important dimension: it has become a competitive factor.

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Due to stronger competition from extra-EU companies, that have comparative advantages arising both from production cost structure and trade capacities[1], European producers have identified in the "leverage quality" a strategic factor able to move the competitive comparison away from the price level, on which they would result as losers.

The common policy on agricultural quality has been going hand in hand with that awareness. It was indeed necessary to wait until the early nineteen nineties to see the birth of regulations on quality products, with the aim of harmonising the existing national legislation and safeguarding Protected Designation of Origin (PDO), geographical indications (PGI) and Traditional Speciality Guaranteed (TSG). Again, it was necessary to wait until the CAP reform of 2003 in order to have more tools to support quality of food products.

In this process of harmonization and development of a framework of quality policies, it should be remembered how the European Community has faced numerous difficulties in identifying a clear, unambiguous and shared concept of food quality.

These difficulties arise mainly from the differences in consumer perception: for some the meaning of quality coincides with health and hygiene safety (in the case of consumers the countries of Central and Northern Europe) while for others (those of southern European countries) quality is mainly linked to the territorial origin.

The different perception of quality, based on local source or on food safety, does not exist only among EU consumers, but is also found worldwide, particularly in the field of international law, where the provisions concerning the quality of food are inextricably intertwined with the food security issue.

It is worth remembering - in this respect - how the Codex Alimentarius and the TRIPS agreement represent some of the most important regulatory framework designed to promote a progressive harmonisation of food legislation in order to facilitate international trade.

While in Europe quality means compliance with a number of specific rules on safety and protection of public health, unlike other countries, the European Union has sought to regulate and to protect the quality *of the products related to the territory and to the traditional production processes.*

The EC Regulations 2081 and 2082 of 1992 (establishing the PDO, PGI and TSG)[2] are not only issued to meet the need for harmonisation of different rules in the different Member States concerning food quality. They represent a starting point on which to graft tools and measures to promote local products from rural areas in Europe.

With the integration, under the EC Regulation 1698/2005 on support for rural development, of measures that have the dual objective both of supporting producers in quality supply chains and of promoting those products to the consumer of PDO, PGI and TSG brands, those instruments assume also the function of marketing tools.

But it was only after the Commission Communication (2010a) on the CAP post-2013 that the policy of food quality became an integral part of the CAP.

The challenge is now to understand, in the light of the ambitious objectives assigned to the

[1] The European agricultural and food industries companies present lower structural dimensions than those of advanced economy countries in general; consequently, this involves lower organizational capabilities and lower financial capabilities, which may penalize the companies, as regards the investments in innovation and promotion, necessary to compete on the global market.

[2] Regimes related to geographical indications exist in the sector of wines and spirits: the Regulation EC 607/2009 laying down certain detailed rules for the implementation of Council Regulation (EC) No. 479/2008 as regards protected designations of origin and geographical indications, traditional terms, labeling and presentation of certain wine sector products has provided harmonisation of the system of designations of origin and geographical indication for wines with the system of PDO and TSG labels.

European local products of quality, whether the provision included in the quality package[3] will be able to support the growth paths of these products and, consequently, to ensure the development and vitality of the rural areas.

2. The answers of the quality package to the needs of development of quality products

2.1. The need for improved consumer knowledge of quality brands

One of the key messages highlighted by the Commission in the "quality package" regards the goal of better information on food quality.

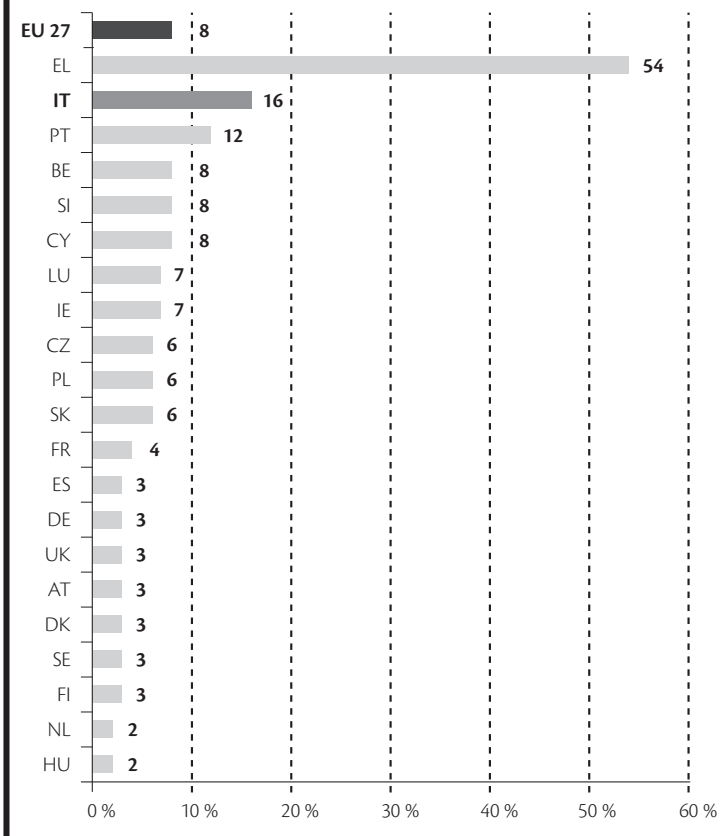
Several surveys have been carried out over the years in order to understand the degree of consumer awareness of the PDO or PGI brands (Eurobarometer, 1999). The same result was seen in each case: the degree of brand knowledge and awareness is very low, even where the use of the brand has been longer established.

The latest survey, performed by London Economics (2008) in the EU-27, shows large regional differences. Although brand awareness is directly proportional to the number of certified products, the survey points out some exceptional situations. The case of Greece is surprising: over half of the respondents claimed to recognize the symbol of the PDO or PGI, thanks primarily to the widely reported debate in the press for registration of PDO "Feta cheese". The average European degree of awareness of the PDO or PGI symbol is only 8% *(figure 1).*

On the other hand, there is an increased rate of market penetration by other symbols, such as organic or fair-trade.

In general there is very

Fig. 1 - Recognition of PDO or PGI symbols (by country), 2008



Source: London Economics

[3] European Commission (2010b), Proposal for a Regulation of the European Parliament and of the Council on agricultural product quality schemes (COM (2010) 733).

low consumer involvement towards any type of mark referring to a food quality and/or safety guarantee: about two-thirds of respondents, did not recognize any symbol, whether PDO, PGI, traditional product, biological product or fair trade. Moreover only 51% of the consumers who claim to know the PDO/PGI symbols know that these logos are meant to indicate that a product is produced in a specific geographical area.

The knowledge gap concerning PDO, PGI, TSG labels represents a major competitive disadvantage for those types of products. In practice, the function of reducing asymmetric information that should be carried out by the signs of quality is seriously undermined by the limited knowledge of the EU logos on the part of consumers.

Although the "quality package" confirms, by the strengthening of the 'Groups' 'role, the possibility of developing informative and promotional activities to communicate to consumers the properties that give value to their products, it would be helpful to accompany these measures with institutional information campaigns by the EU on the PDO, PGI and TSG logos and on their significance, in complete autonomy from individual products[4].

No policy intervention aimed at enhancing PDO, PGI, TSG products will ever fully and effectively achieve its goals for as long as a large proportion of European consumers is unable to recognize these logos and the values that they express.

2.2. The need for international protection of quality products

The heterogeneity that distinguishes PDO/PGI products in terms of production volumes is synonymous of different needs of producers and transformers. While small PDO/PGI are located in local/national markets, those with higher volumes of production use the community brand in order to gain market shares in foreign countries, thanks to the protection given by the denomination inside Europe. On the other hand, 18% of the 14.5 billion euro PDO/PGI production value is obtained on foreign markets (Commission staff working paper, 2010).

However, there are some limitations in the denomination protection given by EC 509 and 510/06 Regulations. The protection is limited to the territory of the European Union. In addition, it does not relate to Community laws able to penalize the possible illegitimate use of the denomination, nor to identification of the institutions which are expected to verify and, eventually, impose the penalties.

Imitation of quality products is a common practice in extra-European markets and is one of the main obstacles to development of the PDO/PGI system in those contexts. We cannot underestimate the opportunities that extra European markets offer to these products: even if today the share of European quality products in those markets is only 5% of the total, for some PDO/PGI the potential for growth is undoubtedly much higher *(table 1).*

A large proportion, 57% of turnover, obtained by PDO/PGI products on the extra-EU market comes from Italian products. At the Italian level, it is 8%. Other rates are 23% of total value in the Czech Republic, 15% in Denmark and 13 % in Portugal. As far as types of products are concerned PDO/PGI cheeses are the most exported products outside EU countries (especially to the United States) amounting to 7% of the total value of that sector *(table 2).* As far as names are concerned, 51 cheeses are exporting part of their production in third country markets (Commission staff working paper, 2010).

[4] With the term Groups (art. 42 Proposal for a Regulation of the European Parliament and of the Council on agricultural product quality schemes (COM (2010) 733)) is meant Association of producers and/or processors connected with the quality product.

Tab. 1 - Value of PDO/PGI by Member State: share of Extra-EU export (2008)		
Member State	**PDO/PGI Extra-EU Export**	
	(% total value)	**(€ '000)**
EU -27	**5**	**725.934**
Italy	8	416.408
Germany	2	72.240
France	1	25.856
United Kingdom	7	69.206
Spain	4	34.342
Greece	6	36.614
Czech Republic*	23	21.380
Austria	8	9.417
Denmark	15	12.329
Portugal	13	9.359
Other MS	0	18.081
Source: author's calculations on European Commission data.		

Tab. 2 - Value of PDO/PGI by type of products: share of Extra-EU export (2008)		
Type of products	**PDO/PGI Extra-EU Export**	
	(% total value)	**(€ '000)**
EU -27	**5**	**725.934**
Cheeses	7	393.721
Beers	4	94.633
Meat products	3	78.483
Fresh meat	0	–
Fruits, vegetables and cereals	3	26.101
Bread, pastry, confect.	1	7.419
Oils and fats	8	28.792
Other products	12	96.785
Source: author's calculations on European Commission data.		

With reference to the above-mentioned issues regarding community protection, the proposals included in the "quality package" lead to the improvement of that function through the adoption by Member States of adequate administrative and legal measures to prevent or stop illegal use of the PDO/PGI (so-called "ex-officio" protection). In other words each MS is requested to organize its own protection system for every European Union PDO/PGI. This measure fills a gap that has, until now, practically reduced the effectiveness of the community brand protection system.

The matter of extra-EU protection is more complicated. The TRIPS agreement is a "potentially" effective tool for improving international protection of geographical indications, thanks in part to the great number of WTO countries (150). This is due to the fact that the TRIPS agreement, unlike other international conventions concluded on the same issue[5], establishes a defini-

[5] On these issues refer to the Convention of Paris dated March 20th, 1883 on the protection of industrial property, the Agreement of Madrid dated April 14th, 1891 concerning the prohibition of false indications of the origins of goods, revised in London on June 2nd, 1934. See also the international Convention on the use of designations of origin and on denomination of cheeses signed in Stresa on June, 1st 1951 and, lastly, to the Lisbon Agreement dated October 31st, 1958 on protection of denomination of origin and on their international registration.

tion of geographical indication that is shared by each member country. This foresees appealing to a unitary and integrated protection and dispute resolution system, uniformly applicable to any issue that is within the competence of the WTO and all its members.

The agreement, in article 22.1 defines Geographical Indications by specifying that "*Geographical indications are, for the purposes of this Agreement, indications which identify a good as originating in the territory of a Member, or a region or locality in that territory, where a given quality, reputation or other characteristic of the good is essentially attributable to its geographical origin*". The protection established by art. 22 is general, generic and with little effectiveness: when the legitimate proprietor of a determined geographical indication is willing to oppose misuse of the geographical indication he is required to demonstrate that the use performed by the counterpart can mislead the public.

Article 23, on the other hand, establishes added protection for geographical indications for wines and alcoholic beverages. These are valid even when the geographical indication is translated or accompanied by expressions like "gender", "type", "style" or similar.

This double structure has created a two level protection system: the first is considered generic, specified in article 22 and applicable to the geographical indications of all products. The second, supplementary, is specified in article 23 and is applicable to indications of wine and alcoholic beverages.

The result of this "double level" system is that according to article 23 it is not possible to use indications like "sparkling wine Champagne style, made in Chile", while it would be possible to use the term "Roquefort Cheese, made in Argentina" or "Parma Ham, made in Canada", since the last two could be considered as not misleading for the public, since the real origin of the product is indicated.

These different treatments between wines and other food products are also indicated in art. 23.4 which states"…*in order to facilitate the protection of geographical indications for wines, negotiations shall be undertaken in the Council for TRIPS concerning the establishment of a multilateral system of notification and registration of geographical indications for wines eligible for protection in those Members participating in the system".*

At the same time the TRIPS agreement does not explain the meaning of "*multilateral system of notification and registration".* This "gap" has created two different positions in the negotiations: one for the European Union and one for the United States, both supported by countries with similar interests.

More specifically the two opposed positions respectively provide for:

– the institution of a multilateral registry of geographical indications extended to all food products – as well as wines and alcoholic beverages – carried out by the WTO Secretariat which provides for registration of denominations according to the requests presented by Member States (MS). The register, which has to be consulted by each MS whenever there is any procedure for protection or registration of trade mark or geographical indication, is the proof of the presence of such denomination and of its connection to a specific territory. This is basically the position expressed by the European Union along with more than one hundred other countries (WTO, 2005; WTO, 2008);
– downgrading a multilateral register to a simple database made on a "strictly voluntary" basis that has to be consulted in order to verify the compatibility with other denominations and brands that need to be registered only in cases where the country participates in the system. This is the proposal made by the United States together with other countries, among them Argentina, Chile, Canada, Australia and New Zealand (WTO, 2005;WTO, 2008). In addi-

tion, the document does not forecast extension of the registration to products that are not wine and alcoholic beverages.

Negotiation within the WTO now has to deal in detail with the single points that should regulate functioning of this multilateral register:

- notification: how a term would be notified and which member would do it (also related to "participation");
- registration: how the system would be run and the WTO Secretariat's role;
- legal effects/consequences of registration, in particular any commitments or obligations on members arising from a term's registration (also related to "participation");
- fees and costs – including who would bear these burdens;
- special treatment for developing countries (officially, "special and differential treatment");
- participation: whether the system is entirely voluntary, or whether a term's registration would have some implications for all WTO members.

Regarding the protection of geographical indications outside of EU, the "quality package", offers some adjustments to harmonise the definition of PDO and PGI within the TRIPS agreement in order to facilitate WTO negotiations.

A possible alternative option to improve the efficacy of international protection of geographical indications is also worth mentioning. It consists of the creation of bilateral and regional agreements between single countries and/or groups of countries, with the awareness that these types of agreements bind only the agreeing parties and would need to be repeated in all international potentially affected markets of PDO/PGI/TSGs.

2.3. The need to strengthen the bargaining power of PDO/PGI producers

The fragmentation of the PDO/PGI system relates both to volumes of production and to the producing firms. In the first place, the quantities to be certified for most denominations of origin and geographical indications are small and also the production system that lies behind them is composed of a multitude of small and medium-size farms and food processing companies.

With respect to this, in Italy and France, there are 76,000[6] and 56,000[7] farmers producing respectively 1.1 million and 600,000 tons of PDO/PGI products. As far as the sector of PDO cheeses is concerned, in Italy (first European producer for quantity and value), there are over 1,400 dairies producing almost 450,000 tons. In Spain, 29,500 tons of cheese are produced by 433 dairies. In France, of the 187,000 tons produced, 8% (14,800 tons) regards volumes obtained from 1,350 farmers.

On the other hand this production has to face up to highly concentrated large scale retailers. Over 70% of French PDO cheese production is distributed by large-scale retailers[8]. In Italy this percentage exceeds 60% (Nomisma, 2008).

In other words even PDO/PGI products are subject to this "hour-glass model"(Grievink, 2003) that characterizes the agri-food system, determined by oligopolies that cover almost every food sector: an effect that reduces the bargaining power of producers with retailers, generating negative impacts on profitability for farmers.

[6] Source: Istat (http://agri.istat.it/sag_is_pdwout/jsp/Introduzione.jsp?id=14A).

[7] Source: Inao (http://www.inao.gouv.fr).

[8] Source: Inao (2010), "Produit laitiers AOC. Les chiffres clés 2009".

The effects of these models are more or less the same in the primary sector, while its economic consequences are stronger for PDO/PGI producers. The presence of a production specification "*de jure*" and "*de facto*":

- renders homogenous the quantities of products produced by different companies,
- delegates marketing activities related to the same denomination to "Groups" (Consortiums, Associations of producers, etc.).

It is clear that differentiation strategies, used by a single producer within a quality supply chain, are actually quite limited and expensive.

In fact, considering the small size of the companies of the quality supply chain and the costs related to marketing activities, the strategies promoting trademarks are very few.

In case of the production of large quantities of PDO products and the existence of mature markets the capacity of the company to fix the selling price gradually decreases until it becomes equal to that of a commodity producer.

In the case of commodity producers, despite their low capacity to affect selling prices, they may try to retrieve profit margins through gains in productive efficiency (for example, through technological investments, reduction of production costs, etc.); in the case of PDO/PGI products this resilience is hampered by product regulation on qualitative issues that may be incompatible with such efficiency strategies (for example incompatibility between manual and traditional production methods that connote PDO/PGI products and industrial transformation based on automation of the production process).

It is clear that the initial price reduction of PDO/PGI products affects the entire system of producers taking part in the same quality system uniformly and transversally. As a consequence, these producers will have to fully sustain their losses.

The decrease in profits below production costs will definitely lead them to go out of business. The PDO/PGI are usually produced in rural and less favoured areas such as mountain areas, thus it is clear that the closure of a livestock holding or dairy has several negative impacts: not only economic but also social as well as protection of territory and loss of historical and cultural heritage.

The "quality package" may become a tool for achieving a dual purpose, both in the sphere of promotion of PDO/PGI products and in the more general framework of the European farming and agri-food sector.

The proposal for the quality package aims to enhance the producer's or the "Group's" role through monitoring implementation of PDO/PGI/TSG, of information and promotion activities, communication to consumers on the added value properties of their products, and promotion of the activities that guarantee conformity to production specifications in order to improve the efficiency of the quality system.

Even if these proposals would be useful for achieving the identified goal, there is still room for manoeuvre to improve the bargaining power of producers in the European agri-food system.

For these reasons, it is crucial to have tools able to activate the development policies and quality management of PDO/PGI products. It is very important to make agreements aiming to plan the level of production, following market trends, in order to ensure better quality.

In accordance with competition rules and the "milk package" (European Commission, 2010c), the possibility of using contracting mechanisms to manage production efficiently could be introduced. This possibility of planning production, with reference to the "milk package" and what has already been implemented in the fruit and vegetables sector, might be connected to the

registration of organisations of producers or of inter-professional bodies within quality systems (extending this opportunity mainly to "Groups"). This would be done with the aim of increasing the bargaining power of producers despite the rules of competition.

2.4. The need for administrative and commercial simplification

Administrative simplification generally represents one of the main requests expressed by PDO/PGI producers as well as by European farmers in general.

The "quality package" proposes to simplify the current registration process for denominations of origin and geographical indications, both by reducing the time necessary for examination of geographical indications (from one year to 6 months) and by bringing the period for publication of the request for registration in the Official Journal of the European Union and for presenting objections down from 6 to 2 months. On the contrary, however, by keeping separate regimes for food products, on the one hand, and wines and alcoholic beverages on the other, it does not appear to be going in the direction of simplification. The possibility of eventually combining different schemes could permit synergies coming from the consumer communication and information campaigns on the PDO/PGI.

The use of delegated acts is a frequent practice in the "quality package" that should respond, according to the Commission, to the need for executive simplification of the regulatory framework.

According to article 290 of the TFEU (2009), a legislative act may delegate to the Commission the power of adopting non-legislative acts of general importance that integrate or modify the unessential elements of the legislative act itself. For example delegated acts may clarify specific technical characteristics or consist in a further change of some elements of a legislative act. However it is not so simple to distinguish between essential and unessential elements in a basic act and theoretically the practice of delegating acts could threaten the legislative function of the Parliament or at least require greater control from the parliamentary Commissions over the guarantees that the institute of delegation offers to the Parliament. It is to be specified, in this last regard, that the delegation has to come from a legislative act previously and jointly adopted by the Parliament and the Council. In addition the same basic act has to establish the conditions by which the delegation must be taken. And, finally, the Council and the Parliament may revoke a delegation, attribute to it a limited duration and make objections against the delegated act.

For general purposes it seems evident that excessive recourse to delegated acts would end up compromising the balance of institutions, the principle of transparency and the legitimacy itself of the legislative procedures of the Union (Massot, 2010). The use of delegated acts, in the case of the "quality package", is counted in no less than 18 out of 51 articles in the proposal of European Parliament and Council Regulations for the quality regimes of agricultural products, and in 6 cases out of 16 articles regarding the proposal to amend EC Council Regulation n. 1234/2007 on marketing standards (European Commission, 2010d). In many cases the topics and the procedures to be disciplined by delegated acts do not represent secondary aspects. The possibility of widening or reducing the types of agricultural product that may benefit from PDO/PGI/TSG, of making exceptions regarding the production or supply zone of the PDO/PGI, as well as, among other things, of defining specific conditions for the request for and the cancellation of denomination registrations are topics governed by delegated acts.-

With regard to commercial simplification, the "quality package", in addition to the measures contained in the proposed Regulation to rationalize marketing rules especially through the use of delegated acts, there are also two non-binding guidelines on the functioning of the voluntary

certification schemes and, in particular, on the labelling of the products that use geographical indications as ingredients. Regarding these latter guidelines, however, it is necessary to highlight that the Commission has not yet clarified certain provisions related to the use of the registered denomination in the ingredients of a food product, such as, for example the minimum quantity of PDO/PGI product which could give an essential characteristic to the processed food product. This disposition assumes substantial importance when we consider the possible added value that the PDO/PGI ingredient is able to give to the processed product.

If, on the one hand, the indication of the PDO/PGI ingredient on the label or in the package of the food product represents a kind of advertisement and promotion for this product, it is also true that in case of clearly famous ingredients (and European PDO/PGI products are the most famous and the most imitated agri-food products in the world) the processed product may be highly appreciated by the consumer, permitting higher prices.

In terms of economic balance, the payment for the PDO/PGI ingredient is the price paid by the transformer to the producer for the quantity actually purchased. On the other hand the transformer acquires a higher reputation by the presence of the most "famous" ingredient.

It would be proper, given that reputation is the result of the PDO/PGI promotion activities carried out by the Groups, including the related costs, to consider – in the proposal – giving to these associations/organizations the right to authorize[9] the use of their own PDO/PGI products in the processed foodstuffs.

3. Conclusions

The European quality policy originated with the aim of harmonising existing national regulations to protect and increase the value of local products and to promote their trading within the common market. While this initial objective has been achieved, the next goal has moved beyond community borders. In fact, the next objective of the European Union is international protection which will be sought by establishing a multilateral register for geographical indications according to the TRIPS agreement.

But this cannot be the only goal: in light of the continuous requests for PDO/PGI registrations, quality policy, must furnish tools to support the growth of the markets which struggle to adapt in an equal and equally efficient way, to the different production conditions that characterize the many registered denominations.

Should this not be the goal of the European Union then the only positive effect of community quality policy would be to infinitely expand a register made up of individual denominations without a corresponding contextual socio-economic growth, neither of the products nor of the territorial systems linked to them. And in this case, who would gain from this situation?

If we want to convert PDO/PGI/TSG denominations into marketing tools, and not mere means for electoral consensus (as happens in many local areas throughout Europe nowadays), we need to take other elements into account.

Firstly while PDO/PGI/TSG products do have more instruments for differentiation from

[9] Delegation of authorization to use denomination products as ingredients in transformed products to the Groups would be another measure strengthening the role of these producers' associations, in line with what are considered the purposes of the "quality package" and in addition to the provisions already inserted in art. 42 of the regulation proposal by the European Parliament and Council on agricultural product quality systems.

standard products (such as the European logo) at the same time find that the majority of consumers are unable to recognize or understand these instruments. The result is that the competitive logic these products face is practically the same as for every other food product.

The reduced average value assigned to European denominations is not just a peculiarity that differentiates these products: quite often it is the result of a problem, that of market success. If we wrongly believe, that quality only suits small production levels then how can we think of developing the European agri-food sector based on this prerequisite? And what positive effects may the territorial systems enjoy from registered denominations that are able to certify barely more than just a few tons of product?

How reliable in the eyes of the international community can be a system that requires the protection of territorial brands - at the expense of commercial brands- and that continuously grow in number year after year but which, in terms of the overall economic value, is worth less than the turnover of the main European agri-food company in the EU food and drink market?[10]

It will be said that is not fair to compare the system of local products to those of the standard food industry and that the system of territorial brands has been created precisely to give a further instrument to these products to "survive" in a competitive arena where small and very small companies have to cohabit with multinational companies.

Maybe this is the weakness of the European quality policy: it is more inclined to preserve than to develop local products. It tends to facilitate a conservation process (also by being recorded into the community register) and then provides tools to promote and protect them becoming most effective only when these products succeed in being sold outside of their country of origin.

The true challenge for a European quality policy that wants to make PDO/PGI/TSG products true instruments for social and economic development and to vitalize rural areas should be twofold: on the one hand, to succeed in preserving the fragmented system of production and processing companies rooted in rural areas of the Community and, on the other hand, give them the tools to compete and make them grow on the market. Even if these might seem opposing goals they are surely goals that cannot be separated: if, for example, the quality policy tends to reach only the first goal (preservation) then we would find ourselves with a policy that is more social than economic.

An ambitious policy for quality of European agri-food products should identify paths and tools to promote the growth of registered denominations with this double challenge clearly in mind. And the latter can be pursued by giving the companies instruments that are able to increase their competitiveness and their contractual power in the agri-food system.

This means tools that are able to facilitate associations between producers of quality products, to program production in relation to the market and to promote awareness of community brands. But at the same time it means rationalising the system of denomination registration[11] so that international partners will give more credit to a European quality system where products are really different and special when compared to normal standard products.

[10] In 2008, the largest European agri-food company had a turnover of 17.6 billion Euro in the EU food and beverage market.

[11] With regard to this goal, art. 51 of the "quality package" introduces the possibility of cancelling registration of a PDO, PGI or TSG whenever a product that benefits from the community brand has not been in commerce for at least five years.

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TRANSMISSION OF MARKET CRISES IN THE EUROPEAN VEGETABLES SECTOR

JEL classification: F13, Q17, Q18

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Abstract. *The paper analyses the problem of transmission of crises in European fruit and vegetable markets. The analysis is performed on the prices of tomatoes and cauliflowers on some important markets of the European Union close to production or consumption areas. The methodological approach consists in estimating a two regime error correction model capable of capturing the main aspects of price transmission in the absence or presence of market crises. The analysis shows that the transmission of market crises differs according to the characteristics of the markets analysed, their proximity to production or consumption areas, as well as to the products considered. The work has allowed the identification of relevant insights for planning policies for crisis management in the fresh vegetables sector.*

Keywords: *Market crises, vegetables, price transmission.*

1. Introduction

According to the European Commission (EC, 2005), a crisis occurs when "*there is an unforeseen situation that threatens the survival of farms, both locally and through the entire production sector or a broader geographical level*". Such a definition is very close to the concept of natural disaster: however, despite its similarity to disasters, a different definition is required as companies can resume normal activities after the crises are over.

Within such a framework, a peculiarity of market crises is that they are mainly linked to sudden price falls due to an unforeseen decline in consumer demand provoked by concerns arising from outbreaks such as BSE, or environmental disasters (*e.g.* Chernobyl). The economic losses of these crises can be amplified by import bans issued by trading partners that further reduce the market demand for products. The European Commission (EC, 2007) has further differentiated market crises into structural and economic crises. The former requires the adaptation of enterprises to the changing market conditions, while the latter are short-term crises.

Although unexpected, market crises can be considered as one of the risks that companies usually incur in their business activities. In order to cope with such risks firms can implement different management strategies. Among them, preventive strategies are very relevant: they consist in transferring the risks to third parties, or in avoiding losses by savings or credit. The new Common Agricultural Policy (CAP) might – and should - play a relevant role in helping farmers to manage these risks (De Castro *et al.*, 2011, 2012b).

The fresh fruit and vegetables (F&V) sector is often involved in market crises due to the sensitivity of supply to climatic variables and to the perishability of many products. The fresh

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F&V sector is particularly sensitive to structural crises, due to the high incidence of fixed costs on total production costs, which reduce the ability of companies to adapt quickly to market crises. On the other hand, vegetables are very sensitive to economic crises, due to the reduced shelf-life and to the high incidence of transport costs on retail prices. The reform of the Common Market Organization (CMO) for F&V in 2007 has reduced the role of existing measures to stabilize markets: it introduced the possibility of adopting new tools to deal with market crises. In particular, the CMO has established the so-called security funds that are intended to assist firms through financial instruments and/or insurance (Cafiero *et. al.*, 2007). However, a correct planning of risk and crisis management cannot ignore the spatial dimension of market crises: more precisely, understanding the degree and speed of price transmission and therefore the spread of market crises, is important for efficient management of potential market losses.

The term *contagion* indicates the phenomenon of transmission and spread of economic crises in spatially separated countries/areas. On one hand the economic literature on the transmission of financial crises (and the concept of contagion) is large and newly developed (*e.g.* Rigobon, 2003, Bekaert *et al.*, 2005; Dungey *et al.*, 2005; Dungey *et al.*, 2007; Ahlgren and Antell, 2010), on the other, the international economic and agricultural literature has devoted much space to the study of the mechanisms and degree of price transmission using different econometric approaches: threshold auto regressive models (TAR) (Ejrnaes and Persson, 2000, Goodwin and Piggott, 2001; Abdulai, 2000, Serra *et al.*, 2006; Balcombe, Bailey, Brooks, 2007; Ben-Kaabia1, Gil, 2007), switching regimes models (SR) (Ihle, Von Cramon -Taubadel, Zorya, 2009; Hassouneh, Serra, Gil, 2010) and threshold vector error correction models (TVECM) (Meyer, 2004; Brümmer, von Cramon-Taubadel, Zorya, 2009)[1]. However, agricultural economics literature appears to lack works aimed at studying the transmission of price during market crises[2].

Our paper aims to contribute to this issue by analyzing whether, and to what extent, the degree and the mechanism of price transmission of fresh vegetables are influenced by the occurrence of market crises. Our study considers prices of tomatoes and cauliflowers collected on several European markets close to production or consumption areas. The products are two of the main vegetables per volume of production. In addition, tomatoes and cauliflowers are widely affected by market crises. Therefore, the present work highlights aspects of interest for correct planning of policies for market crisis prevention and management.

The article is organized in six sections: Section 2 presents a summary of the main features of the European fruit and vegetables sector with particular emphasis on the products to be analysed; the issue of market crises is explored in the subsequent section; the fourth paragraph describes the methodology, while results are presented in section 5; conclusions and final remarks are developed in the last paragraph.

2. The European fruit and vegetables sector

The European Union (EU) is one of the world's largest producers of fruits and vegetables: its production accounts for more than 8 percent of the total (in particular, the EU produces 12 per cent and 7 per cent of global fruits and vegetables respectively).

[1] See Listorti and Esposti (2012) for a recent survey.

[2] To the best of our knowledge, one of the most appropriate works in agricultural economics literature related to the transmission of market crises has been published in Journal of Economic History (Madsen, 2001).

Tab. 1 - Main European producers of F&Vs (1000 tonnes)			
State	**Annual average production**		
	2000-2002	**2005-2007**	**2005-2007 (share)**
Italy	32.523	32.653	25.3%
Spain	28.179	28.515	22%
France	19.638	16.366	12.7%
Poland	7.391	7.383	6.2%
Greece	8.325	7.472	5.8%
Source: own calculations on EUROSTAT data.			

Grapes are the main item in the sector for volume of production, although they are mainly for the wine industry. Tomatoes are the second product and account for 30 percent of the European production of vegetables.

Italy (38 percent) and Spain (20 percent) are the main EU producers of fresh tomatoes, followed by Greece, Portugal and France. The Spanish fresh tomatoes are directed mainly to Northern Europe, particularly to France, United Kingdom, Germany and Netherlands. In other words, Spain plays an important role as a major producer and as main intra-EU exporter of fresh tomatoes. Almeria and Murcia are respectively the first and second Spanish provinces for export volume: the former concentrates its exports during the winter, while the latter has a wider and more stable export season (Valenciano de Pablo and Perez Mesa, 2004).

Tab. 2 - Main vegetables – EU volumes of production (1000 tonnes)			
State	**Annual production**		
	2001	**2003**	**2005**
Tomatoes	16.204	15.780	15.579
Carrots	5.079	5.088	5.057
Cabbages	5.434	4.635	4.940
Onions	4.795	4.559	4.906
Lettuce	3.275	3.224	3.804
Cauliflowers	2.114	2.190	2.105
Source: : own calculations on EUROSTAT data.			

Italy, Spain and France provide almost 70 percent of European cauliflower production. Italian production occurs in several geographical areas and is particularly relevant in Campania, Tuscany, Sicily, Marche. The main production areas in Spain are located close to Murcia, Navarra, Valencia and LaRoja: the volume produced in those areas accounts for 85 percent of total Spanish production. Germany is the main partner for Italian exports, while Spanish exports are mainly traded to United Kingdom (40 percent), Germany (15 percent), France (13 percent) and Netherlands (13 percent).

3. Market crises in the European fruit and vegetables sector

According to the definition of the European Commission "[...] *a crisis is understood to be an unforeseen situation that endangers the viability of agricultural holdings, either at a* ***localized*** *level, across a whole sector of production or at a* ***wider geographical level***" (emphasis added) (EC,

2005)". Economic events can cause short-term but intense market crises which may give rise to long-term structural problems. Although the management of risks and uncertainty at a time of economic choices is generally due to individual skills and preferences, the emergence of market crises - by definition unpredictable - has two main effects: firstly it leads to lower profits, secondly it affects several agents simultaneously (Cafiero *et al.*, 2007). In general, market crises cannot be managed by a single firm, while they can lead to considerable damage to the whole industry. For the these reasons both a correct prevention and a proper management of market crises at different levels (regional, national or European) is not only desirable but essential. The level of intervention should be chosen depending on the size of the crisis and the level of contagion[3]: the greater the degree and speed of transmission of crises, the higher will be the level of intervention necessary (*e.g.* if market crises are spread internationally, an intervention at Common level is required).

Market crises may be caused by several factors such as disasters, health problems, economic dynamics, and, in particular, they are caused by market disequilibria (*e.g.* over-production, sudden changes in demand, excess of imports, *etc*.).

In an era of volatile prices, food insecurity and market instabilities (De Castro *et al.*, 2012a), the European Commission intervenes with specific agricultural policies aimed at prevention and management of market crises - wine distillation, publicly supported storage, market withdrawals, *etc*..

The F&Vs sector is particularly exposed to market crises due to the perishability of the produce, and due to the sensitivity of production and consumption to climatic variations (EC, 2007a). In particular, the perishability of the produce prevents storage as a form of temporal arbitrage and might force producers to sell the ready produce during periods of low price. A second side effect of perishability is the strong seasonality in consumption. The sensitivity to climatic conditions influences both consumption and production (EC, 2007a). The last reform of the fruit and vegetables CMO has introduced a new tool to help in stabilizing the markets, the Operating Fund, aimed at transferring risks to other economic agents (EC, 2007b). It is important, however, to emphasize that the effectiveness of such a policy tool is strongly linked to the spatial dimension of market crises, and more precisely, it is affected by their speed and degree of transmission. The European Union aims to stabilize farmers' revenues also through trade policy measures such as the entry price The latter was introduced to stabilize the domestic price and prevent market crises, but its effectiveness is still unclear (Swinbank and Ritson, 1995; Cioffi and dell'Aquila, 2004, Goetz and Grethe, 2009). Recent analyses on the stabilization effects of the entry prices seems to indicate a rather modest effectiveness (Cioffi *et al.*, 2011; Santeramo and Cioffi, 2012). Price dynamics and market crisis transmission are key issues also in the correct planning of stabilization policies: for products whose markets are isolated the relevance of the entry price scheme could be quite limited, while the contrary is true for more integrated markets with fast price transmission.

To sum up, market crises are quite frequent in the European fruit and vegetable sector, and their size depends crucially on the degree of market integration: market crises occurring in poorly integrated markets tend to be localized, while market crises occurring in highly integrated markets lead to global crises. In this latter case despite the fact that it spreads the phenomenon, spatial arbitrage helps to reduce the intensity of the crises.

[3] In particular, the World Bank adopts three definitions of contagion: the first, a very general one, indicates the degree of price transmission between countries; the second definition links the concept of contagion to the transmission of shocks which are not explained by economic fundamentals; the third definition, most often adopted, defines contagion as a change in the price transmission mechanisms during periods of market crises (Ahlgren and Antell, 2010).

The present study focuses on two products particularly relevant in the EU as they represent the main vegetables for volume of production and are strongly affected by crises: cauliflowers and tomatoes (Cafiero *et al.*, 2009). They permit a limited degree of preservation, and differ by degree of perishability and unit costs of transport. As shown in Santeramo (2012), those features play a relevant role in spatial price transmission, therefore they will be taken into account for the interpretation of results.

Santeramo and Cioffi (2010) provided preliminary evidence on the degree of spatial price transmission in the tomato and cauliflower sectors, pointing out that market crises might be rapidly transmitted within *regions* whilst they tend to be confined to them rather than be transmitted to spatially separated *regions*. Such a result seems to be clearly demonstrated for cauliflowers as the low degree of integration and price transmission on the relevant markets suggests a low tendency towards the cross-regional transmission of market crises.

4. Methodology and data

As a preliminary step to the analysis of the effects of market crises on price transmission, we defined *crisis* the event occurring when the observed price, in a certain period of the year, is more than 25 percent below the five-years average price recorded in the same market. In analytical terms, the event "*crisis*" is defined as follows: $P_t < 0.25 * MM_{5t}$, where P_t is the market price at time t, MM_{5t} indicates the moving average of prices recorded for the same period in the previous 5 years. Our data-set includes daily prices - collected at wholesale level - and it covers the period from January 2001 to December 2006. The original data, extracted from the Agriview database of the European Commission, have been temporally aggregated to obtain weekly frequency. Prices have been collected on main EU vegetables markets by volume of trade. The data-set, in fact, includes the following markets for the tomato sector[4]: Almeria (Spain), Chateau-Renard (France), Dublin (Ireland), London (United Kingdom), Den Bosch (Netherlands). As regards the prices of cauliflower, the data-set includes the following markets: La-Roja (Spain), London (United Kingdom), Den Bosch (Netherlands), Sint Katelijne Waver (Belgium). We analysed price transmission among Spanish markets (Almeria or La Roja), which are close to the large production areas, and the other European markets, relevant for volume of consumption. Market crises have been identified in several of the main Spanish markets for volume of production: such a selection procedure allowed the investigation of the transmission of market crises from production Regions to consumption Regions. The selected markets in Spain are as follows: Almeria, Malaga and Murcia for tomatoes, and Barcelona, La Rioja, Navarra, Valencia for cauliflowers.

The analysis is conducted in two steps: firstly we evaluate the degree of market integration; secondly we estimate an econometric model able to take into account the event of *market-crisis*, that is we allow spatial price dynamics to differ under the *normal* regime and the *market-crisis* regime. The first econometric specification is as follows:

$$\Delta X_t = \alpha + \sum_{i=1}^{n} \beta_i \Delta X_{t-i} + \rho X_{t-1} + \varepsilon$$

[4] For sake of simplicity, we omitted results related to markets for which we cannot find price relationships.

where X_t represents the prices difference ($P_t^A - P_t^B$), ρwill indicate the coefficient degree of transmission, and $\varepsilon \sim \mathbf{N}(\mathbf{0}, \sigma_I^2)$.

As far as the second step, we adopted a vector autoregressive error correction model (TVECM) in which the *market crisis* regime is deterministically determined by the occurrence of a market crisis in the Spanish markets. The econometric specification is as follows:

$$\Delta X_t = (1 - I_t)\left\{\alpha_I + \sum_{i=1}^{n} \beta_{i,I} \Delta X_{t-i} + \rho_I X_{t-1} + \varepsilon_I\right\} + I_t \left\{\alpha_{II} + \sum_{i=1}^{n} \beta_{i,II} \Delta X_{t-i} + \rho_{II} X_{t-i} + \varepsilon_{II}\right\}$$

where X_t represents the prices difference ($P_t^A - P_t^B$), while I_t is the *switching variable* assuming value 0 in the normal regime and 1 in the *market crisis* regime, $\varepsilon_I \sim \mathbf{N}(\mathbf{0}, \sigma_I^2)$ and $\varepsilon_{II} \sim \mathbf{N}(\mathbf{0}, \sigma_{II}^2)$ are the error terms.

According to the above mentioned specification, the coefficients ρ_I and ρ_{II} represent the degree of transmission in the first and second regimes.

5. Results

The model is estimated through OLS, which allow consistent estimates under regularity conditions (Tsay, 1989). The number of autoregressive lags of our econometric specification has been chosen by minimizing the values of information criteria (AIC, BIC, SIC).

The analysis of the price transmission shows that market prices are correlated and price transmission occurs (Tables in appendix).

As far as cauliflowers are concerned, the coefficients ρ are respectively equal to -0.20, -0.45 and -0.21 for Den Bosch, London and St. Kateljine Waiver, highlighting a sufficient degree of price transmission (Table A.1). The degree of price transmission is larger for tomatos: the values of ρ are respectively equal to -0.43, -0.64, -0.40 and -0.37 for Chateau Renard, Den Bosch, Dublin and London (Table A.2). It should be emphasized that our estimates might be subject to upward bias as we do not take into account transaction costs and the consequent *inactivity band*.

The second step of the analysis dealt with the effects of market crises on price transmission. As regards cauliflowers, we found that price transmission for Den Bosch and Saint Kateljine Waiver occurs only in the first (normal) regime, and not in the second (crisis) regime. On the contrary, price transmission between LaRoja and London occurs under both regimes (Table A.3). The latter case is probably due to the large volume of cauliflowers traded from Spain to the United Kingdom (about 40 percent of total exports to countries in the EU-25). Tomato prices are indeed transmitted both in the first and in the second regimes only for Den Bosch and London. Our findings suggest that market crises are transmitted from Spain to areas of net consumption (*e.g.* Netherlands and United Kingdom). In contrast, the transmission of market crises across production areas (*e.g.* Chateau Renard in France) or towards countries with small import volumes from Spain (*e.g.* Ireland) is absent.

To sum up, our analysis shows that price shocks in the vegetable sector are weakly transmitted during market crises, therefore market crises occurring in production areas tend to be localized and do not affect distant European markets. A plausible explanation would be that the perishability of vegetables and the high unit costs of transport reduce arbitrage opportunities in international markets. Results from the tomato sector also suggest that market crises tend to spread from production areas to net-importer areas: the limited shelf life of tomatoes does not prevent arbitrage in international markets and price adjustments tend to be fast and consistent.

6. Concluding remarks

Due to the sensitivity of supply to climatic variables and to the perishability of many products, the fresh fruit and vegetables sector is often involved in market crises. The relevance of these crises led the European Union to introduce, in the reform of the Common Market Organization for fruits and vegetables, new tools to deal with market crises, such as the so-called security funds., In order to plan crisis management efficiently, however, it is crucial to take into account both the frequency and the spatial dimension of market crises. The latter feature has been addressed in the present paper, through the estimation of a non-linear time series econometric model.

A preliminary analysis on the degree of spatial integration of European fruit and vegetables markets shows a strong price transmission between markets close to production and consumption areas, while the phenomenon is less evident among markets located in the production area. The findings lead to interesting empirical and policy implications: market crises occurring in production areas have negligible effects on market prices of other production areas, implying that market crises determined by a temporary and unexpected surplus in production, tend to be localized. From a policy perspective, the crisis management tools should be planned on the basis of the peculiarities of each production area and its market structure. In other terms, policy-makers should implement the market regulatory tools most efficient at local level.

A further result of our analysis consists in having detected the changes in the mechanisms of price transmission during *market crises*. In particular we found that the occurrence of market crises tends to interrupt price transmission among markets at a distance from each other or located in the same production area. A second implication of our work is therefore that market crises in production areas tend to be localized and intense, lowering local prices for long periods. Under this scenario, the social planner should be aware that market crises in perishable markets would strongly affect producers' welfare. As the perishability of vegetables makes it impossible to adopt stabilization tools such as public or private storage, it seems appropriate to plan policy intervention that compensates producers' losses – e.g. relying on market crises funds might be a feasible approach.

Despite the fact that our results may be weakened by data limitations – in particular our results may be specific for the two products under analysis - we provide relevant insights for policymakers aimed at planning policies for market crisis management.

A further limitation could be due to the definition of market crisis as exogenously determined. The adoption of a simple time series model might bias our results and hide further changes in the price dynamics during market crises. In reality market crises are a smooth process that might be better captured by highly non-linear models (e.g. STVECM).

Future research should take into account recent trends in the European fruit and vegetables sector. The increasing volume of contracts among sellers and buyers and the declining role of the wholesale fruit and vegetable markets in particular, have two important implications: firstly, prices collected on the traditional fruit and vegetable markets are less informative on the relationships between demand and aggregate supply; secondly, it would be important to take into account vertical price transmission.

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ESTIMATION RESULTS

Tab. A.1 - Price transmission in the cauliflower sector –La Roja vs other European markets

	Den Bosch Linear model		London Linear model		St. Kateljine Waiver Linear model	
α	6.06 *	*(2.62)*	5.15 ***	*(0.89)*	15.81***	*(3.76)*
β_1	-0.80	*(0.07)*	0.11 *	*(0.05)*	0.07	*(0.05)*
β_2	-0.11	*(0.07)*			-0.03	*(0.05)*
β_3	0.1 ***	*(0.07)*			-0.11 *	*(0.05)*
ρ	-0.2 ***	*(0.05)*	-0.45 ***	*(0.05)*	-0.21 ***	*(0.04)*

, **, * indicate statistical significance at 10%, 5% and 1% level*

Tab. A.2 - Price transmission in the tomato sector –Almeria vs other European markets

	Chateau Renard Linear model		Den Bosch Linear model		Dublin Linear model		London Linear model	
α	6.89 *	*(4.02)*	22.29 ***	*(7.75)*	13.62***	*(4.19)*	16.37 ***	*(5.81)*
β_1	-0.12	*(0.11)*	0.01	*(0.13)*	0.12	*(0.11)*	0.02	*(0.09)*
β_2	-0.30 ***	*(0.10)*	0.11	*(0.11)*			0.28 ***	*(0.09)*
ρ	-0.43 ***	*(0.13)*	-0.64 ***	*(0.15)*	-0.40 ***	*(0.09)*	-0.37 ***	*(0.09)*

, **, * indicate statistical significance at 10%, 5% and 1% level*

Tab. A.3 - Cauliflower price transmission in *normal* and *market crisis* regimes

	Den Bosch		London		St. Kateljine Waiver	
	Regime I	**Regime II**	**Regime I**	**Regime II**	**Regime I**	**Regime II**
α	6.92 ** *(3.07)*	3.78 *(6.22)*	4.98 *** *(0.95)*	7.03 ** *(3.29)*	5.96 *** *(4.09)*	12.85 *(9.89)*
β_1	-0.80 *(0.07)*	-0.04 *(0.31)*	0.12 ** *(0.05)*	-0.12 *(0.24)*	0.04 *(0.06)*	0.23 *(0.15)*
β_2	-0.12 *(0.07)*	-0.07 *(0.42)*			-0.05 *(0.06)*	-0.02 *(0.17)*
β_3	0.1 *(0.07)*	0.7 *(0.22)*			0.12 * *(0.06)*	0.07 *(0.14)*
ρ	-0.21 *** *(0.05)*	-0.17 *(0.23)*	-0.45 *** *(0.05)*	-0.35 ** *(0.24)*	-0.21 *** *(0.04)*	-0.13 *(0.12)*

, **, * indicate statistical significance at 10%, 5% and 1% level*

Tab. A.4 - Tomato price transmission in *normal* and *market crisis* regimes.

	Chateau Renard		Den Bosch		Dublin		London	
	Regime I	**Regime II**	**Regime I**	**Regime II**	**Regime I**	**Regime II**	**Regime I**	**Regime II**
α	7.57 *(4.65)*	5.15 *(9.46)*	14.45 *** *(9.04)*	37.48 ** *(14.66)*	15.73 *** *(4.71)*	3.52 *(9.91)*	14.33 *** *(6.37)*	27.72 ** *(15.57)*
β_1	-0.10 *(0.13)*	-0.19 *(0.28)*	0.21 *(0.19)*	0.11 *(0.23)*	0.13 *(0.11)*	0.13 *(0.26)*	-0.01 *(0.11)*	0.16 *(0.22)*
β_2	-0.32 *** *(0.12)*	-0.22 *(0.21)*	-0.19 *(0.18)*	-0.03 *(0.17)*			-0.33 *** *(0.10)*	-0.11 *(0.21)*
ρ	0.46 *** *(0.15)*	-0.34 *(0.29)*	0.44 ** *(0.17)*	-1.07 *** *(0.31)*	-0.44 *** *(0.10)*	-0.22 *(0.21)*	-0.33 *** *(0.10)*	-0.57 ** *(0.24)*

, **, * indicate statistical significance at 10%, 5% and 1% level*

THE EFFECTS OF DECOUPLING ON THE COP SECTOR IN ITALY: AN EX-POST PERFORMANCE ANALYSIS

JEL classification: Q18

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Abstract. *One of the main objectives of the 2003 CAP reform was enhancing farm competitiveness by enabling farmers to catch market signals and to adjust their production level and specialisation accordingly.*

The aim of this paper is to evaluate the effects of decoupling on the COP sector in Italy, by comparing some structural and economic indicators, based on ISTAT and FADN data, of a sample of farms before and after the 2003 reform.

The analysis shows an improvement in the economic performance both for farms that kept COP specialisation and for farms that opted for a different specialisation, suggesting that decoupling farm support from production has contributed to a more efficient and market-oriented COP sector in Italy.

Keywords: *CAP, decoupling, Italian FADN, COP sector.*

1. Introduction

The 2003 CAP reform (also known as Fischler reform) has implied a big change in the recent history of the CAP. It can be considered a breaking point with the past and, at the same time, it has paved the way to a new direction for the future. The breaking point is represented by the switch to decoupled payments as the main support measure, a change that started in 1992 with the MacSharry reform and reversed the logic itself of public support in agriculture. At the same time, the reform opened the way to an ongoing process of changes that led to the CAP Health Check of 2009 and to the following debate on the CAP post-2013 (European Commission, 2010).

One of the main goals of the reform was enhancing the competitiveness of farms by enabling farmers to catch market signals and adjust their production level and specialisation accordingly. However, one of the main risks related to the implementation of this reform was an increasing abandonment of the primary activity, especially in marginal and mountain areas, where farms are not as potentially competitive as the ones in the plains.

The aim of this article is to analyse the behaviour of COP (cereal, oilseed and protein crops) farms in Italy before and after the implementation of decoupling, by comparing the estimated results of some structural and economic indicators. The specific aim is to analyse the economic

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performance of a sample of COP farms using data from the Italian Institute of Statistics (ISTAT) and the Italian Farm Accountancy Data Network (FADN).

The following section provides a brief description of the Fischler reform, with particular emphasis on the main changes that have affected the COP sector, together with an overview of the available literature dealing with the effects of decoupling introduced by the 2003 reform. Section 3 addresses the structural dynamics of the COP sector in Italy before and after the decoupling, through an analysis of ISTAT data. The ex-post analysis through FADN data is presented in section 4, where the effects of decoupling for the COP sector in Italy are analysed by observing the economic performance of a constant sub-sample of farms during the 2003-2007 period. Finally, section 5 draws some conclusions from the main results of the analysis.

2. Background

2.1. The Fischler reform

The 2003 CAP reform was implemented mainly to address the following issues: (i) the improvement of EU agricultural competitiveness; (ii) the enhancement of a sustainable model of agriculture, through better market orientation but also through tighter cross-compliance of support to minimum environmental and agronomic standards; (iii) the improvement of rural development measures, with a transfer of resources from the first to the second pillar of the CAP; and (iv) the tailoring of the CAP tools to the needs of Member States and their territories, renewing their role in the decision process regarding CAP implementation.

To achieve these objectives, decoupling, cross-compliance, modulation and flexibility became the keywords of the reform process. In practice, the main feature of the new CAP after the Fischler reform was the fully decoupled Single Payment Scheme (SPS), as reported in EC Regulation 1782/2003. The real revolution of the SPS was the break of any explicit link with production, with support assuming the feature of fully decoupled income integration.

Decoupling was accompanied by a process of devolution in the decision making process, since Member States were enabled to choose, among a predetermined set of measures, those they thought were the better suited for their agriculture.

In Italy the implementation of the reform was quite controversial. Even though decoupling was immediately and fully implemented from the first possible year (2005), Italy opted for the historical model of SPS and decided to defend the status quo in terms of distribution of direct payments between historical receipts, by rejecting any form of regionalisation that would have significantly redistributed the financial resources amongst beneficiaries and territories.

With specific regard to the COP sector, Italy opted for a fully decoupled support, which prevented the sector from retaining part of the payments that were still partially coupled[1]. The reform also modified the previous payments for durum wheat and protein crops: durum wheat producers received a specific quality premium (40 euro/ha), an aid granted only for traditional production areas[2], while protein crops received a specific area payment of 55.57 euro/ha. Moreover, the COP sector also received a specific support within the framework of article 69 of EC

[1] The reform offered the possibility of retaining up to 25% of the payments coupled (according to the older area payments for arable crops) or, alternatively, up to 40% of the durum wheat supplement payment.

[2] In Italy the traditional areas coincide with the Central and Southern administrative Regions: Abruzzo, Basilicata, Calabria, Campania, Lazio, Marche, Molise, Umbria, Apulia, Sardinia, Sicily, Tuscany.

Reg. 1782/2003, equal to 180 euro/ha granted to farmers using quality certified seeds for wheat, durum wheat, maize, or those who apply a biennial rotation[3].

2.2. Literature review

The literature dealing with the effects of decoupling on farm decisions is quite extensive, focusing especially on the effects on the US agricultural sector. At the EU level the assessment of the effects of the single payment scheme introduced by the Fischler reform covers a wide spectrum of issues and methodologies. Some of the works are based on qualitative assessment (Garcia-Alvarez-Coque, 2003; Schroeer, 2004; Swinnen, 2008), while others are of a quantitative nature. Most of them are actually based on ex-ante hypotheses, while the ex-post analyses are less developed.

Ex ante evaluations are more numerous and rather diversified on a geographical base (from single regions to the EU level) as well as on the sector coverage. The results of the impact assessment suffer from the constraints of the underlying hypotheses, the types of model utilised, their different capacity to simulate the policy changes, the projections on price trends, and several other limitations. The assessments, moreover, suffer from the simplification needed to simulate the "degree of decoupling" of the single payment. For example, Gohin (2006) and Balkhausen *et al.* (2007) highlight how the results of the impact assessment of the Fischler reform are affected by the assumptions made about the "degree" of decoupling of Agenda 2000's direct payments, which represents the reference scenario[4].

Based on the assumption that decoupled payments have, in fact, an impact on farm choices, the ex-ante studies analyse the most relevant transmission mechanisms[5]. In this literature the most investigated aspect concerns the effect of decoupled payments on the business risk: if farmers are risk averse and if such aversion decreases with increasing wealth, a decoupled payment could lead to an increase in production, a wealth effect and an insurance effect. The first effect is related to wealth available to farmers and will make them more inclined to take the business risk, the second effect works by reducing the volatility of farm income and, consequently, inducing farmers to assume the risk of producing[6]. As highlighted by Moro and Sckokai (2001) the insurance effect has little impact, while the wealth effect is more pronounced. An in-depth analysis of the wealth effect of direct payments based on historical yields and acreage can be founded in Féménia *et al.* (2010).

Another observed mechanism is related to the ability to obtain credit (see Goodwin and Mishra, 2005): since the decoupled payment represents an increase in wealth and, most importantly, a stable component of total income, farmers could get more credit than they would obtain in the absence of a decoupled payment and therefore could increase production and/or investments.

Another mechanism again, observed as an impact of decoupled payments is related to the decision of continuing or abandoning farming. The decoupled payment, in fact, may induce farms, which in the absence of payment would leave production, to stay in business, slowing down the process of structural adjustment.

[3] The actual payments per hectare granted to farmers under article 69 in the period 2005-2008 have been rather smaller than the theoretical ones (around -70%).

[4] The review in Balkhausen, Banse and Grethe (2007) compares 8 selected simulation models whose common feature is the comprehensive coverage of EU agriculture, with a multi-product structure.

[5] See Moro, Sckokai (2011) for a literature review on the issue of the impact of decoupling on farm choices.

[6] See also OECD (2001) for more details on these two effects.

A further mechanism has to do with the impact of decoupling on the factors of production, increasing the cost of land (and thus reducing the mobility of land) or affecting the availability of family labour on- and off-farm[7].

Not irrelevant, then, is the expectation of future policy changes influenced by the current behaviour of farmers. Also in these cases, studies highlight the existence of a link with direct payments, but again there is little analysis focusing on the EU.

Amongst the ex-ante evaluations, the impact assessment of the EU (European Commission, 2003a) based on the communication of July 2002 (European Commission, 2002) is particularly relevant, since it includes six studies, of which two were released by the European Commission Services and four were assigned to external Institutes and run with the support of the FAPRI, CAPRI, CAPMAT and CAPSIM models. Very important are also the successive simulations of the OECD (2004). Regarding the cereal sector, both studies highlight a reduction in the area planted, following the reform, partially offset by an increase in yields. Overall, the reform had a positive effect on the competitiveness of the sector and agricultural incomes. Subsequently, following the presentation of legislative proposals in January 2003 the European Commission (2003c) has produced an update of the two impact assessments carried out by DG AGRI (European Commission, 2003b), whose results do not differ substantially from those produced a few months earlier in terms of allocation of land among crops.

Much fewer evaluations deal with an ex-post approach, usually focusing on rather limited territories. In Blanco et al. (2008), the ex-post analysis deals with the capacity of Positive Mathematical Programming models (PMP) to forecast a change in cropping patterns in an irrigated area of central Italy as a consequence of the Fischler reform. In Gallerani et al. (2008), the ex-post analysis is based on an empirical survey of 82 farm households in Emilia Romagna where an ex-ante analysis of the decoupling impact was integrated with a specific focus on farmers' investment behaviour. The same authors (Viaggi et al., 2009) have extended their analysis to the investment behaviour of 250 farm households in eight Member States. The study shows that in limited cases where families have reacted to the decoupling, the behaviours were different between the more efficient and more dynamic (decoupling was seen as an opportunity to invest in the farm) and the smaller and poorer (who saw the introduction of the SPS as an opportunity to extend production).

Petrick and Ziel (2009) have investigated, through an econometric ex-post evaluation, the impact of the reform on agricultural employment in three Länder in Germany, pointing out that the 2003 CAP reform did not have desirable effects on job maintenance and on the creation of new jobs in agriculture.

Zhu and Lansink (2010), using FADN data (1995-2004), analysed the impact of decoupling on the technical efficiency of crop farms in three member States (Germany, the Netherlands and Sweden). Their study concludes that the Fischler reform "might not have positive impacts on the technical efficiency in the case study countries, while coupled subsidy might have positive impacts at least in the Netherlands and Sweden". This is because, the (extra) income deriving from the decoupled subsidies might have induced farms to work less efficiently.

In this article, an ex-post analysis was carried out in order to investigate trends in Italian COP farms, in terms of diversification and economic performance, after the Fischler reform in com-

[3] Ciaian, Kancs, Swinnen and Vranken (2010) assess the impact of decoupled payments on land values. Brady, Ekam, Rabinowicz (2010) summarizes the main results of the IDEMA project which aims to assess the impact of the move from the direct payments granted by Agenda 2000 to the decoupled payment of income support of the Fischler reform.

parison with a pre-reform period. In particular, the analysis is based on a constant sub-sample of 6,232 farms included in the FADN dataset between 2003 and 2007. The originality and significance of the work lies in the fact that there are no similar works available for the COP sector in Italy at farm level and covering the entire national territory.

3. The COP sector in Italy and the evolution of CAP support

ISTAT data (Farm Structure Surveys) on COP specialised farms show that during the 2003-2007 period the sector experienced a significant decrease in the number of farms (-24.4%). This was particularly evident in mountainous and hilly areas (Table 1:).

Tab. 1 - Evolution of the number of farms specialised in COP crops in Italy (2003-2007)

Years	Mountains	Hills	Plains	Total
2003	30,889	140,990	143,462	315,340
2005	22,901	111,600	132,627	267,128
2007	15,804	95,756	126,980	238,539
% change 07/03	-48.8	-32.1	-11.5	-24.4
Diff. 07-03	-15,085	-45,235	-16,482	-76,801

Source: own calculations on ISTAT data (Italian Farm Structure Surveys 2003, 2005 and 2007)

Although this decrease involved all the altimetric areas, significant differences were observed in the four different Italian macro-regions: the reduction of specialised farms was particularly significant in the hilly areas of Central Italy, in the plains of North-West Italy (-24.5%) and in all the altimetric areas of Southern Italy (-38.8%). This decrease in specialised farms also involved a significant reduction of the related Utilised Agricultural Area (UAA), with a reduction of almost 840,000 ha (-27.7%) during the 2003-2007 period at national level.

Tab. 2 - Evolution of the UAA (000 ha) of farms specialised in COP crops in Italy (2003-2007)

Years	Mountains	Hills	Plains	Total
2003	267	1,389	1,370	3,026
2005	181	1,029	1,266	2,476
2007	118	875	1,195	2,187
% change 07/03	-55.9	-37.0	-12.8	-27.7
Diff. 07-03	-149	-515	-175	-839

Source: own calculations on ISTAT data (Italian Farm Structure Surveys 2003, 2005 and 2007)

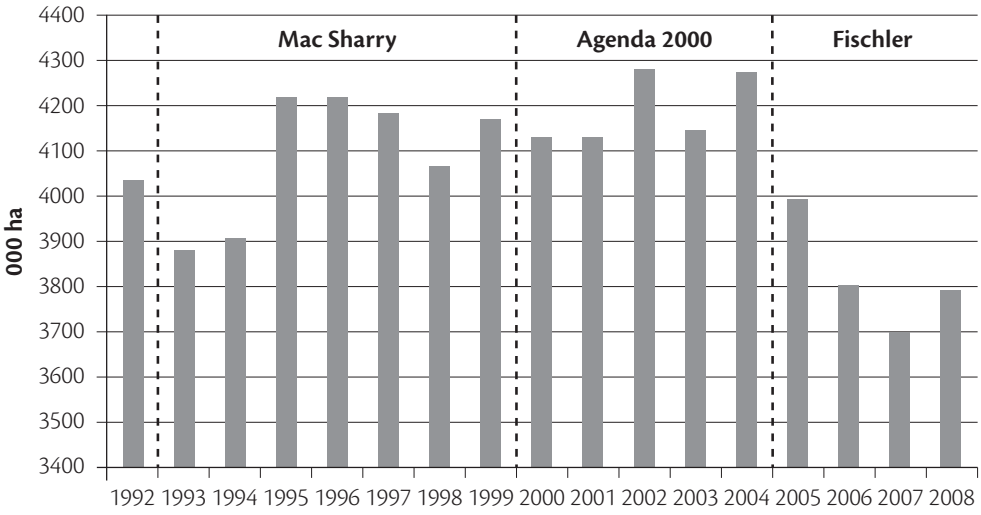
In the context of the 2003 CAP reform, the introduction of decoupling for COP crops may have played a significant role in the structural changes described above. Indeed, the reduction of farm numbers and of UAA was particularly high in the hilly and mountainous areas of Central and Southern Italy, where the transition from coupled aids to the SPS could have decreased the profitability of COP crops. Nevertheless, in order to analyse more in depth the effects of decoupling on the national COP crops sector, it is necessary to observe whether the decoupling has determined some important changes or shocks in relation to the long-terms structural dynamics of the sector. When observing the evolution of the areas with cereals in Italy during the period 1992-2008 (Figure 1), it may be argued that the evolution of the CAP, especially the Common

Market Organisation for cereals, has played a leading role in determining the observed trends for the following reasons:

- the initial reduction of the cereal area after 1992 may be considered a consequence of the implementation of the MacSharry reform, which introduced compulsory set-aside as a tool for limiting EU cereal production. At the same time, in the long term, compensatory payments which were introduced to counterbalance the reduction in institutional prices contributed to maintaining the production of cereals in areas where otherwise cereals would not have been cultivated;
- even though market support mechanisms were further reduced in the context of the 1999 reform (Agenda 2000), in Italy (and in Spain) the regionalization plans for homogeneous areas of yield increased the reference yields for the calculation of payments for cereals, which maintained the incentive to produce cereals[8] (LMC International, 2005);
- the decoupling introduced in the framework of the 2003 CAP reform (implemented in 2005) may have contributed to the significant reduction of the area cultivated under cereals in 2006 and 2007;
- the increase in the cereals area in 2008 is mainly due to market dynamics, especially to the strong increase of prices for wheat and maize in the second half of 2007. In addition, in 2008, compulsory set-aside was abolished.

It may also be argued that, during the decade prior to decoupling, coupled payments in some ways slowed down the structural changes in the sector, since in many cases the production of cereals was not changing according to market signals and coupled payments increased the

Fig. 1 - The evolution of the area under cereals in Italy (1992-2008)



Source: own calculations on ISTAT data (annual data on production, years 1992-2008)

[8] In Italy, the reference yields in the regionalisation plans were differentiated between maize and "other cereals" and between irrigated crops and non-irrigated crops. Usually the highest yields concerned irrigated maize.

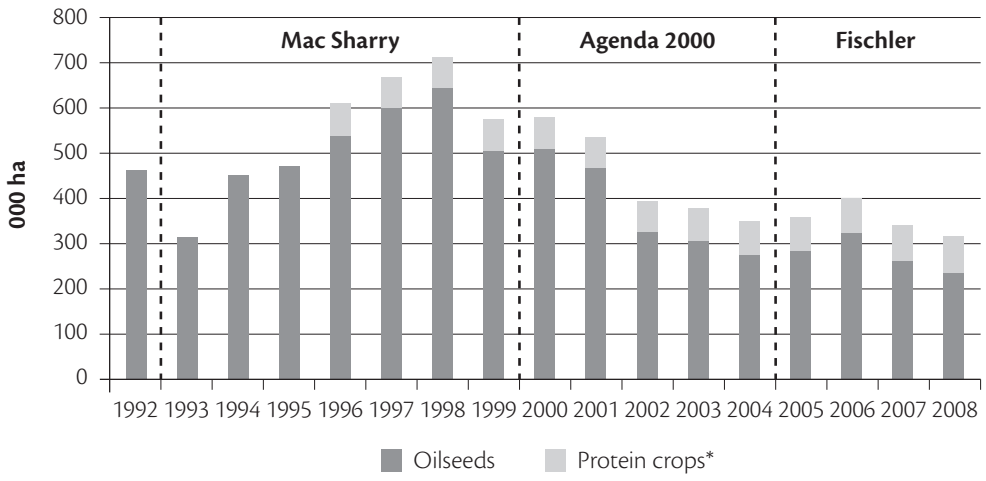
dependence of producers on CAP support (LMC International, 2005). Nevertheless, as already argued, CAP support was not the only factor influencing the observed trends: the significant increase in the area (and production) of cereals in 2008 for example was the result of the combination of agricultural policies and of the market situation (abolition of compulsory set-aside, higher market prices) which seemed to favour the expansions of cereal production (especially soft wheat) in some areas of the country.

During the same observation period (1992-2008) the oilseeds area (soyabean, sunflowers and rapeseed) experienced a trend quite similar to that of the cereals area. On the contrary, protein crops shared an extremely uniform trend, with an average of 70,000 ha during the 1996-2008 period[9] (Fig. 2).

In the case of oilseeds and protein crops, a strong link may be observed between the evolution of CAP support and the cultivated area:

- the partially decoupled payments introduced by the MacSharry reform in 1992 may be considered the main factor affecting the increase in the area cultivated under oilseeds during the period 1993-1999, since the calculation of payments involved higher amounts for oilseeds compared to cereals;
- the trend in cultivated area during the period 1999-2008 reflects exactly the evolution of direct payments. The period 1999-2001 is one of transition towards the downwards alignment of payments between cereals and oilseeds, a process which was completed in 2002, when a strong decrease in the area was observed. Protein crops, on the contrary, maintained an area payment higher than cereals and oilseeds, after Agenda 2000, in order to ensure an adequate profitability of these crops.

Fig. 2 - The evolution of the area under oilseeds and protein crops in Italy (000 ha) (1992-2008)



** Data not available for 1992-1995*
Source: own calculations on ISTAT data (annual data onproduction, years 1992-2008)

[9] Protein crops (peas, field beans, and sweet lupins) represent a very small portion of the COP production in Italy (on average 1.5% of the COP area).

4. An ex-post analysis through FADN data

4.1. Data, methodology and research questions

Italian FADN gathers information on around 15,000 farms[10] using the common European methodology that enables comparative analysis. The FADN data-set includes only "commercial farms", which are farms whose economic size is such as to be considered to have market relationships. 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 family. In practical terms, in order to be classified as commercial, a farm must exceed a minimum economic size[11]. The sample is random and it can be stratified according to the geographical location, the economic dimension and the specialisation (Type of Farming - TF).

In order to follow the behaviour of the same group of farms in the years affected by the Fischler reform, a constant sub-sample of farms was utilised, including 6,232 households spread across all Italian administrative regions (a number significant enough for reaching the research objectives). In more detail, both the diversification of farms production systems and the evolution of the economic performance of COP farms were observed from 2003 to 2007. Data have actually been stratified by geographical areas (according to Italian macro-regions) and by altimetry (mountains, hills, plains). In this way, it was possible to assess the diversified reactions to the reform in different areas of the country.

The type of farming considered in this paper is "specialised COP" (principal TF 13) that included 904 specialised farms in 2003[12]. According to FADN methodology, the farms specialised in COP production (TF 13) comprise all farms where the production of COP crops contributes more than 2/3 of farm's total Standard Gross Margin[13].

Amongst these 904 COP farms, 547 were still in the same TF 13 (specialist COP) in 2007, while 357 abandoned the specialisation migrating towards other TFs.

The paper aims at answering to a specific set of questions through a group of structural and economic indicators, including Farm Size, Gross Output, Net Income and the amount of direct payments per farm. The farm's performance was analysed comparing the structural and economic indicators before the CAP reform (average 2003-04) and after its take off (2007) for farms that kept the specialisation in the COP sector and for those that during the same period changed specialisation.

In more detail, in order to analyse the overall performance of COP farms in Italy in the years immediately after the implementation of the Fischler reforms, we set up a series of more specific questions whose answers will form the bulk of this paper:

1. How many farms, specialised in COP crops in 2003 (TF 13), have changed their specialisation during the 2003-2007 period?
2. What is the economic performance of the farms that kept the COP specialisation (547 farms) in all the period under study?

[10] Since 2008, due to the structural changes in Italian agriculture recorded by the 2005 ISTAT Structural Farm Survey, the Italian FADN sample was reduced to 11,686 farms.

[11] The minimum economic size of FADN farms corresponds to around 4,800 euros of Standard Gross Margin.

[12] FADN farms are classified in 17 principal Types of Farming: specialist cereals, oilseed and protein crops (TF 13) and other 16 TF, as reported in table 3.

[13] The concept of Standard Gross Margin is used to determine the economic size of farms, which is expressed in terms of European Size Units.

3. What is the performance of the farms that opted for a change in the specialisation (357 farms)?
4. What is the result of the comparison between the same set of indicators in 2007 and in 2003 between COP farms and farms that changed specialisation?

A few words of advice are necessary for a better understanding of both the significance and the limitations of the observed results:

- The analysis of the economic performance of farms was carried out at current values. While this may be considered a significant limitation in assessing the impact of the decoupling, it may be argued that, by analysing the performances of farms in a real situation, the observed results are even more interesting and reliable;
- Although the data regard a sub-sample of FADN farms which is not representative of the universe of farms, the observed trends may be useful for understanding the main impacts of the Fischler reform on the COP sector, especially with regard to the economic performance of farms;
- Even though the farms under study are specialised in COP production, they also cultivate other types of crops which may have influenced to some extent their overall economic performance.

4.2. Comparing samples

Although the evolution of CAP support certainly played a leading role in influencing the structural changes, it is also clear that the observed economic performance of COP farms were also influenced by other factors such as: (i) the dynamics of the markets for products[14]; (ii) the evolution of production costs (i.e. cost of fertilizers, machineries etc.); (iii) the evolution of production techniques. For this reason, the analysis was supported by the Student's *t-test*[15]

Among the most commonly used statistical significance tests, Student's *t-test* is used for the comparison of two means. Two-sample *t-tests* for a difference in mean have been applied: a) on two different samples of farms belonging to TF 13 - Specialized COP and TF 14 - General field cropping (unpaired, independent sample), year 2007; b) on the same sample TF 13 that has been considered for year 2003 and 2007 (paired, dependent sample). The Student's *t-test*, allows comparing the means of two samples so the null hypothesis is that the difference is random. Looking at the mean of the variable Net Income in the two larger groups of farms, TF 13 and TF 14, year 2007, the question is whether this difference is due to chance or to other factors. Table 3 (left side), shows that the *t-test* value 2.031 is higher than the tabulated one for P = 0.05. Therefore, the null hypothesis is rejected, meaning that the difference between the means of the observed variable is statistically significant with a probability level of 5%. So there is a probability of less than 5% that the difference is due to chance. In other words, we can say that the difference observed between the two samples belonging to the two different TF is significant at p = 0.04254713.

Investigating farms before and after decoupling aims to establish in particular whether the

[14] It must be highlighted that in case of COP crops, food and non-food markets must be taken into account, since the majority of COP products may also be utilized as feedstuffs in the livestock sector and for the production of biofuels.

[15] The main objective of this test is to compare the mean of some variables within two groups and to determine whether their difference is significant or occurred by chance. Is this difference due to random or to other factors? This test assumes a normal (gaussian) distribution for the populations of random errors, and that there is no significant difference between the standard deviations of both population samples.

difference between means of Net Income is statistically significant, so subjects are considered prior and after the treatment. The results are shown in the right side of table 3. The test cannot determine with certainty that the null hypothesis is true, but can only provide a level of probability and give evidence of the strength with which the data reject the null hypothesis. Relying on results, it is possible to state that there are some factors other than chance that affected the Net Income trend of these samples and which have helped make them different on average. In fact, the *t-test* value 5.762 is higher than the tabulated one for P = 0.05. Therefore, even in this case the null hypothesis is rejected, so there is a probability of less than 5% that the difference is due to a random event (the test result shows that this probability is very close to zero). It seems important to emphasize that the test provides a powerful result especially in the case of the comparison before and after the introduction of decoupling. However, it is not possible to attribute with certainty the outcome of this difference to the agricultural policy, but only give it a high probability.

Tab. 3 - The application of the Student's t-test for TF 13 and TF 14 (2007); TF 13 (2003/2007) P = 0,05

	TF 13	TF 14	TF 13	TF 13
	Net Income 2007	Net Income 2007	Net Income 2003	Net Income 2007
n	n1 = 623	n2 = 173	n1 = 902	n2 = 623
mean	m1 = 54993.79	m2 = 33395.78	m1 = 25313.21	m2 = 54993.79
standard dev.	s1 = 135051.62	s2 = 68549.83	s1 = 62738.63	s2 = 135051.62
t-Student	**2.031**		**5.762**	
degrees of freedom	794		1523	
P (significance level)	0.04254713		0.000000010042933	

Source: own calculations on FADN data

With regard to the impact of subsidies on Net Income, table 4 shows the results for the most represented TF of the FADN sub-sample considered (constant sample).

Tab. 4 - Impact of subsidies on Net Income TF 13, 14, 60, 81

Type of Farming	2005		2007		
	n. of farms	% Subsidies Net Income	n. of farms	% Subsidies Net Income	DELTA
Specialized COP	746	93.4	623	59.2	-36.6
General field cropping	87	79.2	173	46.4	-41.4
Mixed cropping	39	58.6	55	42.9	-26.8
Field crops-grazing livestock	**13**	**69.9**	**26**	**51.3**	**-26.6**
Total	885	84.2	877	54.3	-35.5

Source: own calculations on FADN data

In 2005, after decoupling had been implemented, TF 13, 14, 60 and 81 represent 98% of the sub-sample and they represented the 97% in 2007. The impact of subsidies on Net Income has declined considerably during the period considered, from 84.2% to 54.3% (as a whole). The sector with the most relevant reduction (-41.4%) is the general field cropping, followed by the farms specialized in COP production.

As far as the subsidies are concerned, the *t-test* has been applied looking both at the overall subsidies that farms received (TF 13) and at only those referred to the first Pillar (table 5).

The null hypothesis is rejected again: the t-test value shows that there is a very low probability that the difference between means of subsidies received by farms before and after the implementation of decoupling is due to a random event.

Tab. 5 - Student's t test implementation for TF 13 (2003/2007), P = 0,05

	Total subsidies 2003	Total subsidies 2007	Total subsidies 2003	Total subsidies 2007
n	n1 = 895	n2 = 618	n1 = 897	n2 = 894
mean	m1 = 20083.14	m2 = 32821.44	m1 = 19172.81	m2 = 25976.27
standard dev.	s1 = 32910.98	s2 = 88847.37	s1 = 30764.43	s2 = 74300.70
t-Student	**3.918**		**2.533**	
degrees of freedom	1511		1789	
P(significance level)	0.0000932633		0.011387949	

Source: own calculations on FADN data

4.3. Diversification

With regard to the first research question, related to the diversification of production systems of the farms in the sub-sample, the in- and out- flows of COP farms (principal TF 13) were observed from and to other general TFs (TF 1-8) during the 2003-2007 period. It is worth noting that the number of farms within TF 13 decreased by nine units in the time span considered. In a previous time span (1998-2000) specialised farms in TF 13 increased by 101 units (+14%) This is referred to a constant sample of FADN farms in 1998-2000.. In other words, there seems to be a breaking point in the dynamics of the TF before and after the years under study.

With regard to TF 13, several farms have changed their specialisation in the period under study: 410 specialised moved towards the TF 13, while 419 left the TF 13 towards other types of farming. It may be argued that though farms, in general, kept a rather extensive specialisation, they had the possibility, given the decoupling of direct payments, to shift to other types of production without losing the support and moving towards more remunerative products, following market signals.

Table 6 shows the net outcome of the migration of farms from and towards TF 13 for each year. It highlights that the majority of flows took place in 2005, when 77 farms left the TF13: 50 farms left the COP specialisation but remained within the general TF 1 (general field cropping), while a consistent number of farms (19) moved towards mixed cropping. These data show that during the first year of implementation of Fischler reform, Italian COP farms increased the differentiation of their production systems, since the flows described above involved 53% of the COP farms under study.

Diversification affected not only the crop specialisation, but also the land use within the TF 13, that includes different grain crops (soft and durum wheat, oats, maize and so on). Figure 3 shows that the area covered by durum wheat has decreased, in the period under study, by about 2,000 hectares, with the largest drop recorded in 2005, the first year of the implementation of the 2003 CAP reform.

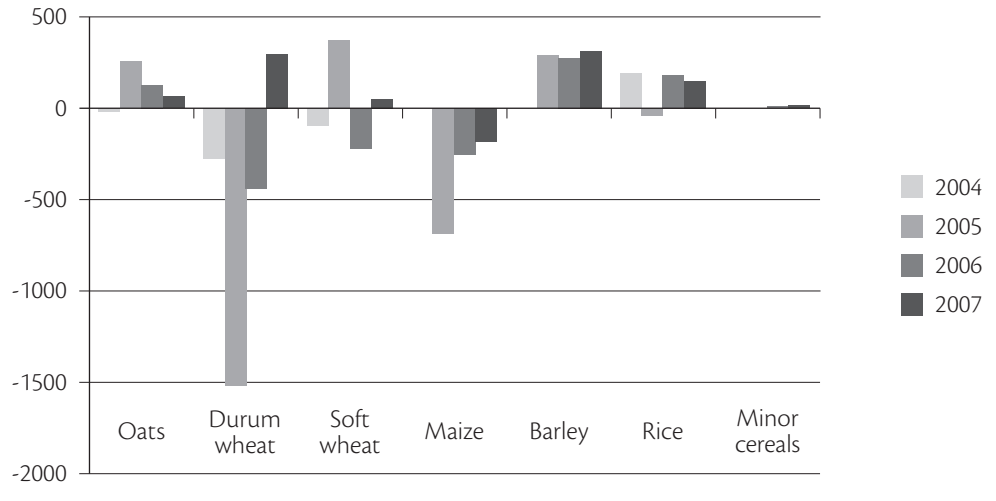
Tab. 6 - Balance of flows of COP farms (TF 13) with respect to the other TF

	Principal type of farming	2004 Nr.	2005 Nr.	2006 Nr.	2007 Nr.	TOTAL Nr.
14	General field cropping	18	-50	25	-3	**-10**
20	Specialist horticulture	-1	1	0	1	**1**
31	Specialist vineyards	0	1	-1	0	**0**
32	Specialist fruit and citrus fruit	0	1	1	-1	**1**
33	Specialist olives	1	-3	-1	1	**-2**
34	Various permanent crops combined	-2	-1	1	-1	**-3**
41	Specialist dairying	-2	1	1	1	**1**
42	Specialist cattle-rearing and fattening	1	0	0	2	**3**
43	Cattle-dairying, rearing and fattening combined	-1	0	1	0	**0**
44	Sheep, goats and other grazing livestock	0	0	1	0	**1**
50	Specialist granivores	0	-2	1	1	**0**
60	Mixed cropping	2	-19	-20	24	**-13**
71	Mixed livestock, mainly grazing livestock	-	-	-	-	**-**
72	Mixed livestock, mainly granivores	0	-1	1	2	**2**
81	Field crops-grazing livestock combined	5	-4	1	5	**7**
82	Various crops and livestock combined	0	-1	1	3	**3**
	TOTAL FARMS	**21**	**-77**	**12**	**35**	**-9**

Source: own calculations on FADN data

This supports the idea that the reform did actually favour a reorientation of production towards products with better market conditions compared to those whose production was mainly justified by the support granted. In this case, the announced reform enhanced the choice of new crops, within the same type of products: the area under "other cereals" has, in fact, increased from 2005 on, with the only exception of maize In the case of soft wheat the increase in area is not as linear as for the other crops..

Fig. 3 - Annual variations of the area under cereals, 2003-2007 (ha)



Source: own calculations on ISTAT data (annual data on production, years 1992-2008)

4.4. The economic performance of farms

Together with the flows of farms in terms of specialisation, as already shown, the paper aimed at observing the economic performance of a constant sub-sample of farms during the period 2003-2007. The second question addresses the issue of the performance of farms that, within this constant sub-sample, kept the specialisation on COP crops over the period under study. Table 7 shows an improvement of the economic indicators for farms in terms of Gross Output and Net Income. It is worth underlining that, in absolute values, the increase in Gross Output is larger than that in Net Income, which is due to an increase in both fixed and variable costs.

In 2007 public support from the first pillar of the CAP decreased both in the mountain and hill areas, while it increased in the plains, resulting in a decrease of the share of direct payments on Net Income everywhere, although more clearly in the mountain areas. Thus, even though public support decreased in the mountains and in the hills, specialised farms have improved their economic performance in the hills and even more so in the mountains. This may be explained by the fact that these are the farms that have chosen to maintain their specialisation, which was justified by the related overall good economic results.

Tab. 7 - The economic indicators of the same 547 COP farms in 2003-04 and in 2007

		Avg. 2003-04			2007			% change 2007/2003-04		
		Mountains	Hills	Plains	Mountains	Hills	Plains	Mountains	Hills	Plains
Farms	Nr.	28	220	299	28	220	299			
Gross output per farm	€	27,740	58,594	116,956	39,671	82,155	158,925	43.0	40.2	35.9
Farm Net Income	€	7,895	18,678	41,388	18,073	37,348	70,936	128.9	100.0	71.4
Direct payments per farm	€	9,430	20,369	34,499	8,494	19,102	40,578	-9.9	-6.2	17.6
Direct payments/Farm net Income	%	119.4	109.0	83.3	47.0	51.1	57.2	-60.6	-53.1	-31.4

Source: own calculations on FADN data

Meanwhile, what happened to the farms that did change their specialisation? When considering the third question, we observed the trend of the same indicators for the 357 farms that during the same period abandoned the TF 13 (table 8).

Tab. 8 - The economic indicators of the 357 farms leaving TF 13 in 2003 and in 2007

		2003			2007			% change 2007/2003		
		Mountains	Hills	Plains	Mountains	Hills	Plains	Mountains	Hills	Plains
Farms	Nr.	47	211	99	47	211	99			
Gross output per farm	€	51,683	58,054	60,942	65,761	86,269	96,551	27.2	48.6	58,4
Farm Net Income	€	14,589	19,980	20,241	23,237	45,150	39,069	59.3	125,9	93.0
Direct payments per farm	€	12,230	17,705	12,697	9,871	15,454	15,159	-19,3	-12.7	19.4
Direct payments/Farm net Income	%	83.8	88.6	62.7	41.4	34.3	50,1	-50.6	-61.3	-20.1

Source: own calculations on FADN data

In this case, all the indicators show an improvement, the structural ones at a slower pace, more noticeable in the case of the economic indicators. Direct payments only show a decrease in the mountains and in the hills, while on the plains an increase of 19.4% is recorded. Both Gross Output and Farm Net Income show an increase, especially in the hills and plains areas. On the

other hand, the underlying hypothesis in this case is that these farms, being free from any constraint in terms of what to grow and in what amounts, have opted for other products according to market signals, with possible positive agronomic effects also on soil use.

Data in table 8 show that the share of direct payments on Farm Net Income decreases everywhere, even though in a more limited way in the plains. This confirms that farms reduced their dependence on direct payments (especially in the mountains and hills). Farms in hilly areas have been particularly able to better their economic performances thanks to a change in specialisation. It is worth underlining, in fact, that it is in the hills that the highest reduction of area sown to durum wheat was recorded (-1,583 hectares in 2007 compared to 2003).

All in all, data show that the choice of moving away from specialisation in the COP sector for these farms was definitely positive, especially in the more marginal areas. It is also worth remembering that the process of income diversification enhanced by the CAP has had a positive effect on farms, and especially on those in marginal and more remote areas (see Wilson, 2007 and 2008). To address the final question, we first compared the performances of farms that have kept the COP specialisation with those that have not in 2007, then we look at the starting point, comparing the same group of farms in 2003 (tables 9 and 10). In the first case, results are different according to the altimetry (table 9): for farms located in hilly and mountain areas the economic results in 2007 are better for those farms that have modified their specialisation, even with a reduced share of support per farm (as in the hills); on the contrary, for farms located in the plains, results are better for COP farms than for those that changed specialisation.

Tab. 9 - Comparison between COP farms and farms leaving FT 13 in 2007

		COP farms			Farms leaving FT 13			Difference % Farms leaving FT 13/COP farms		
		Mountains	Hills	Plains	Mountains	Hills	Plains	Mountains	Hills	Plains
Farms	Nr.	28	220	299	47	211	99			
Gross output per farm	€	39,671	82,155	158,925	65,761	86,269	96,551	65.8	5.0	-39.2
Farm Net Income	€	18,073	37,348	70,936	23,237	45,150	39,069	28.6	20.9	-49.1
Direct payments per farm	€	8,494	19,102	40,578	9,871	15,45	15,159	16.2	-19.1	-62.6
Direct payments/Farm net Income	%	47.0	51.1	57.2	41.4	34.3	50.1	-11.9	-32.9	-12.4

Source: own calculations on FADN data

The share of public support on Farm Net Income in the case of the former COP specialised farms is definitely smaller than for those still specialised in COP, and in any case well below the value featured by the sector in 2003-04. Looking at the comparison in 2003 for the same farms, we can get a clearer picture of the situation before the reform and we can check if the differences found in 2007 were already there in pre-reform years (table 10). The best economic results were observed for COP farms, confirming the hypothesis that decoupling pushed the least efficient farms to change their specialisation in order to meet market requirements and to rethink the farm production systems and production plans.

Tab. 10 - Comparison between COP farms and farms leaving FT 13 in 2003										
		COP farms			Farms leaving FT 13			Difference % Farms leaving FT 13/COP farms		
		Mountains	Hills	Plains	Mountains	Hills	Plains	Mountains	Hills	Plains
Farms	Nr.	28	220	299	47	211	99			
Gross output per farm	€	27,740	58,594	116,956	51,683	58,054	60,942	30.3	-29.3	-61.7
Farm Net Income	€	7,895	18,678	41,388	14,589	19,980	20,241	-19.3	-46.5	-71.5
Direct payments per farm	€	9,430	20,369	34,499	12,230	17,705	12,697	44.0	-7.3	-68.7
Direct payments/Farm net Income	%	119.4	109.0	83.3	83.8	88.6	62.7	78.4	73.3	9.7

Source: own calculations on FADN data

5. Concluding Remarks

The analysis presented in this paper clearly reveals the positive impacts of decoupling on the COP crops sector in Italy, especially with regard to its main objective, which is increasing the market orientation of farms. These results confirm the conclusion reached by the impact assessment carried out by the European Commission in the aftermath the publication of the proposals.

Data show that after the Fischler reform a significant number of COP farms changed their specialisation. Together with the reduction of COP farms – which was particularly evident in mountain areas – an increase of the average UAA was also observed, indicating that this de-specialisation involved to a greater extent smaller and more marginal farms. The specialised COP farms showed a significant reduction in the area invested in durum wheat, particularly in 2005, that is the first year of the implementation of the Fischler reform, as reaction to the possibility of following market signals in production choices.

The analysis of the economic performance of farms confirmed that the change of specialisation concerned the less efficient farms with the worst economic results, resulting in a general improvement of the performance of the COP sector, both in terms of Gross Output and of Farm Net Income. It is also worth mentioning that, during the 2003-2007 period, farms leaving the COP sector also improved their economic performance. This could be linked to the evolution of the type of CAP support: for many farms coupled support had become a constraint rather than an opportunity, while the shift to a decoupled system of support gave the COP farms the possibility of re-orienting production plans, at the same time receiving the support. This could have involved a transition towards more profitable products or towards the production of non-agricultural services.

The positive effects of decoupling were also confirmed by other evidence: while in 2003 the economic performance of farms leaving the COP sector was worse than those of farms that kept the COP specialisation, in 2007 an improvement of all the economic indicators was generally observed. On the other hand, farms that kept the same COP specialisation through the years under study improved their economic performance. This result may be considered an effect of the re-organisation and structural changes of the COP sector, since it was reached in a general context of reduction of public support and of a slow declining trend in prices.

This evaluation may also be useful for a better understanding of the structural dynamics of the sector which were observed through the analysis of ISTAT data: the reduction in the number of farms and of the related UAA may be considered closely related to the evolution of the policy

framework. From this perspective, decoupling was certainly a key issue, since it de-linked the production of COPs from public support, by enhancing the ongoing process of specialisation and concentration on larger and more market-oriented farms.

To conclude, the analysis suggests rather clearly that the main goal of decoupling, which is getting farms more oriented towards market needs, has been basically met in the COP sector in Italy. Indeed, data shows that, because of its structural and market features, commercial farms in this sector were able to modify their strategies according to the needs of the market and that decoupling was a positive evolution in CAP support in increasing this capacity. At the same time, data also shows that first pillar payments have continued to play a central role in the overall market performance of the sector, even after the decoupling, a factor that will have to be taken into great consideration in the debate on the CAP post-2013, since the new EU agricultural policy could involve a significant reduction in the budget for the COP sector and, above all, a consistent redistribution of financial resources amongst Member States and territories.

However, additional research is needed both for understanding in depth the effect of decoupling on the agricultural sector, extending the analysis to other sectors and to other countries, and for analysing the potential impact of a reduction of support on farm strategies as result of the next reform of the CAP.

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THE ECONOMIC SUSTAINABILITY OF AGRI-ENVIRONMENTAL POLICIES: THE APPLICATION OF REG. (EC) N. 1095/2007 IN THE RICE SECTOR

JEL classification: C61, Q18, R14

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Abstract. *Positive Mathematical Programming represents a useful tool for agri-environmental policy planning. This paper estimates the consequences of the application of the Regulation (EC) 1095/2007, relating to the ban on the use of the active agent Tricyclazole, which is normally employed to combat rice blast. The main objective is to quantify the variation in farmers' revenues and the change in use of land, in response to variations in the yield of rice produced and its production costs. The research has been focussed on the rice-farming sector in the Parco Agricolo Sud Milano (PASM), a sub-urban agricultural area of the regional capital of Lombardy that, since 1990, has been a protected area and has been under the management of the Province of Milan. The data for the case study was collected in situ and combined with the data from the Agriculture Databank of Lombardy Region considering a sample of farms representative of the rice-farming sector in the PASM. The study present the results of simulations of ten different sce-narios with a view to evaluating the overall sustainability of the cautionary measures introduced.*

Keywords: *Economic Sustainability, Policy Planning, Positive Mathematical Programming, Rice Sector*

1. Introduction

The paper examines the possible effect of a ban on the use of the active agent Tricyclazole in agriculture as foreseen by the Regulation (EC) 1095/2007, in force since the beginning of 2009, in a production area South of Milan. Tricyclazole is a molecule contained in a fungicide utilized for the control of rice blast, an endemic disease which attacks rice, caused by *Pyricularia grisea*. Originally from Asia, it is now widespread and present in 85 countries worldwide (Agarwal *et al.*, 1989; Rao, 1994) and is especially rife in intensive cultivation systems in temperate zones (Kuyek, 2000), as in the zone of the Agricultural Park of South Milan[1] (Parco Agricolo Sud Milano - PASM) in which the research has been carried out.

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[1] Established in 1990, the PASM is a public institution under the Province of Milan with the objective of preserving the economic, environmental and social functions of the rural economy in the area of South Milan (see also Figure 1).

The study is based on the concept of sustainability of production. In general, an efficient economy can be considered sustainable if it fulfills the so-called *three "Es",* that is to say, it guarantees *a prosperous economy, a quality environment and social equity*. There are at least two reasons why such conditions can only be guaranteed by institutional intervention: i) the principle of trade-off between efficiency and equity where a highly profitable economy pays the social costs of a high environmental impact and a certain degree of pollution; ii) the lack of remuneration (positive or negative) for the externalities (positive or negative) produced by agricultural activities.

In a situation that is often worsened by a high degree of asymmetry in information between producers to consumers, the farmers' decisions, aimed at maximizing profit, will probably focus on efficiency, considering equity as an accessorial part of production. For this reason, incentivizing/de-incentivizing or compulsory/prohibitive policies are necessary to guide farmers' behavior towards increased equity.

The use of chemical in order to achieve elevated yields and quality standards probably represents the most common and controversial example of negative agricultural externality. In this sense, Wilson and Tisdell (2001) note how, even given a panorama of increasing costs over the long term on an environmental, health and/or economic scale, farmers will continue to use pesticides and herbicides as long as a positive net return is assured short term. Institutions should therefore discourage or ban their use; but, how can we simultaneously safeguard the ecosystem and the consumer, provide adequate revenues to the farmers and guarantee a certain level of supply of agricultural commodities - that is, in this case: what is the impact on the production sector, where it is necessary to ban the use of a specific chemical?

We try to give an answer to the second question through the application of a Positive Mathematical Programming model using the data collected from a sample of farms. In the next section of the paper, a brief bibliographical review of useful articles is presented in order to focalize the argument, from the point of view both of methodology and of economic application. In section 3, the specific case study and objectives of the research are introduced, the methodology of which is presented in section 4. The main results of the document are outlined in section 5, while the last section of the paper proposes some considerations for future policy planning.

2. Background

Over the last decades, the concept of policy-making assisted by economic impact assessment has increasingly gained ground. In the European Union these have been the years of CAP reform and new definition of agri-environmental and food safety policy frameworks, so that agricultural economic research has greatly benefited from the necessity of analysing results of policy-making by means of *ex-ante* forecast models and *ex-post* evaluations.

Among the methodologies most frequently applied,, mathematical programming (MP) models have gained great popularity since Howitt (1995) proposed a positive interpretation to the maximization problem. Positive Mathematical Programming (PMP), indeed, provides a more credible simulation and eliminates the stop-start answers of the models from the Sixties and Seventies (Heckelei and Britz, 2000) by simulating the realistic options that are available to the farmers, while maintaining the flexibility of the mathematical models, potentially capable of representing any link between agricultural production variables in play, whether economic, biophysical or technical.

Buysse *et al.*. (2007) note that the very establishment of the problem of optimum production proposed by MP has guaranteed its success as a tool for describing the effect of the different agri-environmental policy on a particular farm. In fact, it allows the researcher to introduce variations in price (owing to taxes, subsidies or price support policies), in the use of input (e.g. Nitrates Directive) or in level of output (e.g. milk quota), or to forecast the results of strategies that impose determined standards (e.g. command-and-control policy). In particular, Schader *et al.*. (2008) raise the example of the success of the PMP models and profile a total picture of the main applications proposed over the last decade. Without going into specific detail on the different models (see Schader *et al.*., 2008 and its references), PMP methodology has been applied mostly on a national scale, showing variations on a regional scale. In this light, the current study presents a different approach, proposing the use of the PMP in a specific production sector in a well-defined area.

3. Objectives

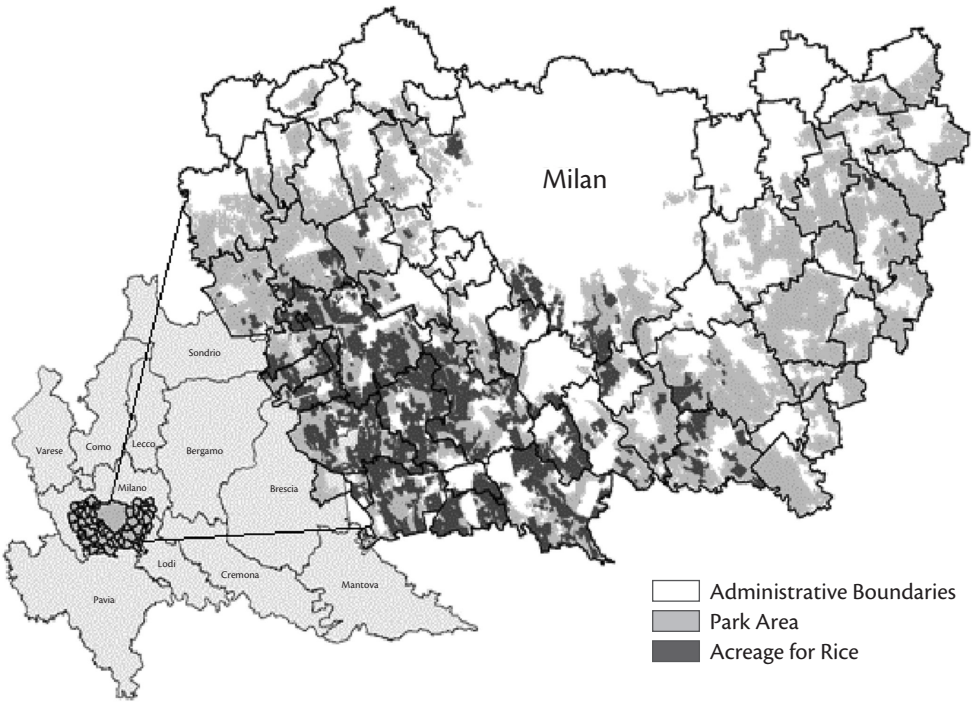
According to ISTAT, in 2008 about 1.4 million tons of rice were produced in Italy, which accounts for less than 0.3% of entire world production. It would seem to be a sector of marginal economic importance, whereas on the contrary it represents about 43% of all the rice produced in the European Community and considering that 93.5% of national production approximately comes from 6 provinces of Lombardy and Piedmont, it is obvious that the concentration of production makes rice an important economic resource in certain rural areas. As far as the province of Milan is concerned, more than two thirds of the surface area occupied by rice crops can be found in the PASM (*Table 1* and *Figure 1*). The area, which covers one third of the province and is characterized by the presence of 576 farms, represents an emblematic picture of the possibility (and necessity) for contact between densely populated metropolitan areas, like Milan, and agricultural land that lies around the outskirts.

Tab. 1 - Rice farms in the Parco Agricolo Sud Milano compared to the rice crops cultivated in Lombardy and Italy (year of reference 2008)

Rice production		PASM	Province of Milan	Lombardy	Italy
Harvested area	Ha	8,500	12,233	93,382	224,196
Production	t	51,000	64,965	589,699	1,388,927
Farms	num	107	216	1,973	4,501
Yields	**t/Ha**	**6.0**	**5.3**	**6.3**	**6.2**
Average farm size	**Ha**	**79.4**	**56.6**	**47.3**	**49.8**

Data: Istat, Italian Rice Institute and the Province of Milan.

Fig. 1 - Rice area in the PASM



The management of diverging objectives such as the protection of agricultural activity and the necessity for the growth of towns poses a number of problems for policy makers. Given the concentration of the rice-farming sector in this area, a simulation was carried out on the possible effects of the abolition of the use of tricyclazole against rice blast. The former is the only efficient product to combat the disease once it has begun to spread (Ghazanfar *et al.*, 2009; Moletti *et al.*, 1998). A ban on the product could lead to many situations; i) due to the lack of any restraint on the pathogen through the use of tricyclazole, and depending on climatic conditions and agronomic choices, it is estimated that up to 10-30% of the yield could be lost (Giudici *et al.*., 2008); ii) secondly, the lowering of chemical input, lowers, in turn, costs of production. The objective of the study is to estimate the combined effect of these changes on the farms in the sector, and forecast the trend in revenues and change in crop patterns.

4. Data and methodology

4.1. The model

PMP has been widely adopted in simulations of alternative policy and market scenarios through the use of technical and micro-economic data relative to the farms of a certain region or specific sector. The methodology has three phases:

1) For *n* sample farms, the first phase consists of setting up *n* linear programming models that resolve the function:

$$\max GM = \mathbf{p}_n\mathbf{x}_n - \mathbf{c}_n\mathbf{x}_n;$$

where *GM* is the gross margin of the farm, $\mathbf{x}_n$ is the vector of the quantity produced, to which the price vector $\mathbf{p}_n$ and the specific variable unit cost vector $\mathbf{c}_n$ are associated. The objective function is tied to a structural constraint $\mathbf{A}_n\mathbf{x}_n \leq \mathbf{b}_n$, and a calibration constraint, $\mathbf{x}_{nj} \leq \mathbf{x}_{Rnj}$, for $\mathbf{x}_{Rnj} > \mathbf{0}$ that allows the imputation of data referring to one year as a basis for future scenarios.

2) Assuming that the price of the input is fixed, in the second phase a function for the global cost of all the farms in the sample panel is formulated. It is assumed to be squared with respect to the produced quantities: $\mathbf{Qx}_R = (\boldsymbol{\lambda}_n + \mathbf{c}_n)$, where $\boldsymbol{\lambda}_n$ is the vector of differential marginal costs estimated in the first phase, Qx_R the symmetrical matrix, positive and semi-defined, and as such follows the following form:

$$\mathbf{C}(\mathbf{x}_R) = \int_0^{Xr} (\boldsymbol{\lambda}_n + \mathbf{c}_n)' \, d\mathbf{x} = \mathbf{x}'_R\mathbf{Q}\mathbf{x}_R/2;$$

with a function of associated marginal costs, of the type:

$$cm(\mathbf{x}) \equiv \boldsymbol{\lambda} + \mathbf{c} = \mathbf{Q}\mathbf{x}_R$$

What distinguishes the *n-th* farm from the remainder of the sample panel is a certain deviation ε_n from the function of border costs. It is supposed that every farm presents a shift from the function of optimum cost owing to farmer choices, so that the function of marginal costs for the macro-farm becomes:

$$cm(\mathbf{x}) \equiv \boldsymbol{\lambda} + \mathbf{c} = \mathbf{Q}\mathbf{x}_{Rn} + \boldsymbol{\varepsilon}_n,$$

Such an approach allows us to consider the process of auto-selection made by farmers, that is, the relationship between their choices and the spectrum of choice presented relative to the variation in the type of crops present on the territory in question.

3) In the third phase of the model, the function of estimated marginal cost is applied to *n* non-linear programming models that reproduce the primary and secondary function of the linear programming model in the first phase.

For every farm, it is necessary to draft a quadratic programming model that is:

$$\max GM = \mathbf{p}'\mathbf{x}_n - (\mathbf{x}'_n\mathbf{Q}\mathbf{x}_n/2 - \boldsymbol{\varepsilon}_n\mathbf{x}_n);$$

The solution obtained from the model reproduces the destination of use and the real production levels of the *n-th* farm for each farm in the panel sample and for the period of reference. Compared to the base model, some limitations have been included relative to subsidies received by farmers under the Mid-Term Reform of the European Community. The current regime of payment for the rice-farming sector has been taken into consideration, which foresees, up to 2013, decoupled aid to whoever has grown rice in the three years of reference, equivalent to 616.08 euro/ha, to which a coupled aid of 453 euro/ha is added, for whoever continues to cultivate rice.

The objective function is as follows:

$$\max ML = \mathbf{p}'\mathbf{x}_n + \mathbf{s}'\mathbf{h}\mathbf{x}_n + \mathbf{eland}*\mathbf{vent} - (\mathbf{x}'_n\mathbf{Q}\mathbf{x}_n/2 - \boldsymbol{\varepsilon}_n\mathbf{x}_n);$$

subject to:

$$\mathbf{A}_n\mathbf{x}_n \leq \mathbf{b}_n \text{ con } \mathbf{x}_n \geq \mathbf{0};$$
$$\mathbf{A}_j\mathbf{x}_j - \mathbf{h}\mathbf{x}_j = \mathbf{0} \quad \text{“}j = 1,\ldots,J;$$
$$eland \leq nent;$$

where **vent** = tpay/nent; being tpay = total payment and nent = number of titles; and $eland + elands \leq hx_j$.

The constraint $eland \leq nent$ indicates that the decoupled grant cannot be more than the maximum grant, while the constraint $eland + elands \leq hx_j$ specifies that the sum of land

admissible and non-admissible for the decoupled grant cannot be more than the total surface area employed by the farm. With this structure, the objective function means a payment that is partly coupled and partly decoupled for rice crops and totally decoupled for other crops.
To simulate the change in production yield for the rice, technical coefficients were used, represented by $\mathbf{A}_n$. In particular, with $\mathbf{s}_{Rnj}$, defined as the vector that represents the use of the land factor of the *n-th* farm, the matrix for the technical coefficients is defined as $\mathbf{A}_n = [\mathbf{a}_{nij}]$, where $\mathbf{a}_{nij} = \mathbf{s}_{Rnj} / \mathbf{x}_{Rnj}$. To simulate the variation in costs of rice production, given by the absence of the purchase and use of fungicide, a parameterization of the costs of production was effected equivalent to that usually applied to sale prices. To do this it is necessary to act on the linear component of production costs and not on the squared component, altering the vector $\boldsymbol{\varepsilon}_n$ of the deviation factors, that expresses the distance each company is from the border function. .

4.2. The Study area and the sample

Model data were collected through direct interviews and the Agriculture Databank of Lombardy Region. Out of the 576 farms effectively operating on the territory of the PASM, 514 were selected for the availability of information inherent to use of land, from which the representative panel of rice farms was selected through quota-sampling, using the following steps: i) classification of the farms in the PASM based on the Type of Farming (TF) and the European Size Units (ESU); ii) further sub-division of the population based on the territorial location of the farm with definition of four different production sectors; iii) calculation of the percentage weighting of the farming category (TF; ESU) in each territorial sector; iv) quantitative determination of the quota, aimed at obtaining a sample panel of rice farms that shows, for each class identified, a percentage weighting as similar as possible to the basic population (*Table 2* and *Table 3*).

Tab. 2 - Distribution of the farms in the PASM on the basis of TF and ESU

ESU - TF	Mixed	Cereal and rice	Cereal no rice	Livest. spec.	Livest. spec.	Total
1-8	17 *3.3%*	**0** ***0.0%***	27 *5.3%*	4 *0.8%*	18 *3.5%*	66 *12.8%*
8-16	9 *1.8%*	**1** ***0.2%***	33 *6.4%*	3 *0.6%*	4 *0.8%*	50 *9.7%*
16-40	15 *2.9%*	**23** ***4.5%***	39 *7.6%*	2 *0.4%*	7 *1.4%*	86 *16.7%*
40-100	9 *1.8%*	**41** ***8.0%***	42 *8.2%*	2 *0.4%*	13 *2.5%*	107 *20.8%*
>100	7 *1.4%*	**42** ***8.2%***	27 *5.3%*	33 *6.4%*	96 *18.7%*	205 *39.9%*
Total	57 *11.1%*	**107** ***20.8%***	168 *32.7%*	44 *8.6%*	138 *26.8%*	514 *100.0%*

Source: our calculations on sample data.

Tab. 3 - Distribution of the sample rice farms in the PASM										
Cereal and rice	**Class ESU**									
	8-16	**%**	**16-40**	**%**	**40-100**	**%**	**> 100**	**%**	**Total**	**%**
Sector 1 *Quota*			4 *1*	3.7% *7.7%*	2	1.9%	3	2.8%	9 *1*	8.4% *7.7%*
Sector 2 *Quota*	1 *1*	0.9% *7.7%*	18 *2*	16.8% *15.4%*	32 *3*	29.9% *23.1%*	35 *4*	32.7% *30.8%*	86 *10*	80.3% *76.2%*
Sector 3 *Quota*			1	0.9%	7	6.5% *7.7%*	3	2.8% *7.7%*	11	10.3% *15.4%*
Sector 4 *Quota*							1	0.9%	1	0.9%
Total *Quota*	1 *1*	0.9% *7.7%*	23 *3*	21.5% *23.1%*	41 *4*	38.3% *30.8%*	42 *5*	39.2% *38.5%*	107 *13*	100.00% *100.00%*

Source: our calculations on sample data.

4.3. Data sources and input variables for input to the model

Information from the Regional Agricultural Databank, regarding the use of land in the PASM territory, has allowed the identification of some farmers whose farms fit the technical and economic characteristics required for the sample panel and are also correctly positioned to be considered in the panel. The drafting of the tabulation model for the recording of data was carried out beforehand using Farm Accountancy Data Network (FADN) methods for the revenues and costs of agricultural firms in the European Economic Community.

For each farm, a series of data was gathered and recorded; the various items examined and their content enabled the calculation of the profit returned by production and its specific costs[2]. In terms of chemical products, the use of fungicide was closely examined and more especially, those products that are efficient combatants against the spread of *Pyricularia grisea*. Information on the quantity used, its distribution and the total costs were obtained so that an estimate of the costs per hectare and ton of product could be made. Lastly, a calculation of the percentage incidence for each active agent used for the control of rice blast was made, in order to collect all the input variables for the model (*Table 4*).

Tab. 4 - Standard model input variables and simulation input			
Input variables	**Year**	**Unit**	**Source**
Land use	2009	ha	SIARL/Farmers
Sold and re-used output	2009	t	Farmers
Variable costs for sold and re-used products	2009	€/t	Farmers
Prices of products sold	2009	€/t	Farmers
Subsidies and payments	2009	€/t	SIARL/Farmers
Average cost variation of tricyclazole application	2009	%	Farmers
Average cost variation of azoxystrobin application	2009	%	Farmers
Rice yield variations	2008	%	Giudici et al..

Source: personal analysis.

[2] Among the items for costs relative to the activity of the business, only variable costs have been considered, in particular: seeds, fertilizers, chemical products, third party activity, crop insurance and fuel and oil consumption.

The substance which is banned through the introduction of the law Reg. (EC) 1095/2007 is the active agent tricyclazole, which is used to fight the delayed outbreak of *Pyricularia grisea*, a primary cause of rice blast. Another active agent, azoxystrobin, is efficient in the prevention phase, but in cases where the fungal disease attacks the stem and cob of the rice plant, tricyclazole is the only efficient remedy against its spreading.

Another alternative is to employ agricultural techniques such as: the management of composts and fertilizers, most especially K-N; the use of strains that are more resistant and seeds that are healthy and robust; early sewing of seeds and a low level density of seeding. These technical measures can prove fundamental for avoiding the spread of rice blast, which can lead to lower than average yields and losses of up to 30% (Giudici *et al.*., 2008).

5. Results

From the data collected during our survey, it can be seen that 85% of rice farmers use tricyclazole to combat delayed outbreaks of the disease, and of these, 41% use azoxystrobin as well. Of the remaining 15% of rice farmers, 8% use absolutely no active agent, while 7% utilize only azoxystrobin.

The introduction of the legislation was simulated, by modifying the production yields and costs of production based on the choices made by farmers. We supposed they could adopt different strategies: simply eliminate the use of fungicides; replace tricyclazole with azoxystrobin; modify their agricultural techniques; or combine all three. Since it is impossible to simulate agronomic changes, simulations are based only on the variations of costs and hypothetical yields, should they cease to use tricyclazole and use azoxystrobin instead. From interviews with the persons concerned, it can be seen that 28% of farmers who use only tricyclazole would not use anything else; in this case, it is possible to forecast the reduction in production costs for each ton of rice, given the absence of purchase of fungicide. It was estimated that for those farmers who would replace tricyclazole with other active agents, the costs in production do not change significantly. For those who used both tricyclazole and azoxystrobin at the same time, on the same cultivated land, the total reduction in production costs was made based on an absence of purchases of tricyclazole.

Two possible hypotheses were considered regarding production costs, as shown in *table 5*. The first demonstrates, in the case of the 85% of rice farmers who used tricyclazole in the past, a reduction of 4.71% on the costs of production, while the costs pertaining to the remaining 15% of rice farmers have remained unchanged. The average percentage incidence of the cost of using tricyclazole on the total production cost of rice is 4.71%. In the second hypothesis, once again taking the figure of 85% of rice farmers as the point of reference, production costs are cut by 2.27%; this figure is the average percentage value of cost reduction compared to the total production cost if tricyclazole is replaced by azoxystrobin.

Tab. 5 - Scheme of scenarios examined		
Scenarios	**Cost hypothesis**	**Reduction of rice yield**
SIM_01	4,71% decrease	10%
SIM_02	4,71% decrease	15%
SIM_03	4,71% decrease	20%
SIM_04	4,71% decrease	25%
SIM_05	4,71% decrease	30%
SIM_06	2,27% decrease	10%
SIM_07	2,27% decrease	15%
SIM_08	2,27% decrease	20%
SIM_09	2,27% decrease	25%
SIM_10	2,27% decrease	30%

Source: personal analysis.

For each of the two hypotheses, variation in yield with losses from 10 to 30% were simulated, and simulations performed 10 times in total. In *table 6*, the results of the simulations are listed, showing the estimated trends in farm's average production and gross revenues. If tricyclazole is not replaced and the reduction of the yield is slight, that is, equivalent to 10% (SIM_01), the gross revenues of the farmer are increased. It is plausible to assume that if an alternative product is not used in place of tricyclazole, the yield is reduced to a greater degree, but in (SIM_01) it is interesting to note that the cost incidence of tricyclazole is approximately equal to 10% of total production. In the case of higher production losses, (SIM_04 and SIM_05), the gross revenues can decrease by 4-5%. This is perhaps the most realistic simulation, in the short term, for those farmers who do not intend to replace tricyclazole and for whom a better understanding of the changes that arise from not using the active agent follows a learning curve that they will undertake over the course of the several years.

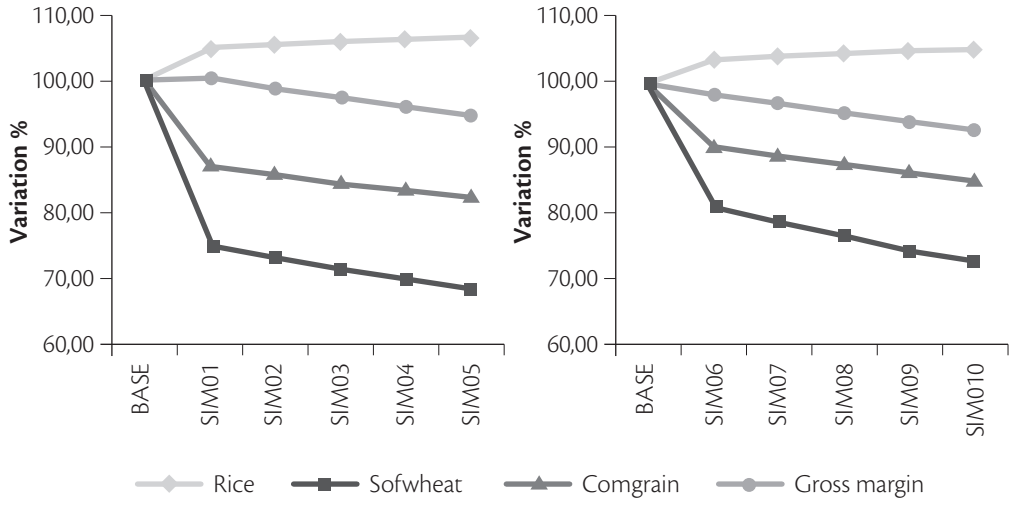
For those farmers who are keen to replace tricyclazole, on the other hand, it is more realistic to consider only a slight reduction in yield; in SIM_06 and SIM_07, the gross revenues decrease by 2-3%. However, where certain atmospheric conditions prevail and in the case of a delayed outbreak of rice blast, the ban on the use of tricyclazole could cause much higher yield losses, even around 30%, which would in turn cause a reduction in revenues of up to 7% (SIM_10).

Tab. 6 - Crop production and gross margin												
CROPS	**UM**	**BASE**	**SIM_01**	**SIM_02**	**SIM_03**	**SIM_04**	**SIM_05**	**SIM_06**	**SIM_07**	**SIM_08**	**SIM_09**	**SIM_10**
Corn	ton	848.3	729.4	719.1	709.5	700.6	692.3	762.3	751.1	740.7	731.0	721.9
	% var.	*100.0*	*85.2*	*84.0*	*82.9*	*81.8*	*80.9*	*89.1*	*87.7*	*86.5*	*85.4*	*84.3*
Soft wheat	ton	382.2	293.6	289.5	285.9	282.6	279.5	320.1	313.8	308.0	302.7	298.5
	% var.	*100.0*	*76.9*	*75.9*	*74.9*	*74.1*	*73.2*	*83.9*	*82.2*	*80.7*	*79.3*	*78.2*
Rice	ton	4,437.7	4,230.4	4,060.2	3,902.9	3,757.5	3,622.6	4,180.5	4,016.0	3,864.0	3,723.1	3,591.1
	% var.	*100.0*	*95.4*	*91.6*	*88.0*	*84.8*	*81.7*	*94.3*	*90.6*	*87.2*	*84.0*	*81.0*
Gross margin	**% var.**	**100.0**	**100.3**	**98.7**	**97.3**	**95.9**	**94.6**	**98.5**	**97.0**	**95.6**	**94.3**	**93.1**

Source: our calculations on sample data.

What arises in general from the results is that, given a reduction in yield of the rice crop, which is their main source of income, farmers are persuaded to do away with the marginal crops, like wheat and corn, and to plant more rice, as described in *Fig. 2*. In other words, to maintain an adequate gross margin, the phenomenon of single crop cultivation is pursued by cutting out the hectares given over to wheat and corn. An increase in the single crop cultivation of rice, however, is in direct contrast with the aim of improving and implementing best practice techniques of crop growing, so useful in the fight against the spread of disease. Whereas one technique against the fungus is to reduce the density of sowing, intensification is a mechanism that is founded on principles that are diametrically different, as rotation is a technique used to prevent the spread of diseases. From this point of view, the simulations would seem to present the new regulation as counter-productive, to be borne in mind, with a view to monitoring the changes in the Italian rice-growing sector over the mid- to long-term.

Fig. 2 - Land use and gross margin



Source: personal analysis.

6. Final remarks

The concept of sustainability nowadays is the guideline in agro-environmental policy-making. This means trying to guarantee both economic prosperity and a safe environment for everyone, not an easy objective to reach, given market constraints. Agricultural policy is a long-standing example of this difficulty: any incentives arising from low intensity production models, that have a low environmental impact, is in contrast with the need to ensure a certain level of supply on the commodity market, to sustain a threshold of revenue for the farmer and consequently, the survival of the farming business and its involvement in the preservation of the land.

The radical reforms of the CAP made over the last few years have provided a boost for the field of research into forecasting analysis for situations linked to specific policy choices. Most notably, the method of the PMP has gained ground, for many different reasons, and nowadays

is in widespread use for regional and sectoral analysis. In this paper we looked at a PMP model that illustrates some of the results following from a ban on the use of tricyclazole in the rice-farming sector in a well-defined production zone. The simulations conducted highlight two effects: i) reduction of the farm's gross margin e ii) an increasing tendency towards single crop cultivation of rice. The ban is necessary, however, for environmental reasons and for consumer protection, and its costs, perceived as a loss in revenues for the farmer, could be a viable option for policy-makers, but the increase of single crop cultivation also presents a high risk in the long term for agricultural land and the surrounding environment, and although these costs cannot be estimated, they could be more significant.

The analysis focuses on a positive policy-making approach that outlines a reaction on the part of farmers that could even be counter-productive for the overall sustainability of the regulatory intervention. The present application shows the side effects of a specific introduction of the ban, underlining the effects on losses in gross margin and the possible strategies of farmers to contrast them. This demonstrates, should it still be necessary to do so, that economic research applied to agriculture is of great assistance to decision makers. In this case, for example, the policymaker should consider the possibility of setting up a technical-agronomical database capable of identifying feasible substitutes to tricyclazole in combating rice blast in order to compensate the decrease in farmers' gross margin.

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