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The impact of the 2013 Common Agricultural Policy reform on farmer's investment decisions: an ex-ante evaluation

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The research question addressed in this study is the impact of the CAP 2013 reform and alternative CAP scenarios on farm investment behaviour and economic performances in different farming systems. An ex-ante analysis of the farmers' response to different policy scenarios is performed simulating some of the main changes introduced by the reform in both CAP pillars, accounting for regional variations across Europe. The methodology consist in the implementation of a farm-level mathematical programming model. The model is cast as an integer dynamic linear programming model based on the model developed by Viaggi et al. (2010) using GAMS software. The models are calibrated using a set of real farms data and accouting for farmers stated intentions collected through survey (Lefebvre, 2014). In this paper we present the model structure, the policy scenario and the results of the simulations carried out on 50 models, each corresponding to a surveyed farm.

Keywords

linear programming, CAP reform, investment decisions, ex-ante analysis

JEL codes:

C - Mathematical and Quantitative Methods- General, Q18 - Agricultural Policy; Food Policy

1. Introduction and objectives

The main research question addressed in this study is the impact of the CAP 2013 reform and alternative CAP scenarios on farm investment behaviour and economic performances in different farming systems. Its final aim is to perform an ex-ante analysis of the farmers' response to different policy scenarios, representing some of the main changes introduced in the direct payment system and in the implementation of the investment support measures, accounting for regional variations across Europe. Most of the available studies evaluate the impact of different CAP scenarios on farmers' investment behavior focusing on the effects of decoupling (Gallerani et al., 2008; Viaggi et al., 2011b; Moro & Sckokai, 2013). The evidence on the effects of investment support through Rural Development Programmes (including *Special Accession Programme for Agriculture and Rural Development* (SAPARD)) is restricted to new Member States (Bojnec & Latruffe, 2007; Bryla 2011; Medonos et al. 2012).

In terms of effects on farm investment behaviour, the main difference between 1° and 2° pillar consist in the channels that the two categories of policy support schemes can activate to influence farmers' decisions. Direct Payment can affect investment in two ways: releasing financial resources (particularly efficient in case of restricted credit access) and/or favouring better credit conditions (e.g. reducing interest rate), as agreed by Vercammen (2003) and Guyomard et al. (2004). Investment subsidies in 2° Pillar, according to the design of RDPs in the last two CAP reforms, can also affect investments through two channels: granting capitals or subsidizing credit interest rates, as pointed out by Cahill & Moreddu (2004). Concerning direct payments, a single scheme, the Basic Payment Scheme (BPS), is being implemented across the European Union and will replace both the Single Area Payment Scheme (SAPS) and the SPS (Single Payment Scheme). All EU member states would have to move towards a uniform payment per hectare at the regional (or national) level by 2019. This change is expected to produce a significant redistribution of payments among farmers in those Member States where the SPS was implemented according to the so called historical model. In the forthcoming regionalized system, all Member States have to define the extension of the regions in which the payment (BPS) should be homogeneous, in accordance with criteria such as the agronomic and economic characteristics and the local agricultural potential, or the institutional or administrative structure. Furthermore, 30% of the total amount of resources allocated for direct payments in each member States would be conditional to the fulfilment of three measures: to maintain on-farm permanent grassland; to diversify crops (arable farmers would have to cultivate at least three crops a year, none accounting for more than 70% of the surface and each

for at least 5%) and to devote 7% of the UAA to "Ecological Focus Areas" (EFA), including terraces, buffer strips, hedges, and set-aside areas.

With respect to Rural Development policy, the latest CAP reform has not introduced relevant changes in its architecture. The measures design and funding are going to be still implemented at regional level through Rural Development Plans by each Member State.In particular, the support for investment in physical assets shall be limited to the maximum support rates (share of cofinancing) indicated by the European Union: 50% for less developed regions, 75% for the outermost regions, 40% for the other regions. Those upper limits can be increased up to a maximum of 90% for some categories (e.g. young farmers, collective investments) and when combined with other support actions (e.g. EIP for agricultural productivity and sustainability).

As far as it concerns CAP post-2013, the analysis should consider other key factors of the reform such as the redistributional effect (Moro & Sckokai, 2013; Chatellier & Guyomard, 2013; Patton et al., 2013), both among farmers and among Member States, deriving from the flexibility given to MS for national/regional implementations of the Direct Payment system and the Rural development Plans.

In this paper we use an integer dynamic linear programming model, which was developed by Viaggi et al. (2010) using GAMS software. The model is fed with the results of a recent survey performed through a questionnaire in 780 farms across Europe (Lefebvre et al., 2014). Within the database, a selection of 50 single farms, representing different farming systems in terms of farm specialization and farm size, is used for the calibration of the models, each model corresponding to a single farm. Scenario variables are the design (payment per ha) of the Direct Payments and the expected amount of investment support.

2. Literature review

Farm investment behavior is still one of the least developed issues in the scientific literature, particularly for what concerns the analysis of policy impact on investment.With respect to other fields of agricultural economics and microeconomics research, there has been a limited contribution of the literature to the issue of the CAP impact on farm investment decisions, Gallerani et al., 2008 and Viaggi et al., 2011b highlights as gaps in the literature, the scarcity of studies directly addressing the effects of CAP reforms on investment behavior and including the effects of market and general economy trends into policy analysis (scenario and model development). However, the

effects of policy changes on farm investment behaviour recently received a special emphasis by the scientific community. This topic was, in fact, directly addressed by several studies in last three years: Guastella et al. (2013), Medonos et al. (2012), Bryla (2011), Bojnec and Latruffe (2011), Viaggi et al (2011a, 2010b).

It is worth to point out that most of the available studies analyses the impact of CAP reforms on farm investment behaviour by focusing on the effects of decoupling or on the effects of enhanced RD programmes, such as those implemented in eastern European and developing countries.

Most of the available studies treat separately the effect of direct payments and of investment subsidies on investments decisions. On the whole, the majority of authors agrees on that the effects of different forms of policy support on farm investment behavior are conditional upon the implementation of specific measures such as the rebate of financial constraints (Bojnec & Latruffe, 2011) and that decoupling has no effect on the majority of farms (Viaggi et al., 2011a).

Kallas et al. (2012) is one of the few who analysed simultaneously the impact of decoupled direct payments and rural development subsidies on farm investments. Their results indicate that both impact positively on machinery and equipment investment.

As far as it concerns the impact of direct payments schemes, Guastella et al. (2013) developed a comparative analysis among different European Union Member States of the investment demand for farm buildings and machinery, under the hypothesis of different types and levels of Common Agricultural Policy (CAP) support. The effect of CAP support on both types of investments is positive, although seldom significant. The simulations of the effects of the reductions in the Pillar I CAP Direct Payments (DPs) confirm the expectation of a worsening of the farm investment prospects for both asset types. Notable exceptions concern investment in machinery and equipment in France and Italy which improve, irrespectively of the magnitude of the implemented cuts in DPs. Severini and Tantari (2014, 2013) analysed the impact of different implementations of the Single Payment Scheme and of the 2013 reform of Direct Payments on DPs and farm income concentration. The main effects of Direct Payments on farm income are the increase of returns and the stabilisation of revenues, which are factors influencing investment decisions. According to the results, the shift to a regional implementation reduces DPs concentration and, to a limited extent, farm income concentration. The results of the analysis suggest the need to avoid a drastic reduction in the level of DPs because this is expected to increase farm income concentration. Of the considered regionalization scenarios, those that redistribute DPs among regions are the most effective in reducing concentration.

Recent studies conducted in eastern European countries indicated that investment subsidies granted through Rural Development Programmes are effective in increasing on-farm investments. Hyytia (2013) concluded that investment subsidies addressed to structural investments impact on investments decision by increasing credit access, lowering the cost of borrowing, reducing risk aversion and increasing productive investment. Medonos et al (2012) analysed the economic effects of Measure 121 (RDP 2007-2013) on Czech farms showing significant benefits of investment support in terms of business expansion (Gross Value Added) and productivity (GVA/labour costs) improvements. On the contrary, the study of Bojnec and Latruffe (2007) on Slovenian farms during the transition to a market economy revealed a non-significant impact of investment subsidies received by farms. They found a positive impact of operational subsidies for small farms on the alleviation of financial constraints. Buysse et al. (2011) analyzed the efficacy of 2° Pillar investment subsidies in increasing agricultural output and concluded that investment support has a positive impact on in the case of measures supporting structural investment, which are effective in costs reduction and succeed in increasing the competitiveness of the farming sector.

Within the other issues concerning farm investment behavior developed by recent literature, there are methodological aspects (Moro and Schokai, 2013; Andrei et al., 2013; Viaggi et al., 2011b; Dries and Swinnen, 2010; Huttel et al., 2010), the role of credit and financial constraint (O'Toole, 2013), contract enforcement (Abdulai et al., 2011); farm structural aspects and land market (Deininger, 2011; Rahman, 2010); household and farm investments (Ji et al., 2012).

Finally, recent papers analysing the impact of CAP post-2013 on production decisions have been focusing on the cost of complying with the environmental constraint of the greening payments (Cardillo et al., 2012), on the impact of the regionalized system on farms' income concentration (Severini & Tantari, 2013) and on specific sectors (Barnes et al., 2014; Howley et al., 2010).

3. Methodology

3.1. The empirical model

The model is a dynamic integer programming model simulating household behaviour derived from the Net Present Value (NPV)-maximising version extensively described in Viaggi et. al. (2011a). Details about the model formulation can be found in Viaggi et al. (2010, 2011b), while previous applications of the model are reported in Viaggi et al. (2013).

In this model the decisional unit is the household which operates the farm. The time unit is the year and the farm household situation at the end of the each year constraints the following year. The model maximises the NPV derived from the discounted farm household cash flow and is constrained by the consumption variable, which is represented by a maximum amount of household expenditures in one year.

The objective function is expressed by the NPV of total household cash flows over the time horizon and takes the form of the following equation:

$$\max Z = \sum_t \rho F_t \quad (x_t) \qquad (1)$$

$$s.t. \quad C_t \leq C^* \qquad (2)$$

where ρ is a discounting factor, $F_t\ (x_t)$ is the net cash flow expressed as a function of the activities X carried out in time period *t*, C_t is the annual consumption and C^* is the minimum yearly consumption acceptable by the household. Consumption is constant and expressed in monetary terms (2013).

Equation 1 is connected to (2) and both are connected to the investment behaviour through:

$$x^t = f(I_{t'}) \qquad (3)$$

$$I_{t'} = g(C_{t'}) \qquad (4)$$

With *F* and *f* being increasing function (i.e. increased investments*I* generate the possibility to carry out a larger set/amount of activities, which in turn allows a higher cash flow), and g being a decreasing function (i.e. investment is negatively correlated to consumption). *t'* represents any time *t '< t*. As stated before, F_t is the cash flow over time, which is composed by several terms (5):

$$F_t = F_t^a + F_t^l + F_t^c + F_t^I - F_t^{tc} + F_t^p \qquad (5)$$

$$F_t^a = \sum_i x_{i,t}\ gm_i\ - v_m^p v_t^p \quad (6)$$

is the farm gross margin from farm activities,

$$F_t^l = \sum_h l_{h,t}^{out}\ w_h^{out} - \sum_j l_{j,t}^{in}\ w_j^{in} \quad (7)$$

is the net household labour income,

$$F_t^c = c_t^- r^- - c_t^+ r^+ \quad (8)$$

is the capital costs,

$$F_t^I = \sum_m \sum_\tau I_{m,t,\tau}^- k_{m,\tau} - \sum_m \sum_\tau I_{m,t,\tau}^+ k_{m,\tau} \quad (9)$$

is the net costs for investment/disinvestment,

$$F_t^{tc} = TC^- \sum_m \sum_\tau I_{m,t,\tau}^- k_{m,\tau} + TC^+ \sum_m \sum_\tau I_{m,t,\tau}^+ k_{m,\tau} \quad (10)$$

represents transaction costs,

$$F_{t,sce}^p = \Psi_{t,sce}^{bl} + \Psi_{t,sce}^{reg} + \Psi_t^c + \Psi_{t,sce}^I \quad (11)$$

is the policy support to farmers, which vary across scenarios (*sce*). It will be extensively described in the next section.

3.2. Implementation of policy support to farmers

The proposed model includes three forms of CAP payments to farmers: decoupled Direct Payments (CAP 1st pillar, equations 12 and 13), payments still coupled to production after the 2003 reform (CAP 1st pillar, equation 14) and investment subsidies (RDPs, equation 15).

The total cash flow derived from CAP payments to farmers (11) is different in the baseline scenario with respect with scenarios accounting for the latest CAP reform due to the differences in the decoupled Direct Payments and investment subsidies.

$$\Psi_{t,sce}^{bl} = SFP\ \frac{\sum_i x_{i,t} n_{i,sce}^u}{n} \quad (12)$$

$$\Psi_{t,sce}^{reg} = BPS\ \frac{\sum_i x_{i,t}\ n_{i,sce}^u}{n} \quad (13)$$

$$\Psi_t^c = \sum_i x_{i,t} * \psi_{i,t}^c \quad (14)$$

$$\Psi_{t,sce}^I = scf^r{}_{sce} * pb^r{}_{sce} * \sum_m \sum_\tau I_{m,t,\tau}^+ k_{m,\tau}^+ \quad (15)$$

In the baseline scenario, representing the CAP before the latest reform (December 2013), decoupled Direct Payments ($\Psi_{t,sce}^{bl}$) are calculated based on owned entitlements, after adjusting for eligible land uses (12). Since the number of the owned entitlements is not known, it is estimated based on the ratio between the SFP received and the regional average SFP per hectares.

Similarly, in the scenarios representing the CAP after the latest reform of December 2013, decoupled Direct Payments $\left(\Psi_{t,sce}^{reg}\right)$ are calculated based on owned entitlements, after adjusting for eligible land uses (13). Since the number of the owned entitlements is not known, it is assumed to be equal to the eligible land operated in 2013. The BPS value is estimated to be equal to the unit value of the regionalised payment multiplied by the number of hectares of available eligible land/entitlements, as expressed in equation (16):

$$BPS = \psi_{t,sce}^{reg} * \sum_i x_{i,t} \quad (16).$$

In all scenarios, coupled payments (Ψ_t^c) are calculated by simply multiplying the hectares of eligible crops by the unit value of the specific subsidy (14). Payments are not tradable in either of the scenarios.

Investment subsidies correspond to the share of the total expenditure that is refunded to the farmer. This share is estimated based on two regional variables: the support rate as stated in RDPs and the probability of being funded through RDP measures for the modernisation of agricultural holdings Application to the measure for the modernisation of agricultural holdings and the delivery of the subsidy to the farmer are supposed to occur in the same year that the investment is made.

3.3. Timeframe

The time horizon of the model is 10 years: from 2014 to 2023. The considered timeframe goes beyond the end of the ongoing programming period (2020). This choice derives from the need of considering a time shift long enough to see the effects of the investments. On the other hand, the 10 years timeframe is still sufficiently short to justify the constant technology assumption.

In the model, the ten years timeframe corresponds ideally to a unique programming period, therefore the policy does not change across years but only among scenarios

An important issue is what happens at the end of the simulation period, as assets would retain some value based on the assumption that farming activity would continue; in addition for land there is not an expected life of the asset. The assumption undertaken in this kind of estimation is that farming would generally continue and there still will be a land market at the end of the simulation period, so that land will maintain the same value and the other assets would keep their depreciated market value. In practice the solution consists in extending the simulation period beyond the time horizon of interest and then taking the results only up until the end of the (shorter) time horizon of interest. Specifically, simulations are run until 2030 and results are used only until 2023.

3.4. Farm selection

As described in the previous section, a database of 780 farms interviewed in 2013 in 6 European countries (France, Italy, Czech Republic, Poland, Spain and Germany; Lefebvre et al., 2014) was used to select the farms for modelling. For the modelling exercise, priority was given to three specialisations defined according to the Eurostat categories: arable crops, livestock, mixed arable and dairy livestock farms. The procedure followed for the selection of farms responded to a few general criteria:

- for each country, one region is selected for each specialisation; the region with the highest national share of agricultural production of a given specialisation is selected for each country.
- within each region, two farms were selected according to size (based on UAA for arable crops and Livestock Units for livestock and mixed): one smaller and one larger than the median of the region (the median value is that derived from Eurostat data

Within livestock specialsed farms, only dairy livestock farms have been selected, since they are linked to the presence of grasslands. The payments associated to land are therefore likely to have a stronger impact, compared to other livestock farms with limited reliance on land. Moreover, investments are relevant for these farms given the technological innovations involved in milk production. Similarly, within mixed farms, we selected only farms combining arable and livestock dairy cows, which are also the most common form of mixed farms in the surveyed countries.
The 50 farms selected for modelling cover the following combinations of geographic areas, size and specialisations:

- for each country, the types of farming are: arable crop (Cereals-Oilseed and Protein crops)

farming systems, dairy livestock farming systems, and mixed arable/dairy livestock farming systems;

- small and large farms, with respect to regional average farm size (based on Eurostat data), located in the selected regions within the specific countries addressed.

Farms have been selected giving priority to those farms run as individual farms, as significant differences in the level of investment activity have been found among farms with different ownership characteristics (Curtiss et al., 2007).

4. Scenario construction

4.1. Scenario variables

The scenario variables considered in this study are policy variables which can be divided in two main groups: one related to the DP calculation system and the other related to the implementation of investment subsidies in RDPs.

The reform of the DP system is the core issue in the definition of scenarios, as it can affect farmer decisions. According to the system introduced by the latest CAP reform, DP calculation includes two components: basic and green payments. Only the basic payment system is simulated in the scenarios, as the data required to introduce all of the constraints associated with the greening payments in the model were not collected in the survey. Moreover, there is no clear argument suggesting that farms will need to modify their investment behaviour in order to comply with the greening. Though some cases may be envisaged (e.g. farms that have to increase the number of crops and related machinery, farms needing machinery to manage the ecological areas) the overall sense is that this may be not relevant or adaptation could largely occur through machinery rental rather than investment. Basic payments are conditional upon cross-compliance, which consists of the achievement of basic environmental standards. It is reasonable to assume that the achievement of those standards has a negligible impact on farm investment and, given that it has been in place since 2005, would not make a noteworthy difference across scenarios. Therefore, the greening requirements are not included in the model. It is simply assumed that the greening payment is received by the farm at no additional cost. Within the basic payment calculation criteria, the regionalisation process is the most relevant change introduced by the reform. Thus, basic payment calculation in the scenarios representing the latest CAP reform is not based on historical SFP but rather on a homogeneous area payments (though the entitlement system will remain in place and

adapted to the new rules for the calculation of entitlements). Given the delayed implementation of the CAP 2013 reform, the homogeneous area payment is set assuming an equal payment across all eligible land for each country. The coupled payments were also included in all scenarios. We include the additional payment for the coupled support proposed in art. 52 of Reg. No 1307/2013.

Investment support is modelled as the expected reduction in the investment cost. The reduction corresponds to the expected amount of the subsidy, which equals the investment cost times the public support rate times the probability of being funded. No detailed information on the rules and budgets for the regional implementation of the 2nd pillar investment payments (public support rate and probability of being funded) was available. Therefore, we rely on the following assumptions.

The public support rate is defined as the rate of the total public contribution to an investment operation funded within the framework of this measure. RD payments supporting investment in, and modernisation of, farm holdings cover a share of the investment (the public support rate), which is partly funded by the farmer's own capital.[1] The support rate is varied across scenarios, following the information available in Annex II of Reg. (EU) No 1305/2013.

The other scenario variable associated with RD investment support is the probability of being funded under this programme. Assuming some continuity in RD investment support schemes (e.g. including allocation rules), we use the success rate of the applicants in the previous programming period as a proxy for the future, otherwise unknown at this stage. The probability of being funded is, therefore, kept stable in all scenarios and set equal to the ratio of the farms funded under the measure 121 programme[2] on the total farms (minus those not explaining clearly their source of funding, i.e. which RD measure[3])[4] in Lefebvre et al., 2014. A ratio equal to 0.2 was applied in all countries

With regard to the implementation details of investment support, which are still not available for the 2013 CAP regulation, the following specific assumptions were imposed on the model based on the Rural Development Programmes from the past programming periods. Those constraints were kept stable in all scenarios, including for investment support:

[1] The payments technically correspond to refunds, as they are granted only after the investment has been made by the farmer, who must pay all of the costs of the investment upfront, often before knowing whether his/her project will be covered by RD funds.
[2] Question code in the GfK database; E1.0_1
[3] Farms showing "-997" as answer to question E1.0_1
[4] This ratio was used instead of the ratio of funded farms over farms having applied because the latter would have been difficult to interpret since many farms may not apply if they know that they will not receive the subsidy. This self-selection artificially increases the success rate.

- all physical assets are considered eligible for investment except for land;
- investment supported by subsidies cannot be sold before 5 years;
- investment support is granted in the same year of the application;
- advisory costs and administrative costs (taxes) are included in the expenditure and are, therefore, treated as part of the investment cost (a share equal to 10% of the expenditure can usually be added to the investment cost and declared as a transaction cost).

4.2. Prices, yields and technologies

Product prices and yields are kept constant across scenarios. This was decided primarily in order to focus on changes due to variations in policy, and also in the absence of credible alternative market scenarios. Average prices deriving from the price forecast information from the 2013 Medium-term Prospect for Agricultural Market and Income published by the European Commission (EC, 2013) are used.

Product yields have been considered as constant in all of the scenarios. Moreover, no technical progress related to input saving technologies has been assumed. This assumption is also motivated by the intention to focus on changes due to variations in policy.

4.3. Scenarios

Based on the scenario variables, four main scenarios are identified and described in the following sections.

4.3.1 Baseline: CAP prior to 2013 reform

The reference baseline scenario (S0) assumes the CAP prior to the 2013 reform to be maintained after 2014 and up until 2023. This scenario is characterised by the occurrence of the DP system prior to the 2013 reform: a SFP is calculated based on entitlements owned by the farmer. The reference baseline scenario (S0) also represents the implementation of RD investment support prior to the 2013 reform (Measure 121 modernisation of farm holdings). The support rate is obtained from Reg. (EC) No. 1698/2005 and set equal to 40% for all countries. The probability of being funded is obtained from Lefebvre et al. (2014).

The coupled payments in the baseline are calculated accounting for the eligibility of crops and livestock according to the MS regulation prior to the 2013 CAP reform. Due to the absence of more detailed information on the unit value of the coupled payments adopted by MS prior to the 2013 reform, their unit values in the baseline scenario are assumed to be equal to those used in the

other scenarios. Thus, the only change concerning coupled payments between the baseline and the other scenarios correspond to the eligibility of crops and livestock categories, while the unit values remains unvaried across scenarios.

3.4.2. Scenario S1: CAP post 2013

Scenario S1 represents the new CAP that will be introduced in 2015 (2014 being a transition period). Scenario S1 accounts for the main CAP modifications to the DP system (regionalisation and implementation of the young farmer scheme as set up in Reg. (EU) No 1307/2013 to establish rules for Direct Payments to farmers under support schemes within the framework of the Common Agricultural Policy) and to the investment subsidies under the framework of RDPs (implementation of Art. 17, Reg. (EU) No. 1305/2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation (EC) No 1698/2005). The probability of being funded is the same as in the baseline.

Based on the available information, the unit coupled payments are estimated as follows: first, we calculated the budget available yearly for coupled payments by multiplying the average annual national envelope of DP by the share assigned to coupled support by each MS (i). Then, we divided the resulting value for the number of eligible crops and livestock categories defined by each MS (ii). Finally, the budget allocated to each of those categories was divided by the national total number of benefiting livestock (e.g. dairy cows) or crops (e.g. protein crops) units as reported in the FADN public database (iii).

3.4.3. Scenario S2: Direct Payments only

S2 scenario simulates the occurrence of a DP scheme implemented according to the latest CAP reform (as in S1), but in this scenario investment subsidies through RD programmes are abolished.

3.4.4. Scenario S3: Investment support only

Scenario S3 simulates the case in which the DPs are abolished and CAP support to farmers consists only of the payments provided by RD investment measures (art. 17 of Reg. (EU) No. 1305/2013). In this case, farmers receive payments only if investments are carried out, contrary to DP payments that are independent of investment choices. Other things being equal, a different effect of policy support may be expected. In order to make the comparison of scenarios easier, the public support

rate of S3 is equal to double (80%) the amount of the official value used in S1 and S2. The probability of being funded is the same as in baseline and S1 (0.2).

3.4.5. Scenario S4: no-CAP

S4 scenario simulates the abolition of both DP and investment subsidies. This will be useful to estimate the "net total effect of DP and RDP investment" on farm investment behaviour. Thus, S4 also represents a reference scenario for policy analysis.

Table 1 contains a synthesis of the main features of each scenario, including reference regulations, data sources and the values assumed by the scenario variables.

Table 1 – Summary of scenarios and scenario variables (variations across scenarios)

<<<<TABLE 1 HERE<<<<

5. Results

5.1. Economic and investment indicators

Net investment and farm income indicators in the baseline scenario are reported in figure 1 for all the 50 models, each simulating a surveyed farm.

Figure 1 - Economic indicators in the baseline scenario: net investment vs farm income indicators

<<<<FIGURE 1 HERE<<<<

The size of both is very differentiated, also according to the variety of farm size in the sample. Net investment is postive for the majority of farms, but several of them have actually a net disinvestment trend even in the baseline.

The impact of scenarios on those two indicators show a huge variety across farms as well as across scenarios (figure 2).

In particular, scenario 1 leaves both the economic indicators more or less at the same level as in the baseline, with a slight increase of income in a relevant number of farms. The remaining farms report a slight decrease of the income. variations in the income are striclty linked to the changes in the DP system (and amount per hectare), which is depending upon the countries where the farms are located. Concerning investments, the majority of farms do not show any change with respect to the baseline level, but a very few exceptions register a decrease of the investments under the hypothesis of scenario 1.

Results are slightly more heterogeneous under the hypothesis of scenario 2, in which more farms show a relevant distance from the origin, but again in all possible directions.

Figure 2 - Scenario impact on economic indicators: net investment vs farm income (percent change with respect to the baseline level)

<<<<FIGURE 2 HERE<<<<

Scenario 3 moves clearly the results to the negative quadrant in terms of income, which means that an increase in investment support cannot compensate for income loss due to the disproportion occurring between the budget allocated to CAP first pillar vs second pillar, as presently established in the CAP. More interesting, also the effect on investments is not starghtforward: while in some cases they increases, in a number of cases they are strongly reduced. This outcome suggest that an enhancement of the investment support through RD subsidies positively impact farm investment behaviour, unless it is not counteracted by a significant reduction of first pillar support taking place simultaneously. In fact, removing first pillar payments makes the agricultural activities unprofitable and hence not worth invesments (in fact these cases are concentrated in the lower left-hand quadrant).

Consistently to the expectations, scenario 4 goes in the same direction but with even more extreme values and with no exception. However for the majority of farms, the income loss is not so evident as reported in previous studies (e.g. Gallerani et al., 2008), in which the market margin was lower.

5.2. Marginal effects

Marginal values of key resources such as capital liquidity and land in the baseline are reported in the graph of figure 3, which denotes a huge variability across cases, probably accountng for both context and farm specificities. It should be clarified that marginal values are the change in NPV due to a unit change of the resource availability and hence cannot be compared to annual values. In addition, as prices for land and capital are already included in the model, these figures only measure the marginal value above the market prices.

Figure 3 - Marginal value of resources in the baseline scenario: capital liquidity vs land available

<<<<FIGURE 3 HERE<<<<

Impacts of scenarios on the marginal value of land and liquidity compared to the baseline level show a distinct trend across scenarios (figure 4). This reflects only partially the overall effects on income and investments described in previous section.

In particular, the effect of scenario 1 is mostly neutral for liquidity, while the marginal value of land shows a slight decrease, likely due to the reduction of the actual payment per hectare in some countries (e.g. France and Germany). The income loss is not compensated by the re-coupling of payment for selected crops, especially in the Member States not implementing coupled payments, as in the case of Germany.

Scenario 2 largely overlaps with scenario 1 results, but with few exceptions, mostly related to increases in marginal value of land and liquidity.

Figure 4 - Scenario impact on the marginal value of resources: capital liquidity vs land rented (percent change with respect to the baseline level)

<<<<FIGURE 4 HERE<<<<

Scenario 3 and 4 show a reduction of both the indicators, but with a strongest effect on land rent than on capital. Exceptions are especially located in a transversal axis from the bottom left-hand side quadrant to the top right-hand side quadrant, which indicates altogether a correlation between

the two parameters. The correlation becomes clearer as the first pillar component becomes less relevant or even disappears. This also hints at some coupling of first pillar payments (though in the minory of farms) throgh a mix of income and liquidity effects.

These effects are less evident on the marginal value of the land owned (figure 5). First, observations are less numerous (due to the fact that the marginal effect is more directly caught by the rent-in constraint). Secondly, observations are less scattered and remain concentrated around the axys origin.

Figure 5 - Scenario impact on the marginal value of resources: capital liquidity vs land owned (percent change with respect to the baseline level)

<<<<FIGURE 5 HERE<<<<

6. Discussion and conclusions

The main research question addressed in this study is the impact of the CAP 2013 reform and alternative CAP scenarios on farm investment behaviour and economic performances in different farming systems. Results show that the reform itself could lead to minor effects in most of the farms, while more extreme scenarios related to the first pillar abolition and the increase of investment support, or to the complete CAP removal, could provide more inshghts on the current role of policy. In particular, the results show the decisional relevance of first pillar payments with respect to an (even potentiated) investment subsidies in second pillar. Enhancement of the investment support through RD subsidies positively impacts farm investment behaviour, provided this is not counteracted by a reduction of first pillar support. This trend suggest that some re-coupling of first pillar payments could play a role by causing a mix of income and liquidity effects.

Finally effects on marginal value of resources such as land and capital liquidity differ across scenarios, hinting at potential asymmetric effects on the markets of the different production factors.

Given the small size of the sample and the variety of conditions, it remains difficult to draw general conclusions on the expected impact of the latest CAP reform on the investment behaviours in all the diverse EU farming systems in terms of specialization, location and farm size. These results are in line with what we can expect in terms of the impact of the policy scenarios and with the outcome of previous studies. The simplifications as compared to policy and the number of points of the reform

still unclear at the time of running the simulations also lead to the conclusion that this remains a rough estimation of the potential effects of the reform and that much of the effect of the reform will depend on implementation details which are decided upon and disclosed during the timeframe of the study. This in particular concerns the mechanisms of first pillar entitlements allocation and the eligibility/priority conditons for investment support in RDP.

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Tables

Table 1

Scenario variables	S0 - Baseline (Pre-2013 CAP)	S1 - Post 2013 CAP	S2- Post 2013 DP but no RD investment support	S3 - Increase in RD investment support, abolition of DP	S4- no DP no RD investment support
Unit value (per hectare) of decoupled Direct Payments (1st pillar)	Farm unit SFP/SAP (source Lefebvre et al., 2014): 0.2 or average regional unit SFP/SAP (source Lefebvre et al.., 2014 or FADN public database[5])	National Unit Basic Payment (including greening) as proposed in Reg. (EU) No. 1307/2013 * projections of change estimated yearly, source DGAgri		-	-
Public support rate in investment subsidies (2ndpillar)	As in Council Regulation (EC) No. 1698/2005 (national level) 40%	As in art. 17 and in Annex II of Reg. (EU) No. 1305/2013 (national level) 40%	-	Double of the official value in art. 17 and in Annex II of Reg. (EU) No. 1305/2013 (national level) 80%	-
Probability of being funded by investment subsidies (2nd pillar)	Number of farms funded under investment subsidies (measure 121)/total number of farms declaring complete data on RD subsidies received, in Lefebvre et al. (2014): 0.2		-	Number of farms funded under investment subsidies (measure 121)/total number of farms declaring complete data on RD subsidies received, in Lefebvre et al. (2014): 0.2	-
Coupled payments	Unit coupled payments as in S1 and S2, eligible crop and livestock categories prior to 2013 CAP reform are provided by DGAgri	Unit coupled payments estimated based on annual average national DP envelope * % allocated to coupled payments (as foreseen in). National ceilings and eligible crop and livestock categories are provided by DGAgri.		-	-
Agricultural product prices	According to yearly projections of the 2013 Medium-term Prospects for Agricultural Markets and Income (EC, 2013)				

[5] FADN (2011) http://ec.europa.eu/agriculture/rica/database/database_en.cfm

Figures

Figure 1

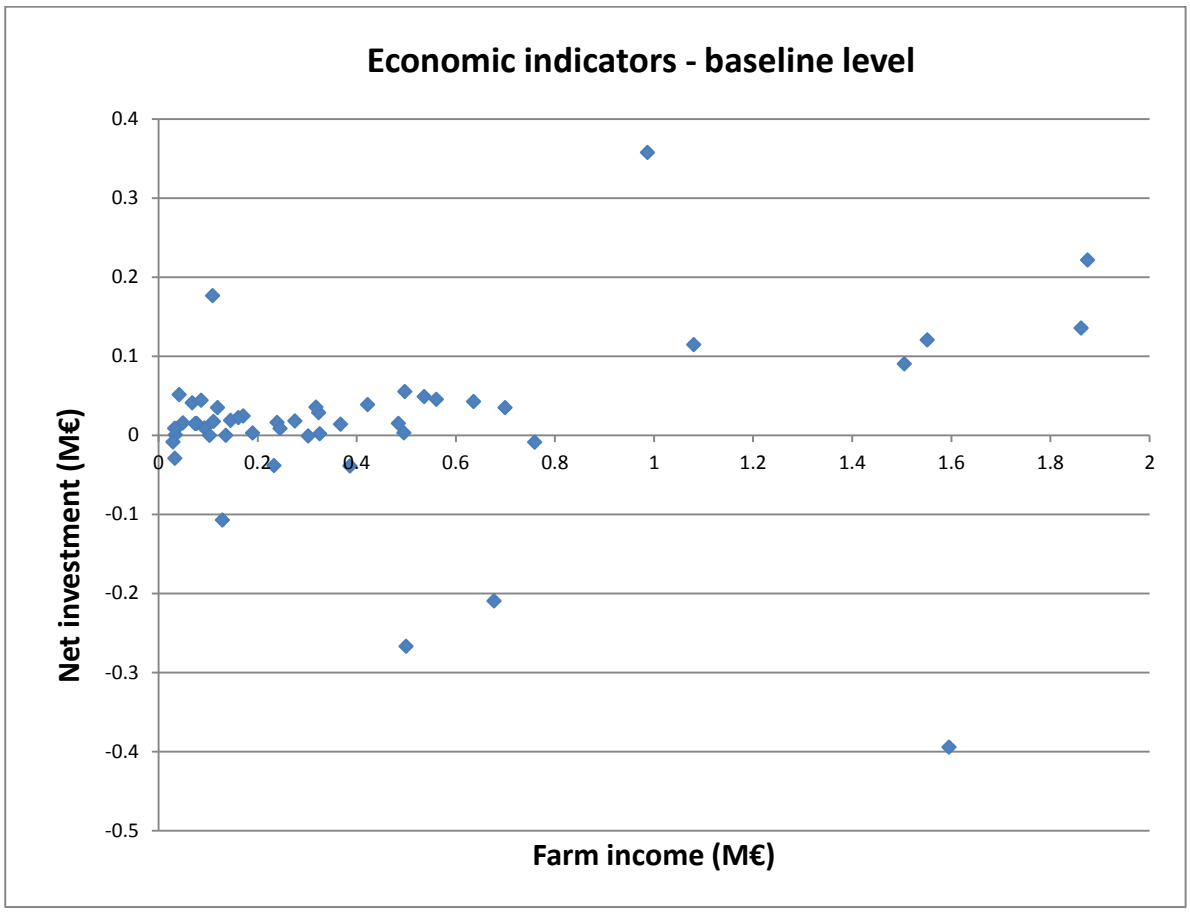


Figure 2

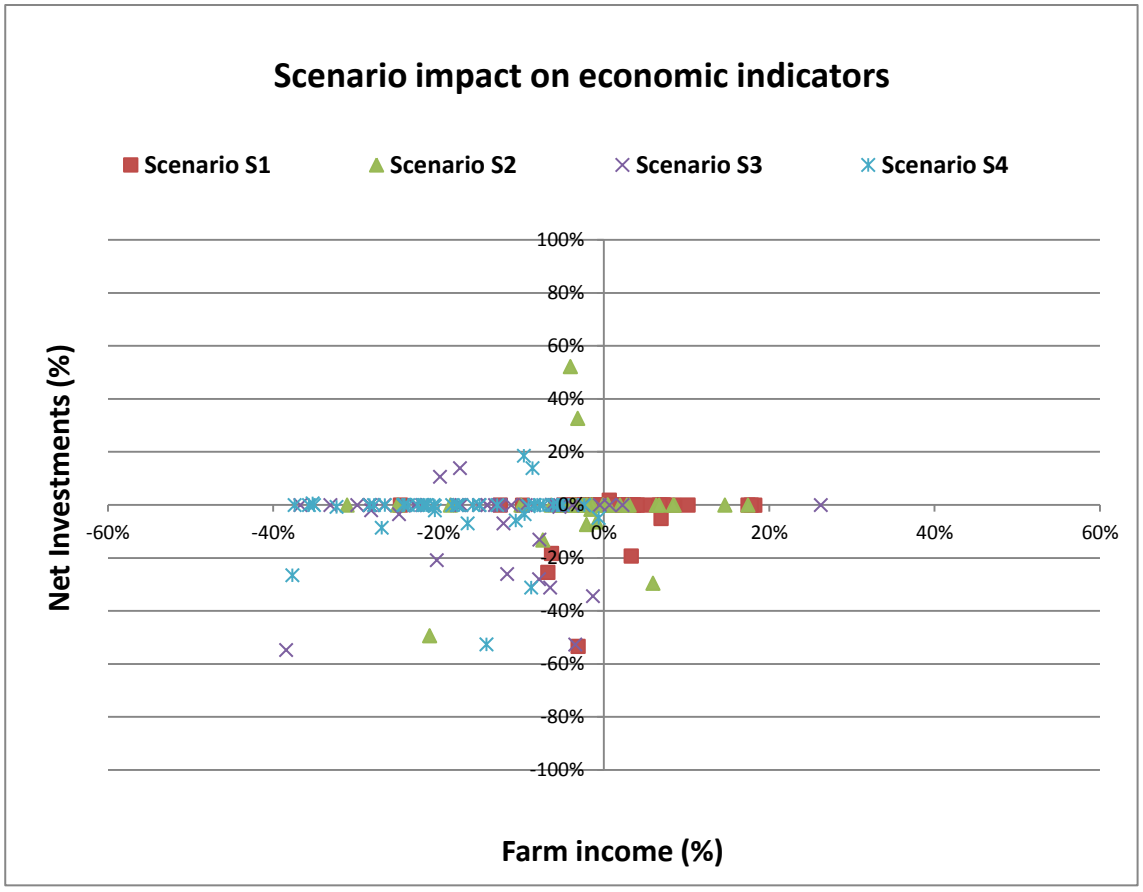

Scenario impact on economic indicators
Scenario S1
Scenario S2
Scenario S3
Scenario S4
Net Investments (%)
Farm income (%)
100%
80%
60%
40%
20%
0%
-20%
-40%
-60%
-80%
-100%
-60%
-40%
-20%
0%
20%
40%
60%

Figure 3

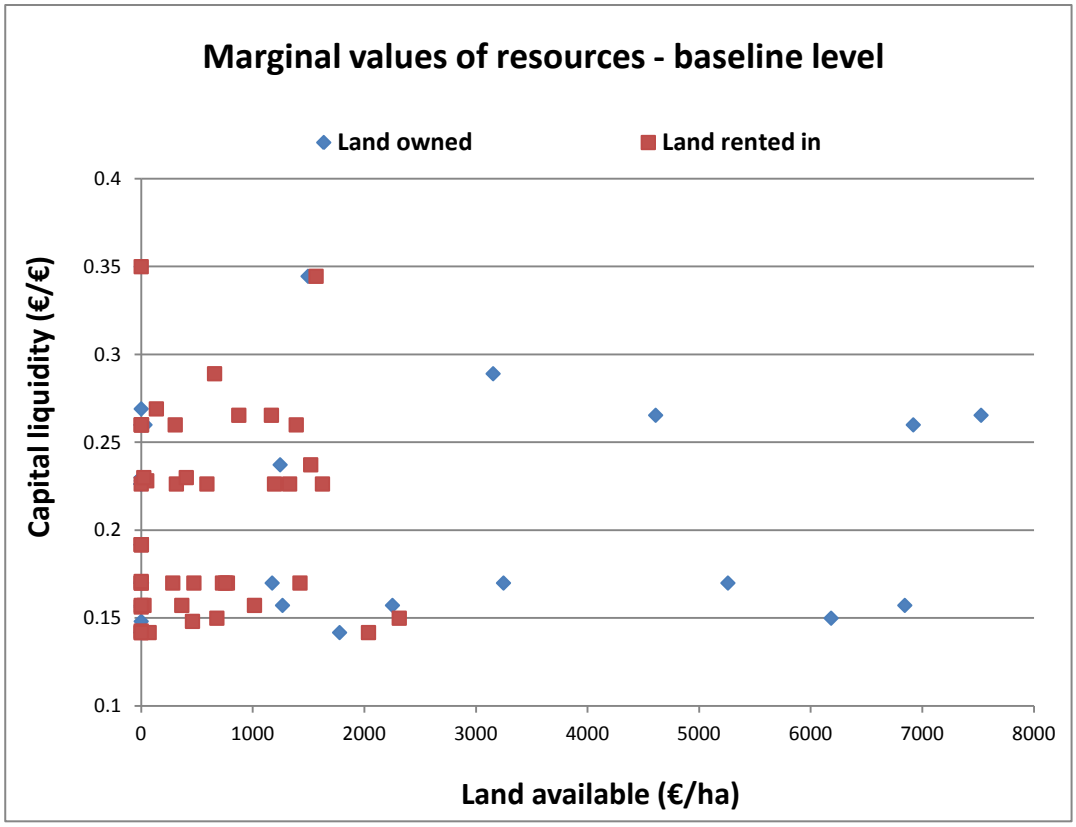

Marginal values of resources - baseline level
Land owned
Land rented in
Capital liquidity (€/€)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0
1000
2000
3000
4000
5000
6000
7000
8000
Land available (€/ha)

Figure 4

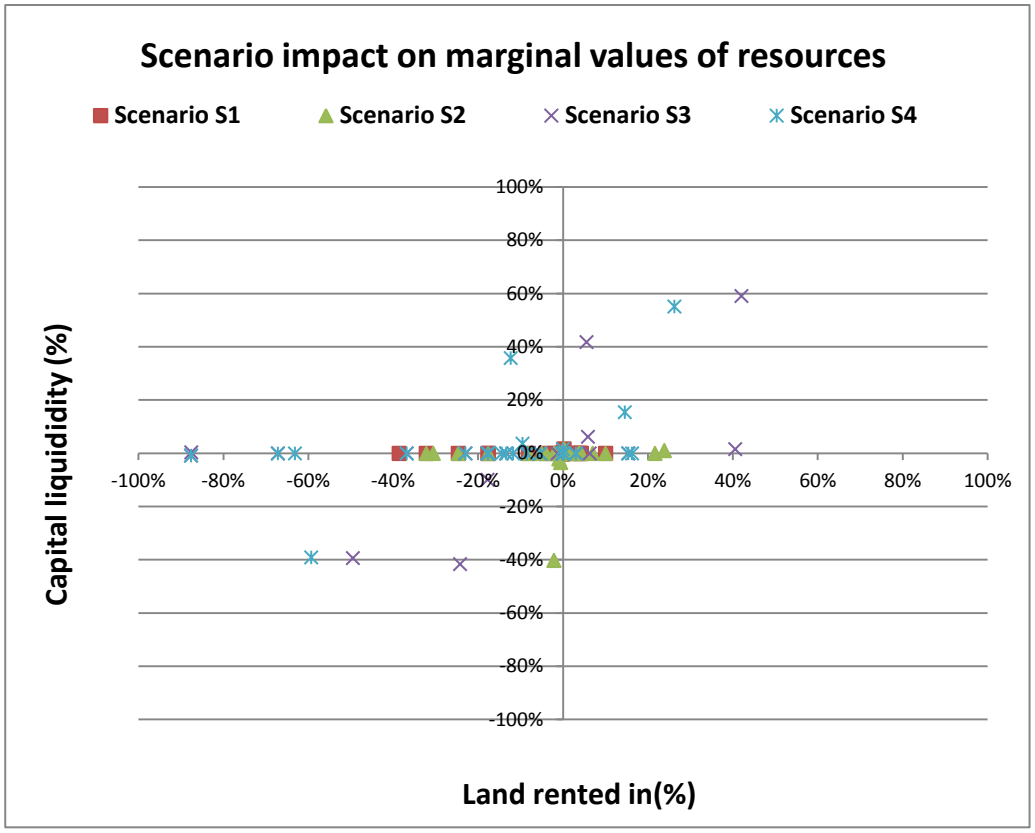
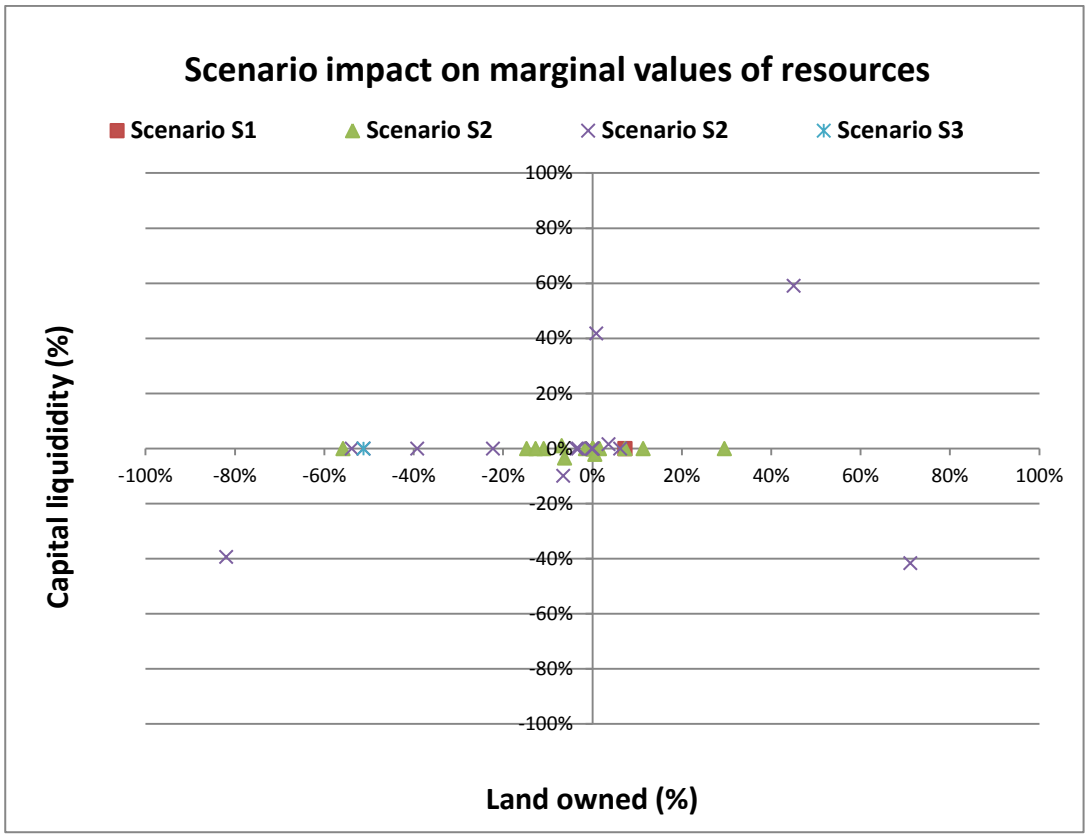

Scenario impact on marginal values of resources
Scenario S1
Scenario S2
Scenario S3
Scenario S4
Capital liquidity (%)
100%
80%
60%
40%
20%
0%
-20%
-40%
-60%
-80%
-100%
-100%
-80%
-60%
-40%
-20%
0%
20%
40%
60%
80%
100%
Land rented in(%)

Figure 5


Scenario impact on marginal values of resources
Scenario S1
Scenario S2
Scenario S2
Scenario S3
Capital liquidity (%)
Land owned (%)
100%
80%
60%
40%
20%
0%
-20%
-40%
-60%
-80%
-100%
-100%
-80%
-60%
-40%
-20%
0%
20%
40%
60%
80%
100%