3. THEORETICAL ANALYSIS

3.1 Introduction

The theoretical analysis focuses on the economics of structural change in agriculture. The analysis moves from the definitions of structural change of the farm sector and a brief review of the main theories that can be used to explain such phenomenon. After this, the Chapter focuses on two theoretical approaches that consider the factors affecting the structural change of a single farm relying on simplified but formal representations of this complex topic. Indeed, the utilised approaches permit to consider the impact of several factors including agricultural policy. The analysis is then extended to the impact of the same factors on structural change of the whole farming sector. In this case, the analysis is less formal and relies on the main general theories developed on this subject.

Structural change is a complex phenomenon that can affect several structural attributes at the same time. The analysis covers some of the most important of them but the main focus is on the following attributes: labour allocation decisions (on and off-farm, including part-time vs. full-time farming) and number of farms; investment decisions and substitution of capital for labour; farm size. The evolution of farm size is directly related to the evolution of the number of farms and is strongly influenced by the substitution of capital for labour. Reducing the number of farms by maintaining fixed the amount of utilised land implies an increase of physical farm size. Increasing the amount of capital invested in the farming sector, maintaining all other factors constant, also implies an increase of the economic dimension of farms. Therefore, studying these two aspects (i.e. evolution of number of farms and substitution of capital for labour) feeds the discussion regarding the evolution of farm size.

The theoretical analysis focuses on the role of agricultural policy and, in particular, of direct payments that are the subject of the evaluation. Indeed, agricultural support policies are drivers of structural change (OECD, 2011), to the extent that they affect production incentives and farm income. In this respect, they can influence labour use as well as other structural attributes. However, it is important to stress from the beginning that the literature on how agricultural programmes influence farm structure often derives conflicting results (Tweeten, 1993). While some studies support the idea that farm commodity programmes accelerate farm structural change and reduce farm number, other studies support the opposite idea that these programmes retard the consolidation of farms structures; a residual group of studies conclude that programmes have no impact. Therefore, theoretical models have not been able to provide a unique and definitive answer to this complex question, but the answer should rather be researched by means of empirical analysis.

This large heterogeneity of views derives from the complexity of structural changes but also from the large heterogeneity of farm policies. For example, Leathers (1992) has suggested that if maintaining farm numbers is a policy objective, “… it may have to be pursued directly, trough such instruments as income transfers, rather than indirectly through programs such as price support.” (Leathers, 1992: page 298) because these two sets of policies may have different implications for structural change. This suggests that it is important to develop the analysis also by differentiating, when possible, between coupled and decoupled forms of support.

The theoretical analysis is organised in the following sections:

- Definition of structural change of the agricultural sector (§ 3.2)
- Theories explaining structural change (§ 3.3)
- Representation and discussion of the role of agricultural policies and other factors on:
  - labour allocation decisions and farm exit (§ 3.4.2)
  - substitution of capital for labour (§ 3.4.3)
- Other themes covered by the evaluation (§3.5).

The objective of the theoretical analysis is to develop a consistent framework to be used in the various parts of the evaluation. Therefore, while providing a general overview of the subject and exploring structural change from a wider perspective, it is focused on the specific themes of the evaluation.
The theoretical analysis provides a framework useful to overcome some of the difficulties that characterise the analysis of structural change. One of the complexities of analysing structural changes is that there are many drivers of change and these are highly interactive. This makes it difficult to attribute structural changes to individual driving forces (Lobley et al., 2002). The theoretical framework helps to identify what drives the decision making process of farmers, what are the causative factors of structural change and to distinguish between the effects of the different drivers of structural change, including direct payments. Another complexity stems from the fact that some driving forces have only an indirect impact on farm structural change because they influence factor markets and this, in turn, affects farm structures. A typical case, discussed in the theoretical analysis, is the impact of agricultural policies on the land market.

The analysis provided in section 3.4 is aimed at discussing the role of agricultural policy on two of the main aspects of structural change that are covered the evaluation questions. This analysis, while less comprehensive than the one developed on the theories (§ 3.3), is aimed at identifying a preliminary list of explanatory variables that can be correlated to the visible effects of structural change (e.g. change in labour use and substitution of capital for labour). Furthermore, this analysis is aimed at highlighting, from a theoretical point of view, the expected sign of the relationships between such variables and the considered aspects of structural change. In this way, the analysis paves the way for the empirical analysis planned to answer the evaluation questions.

### 3.2 Definition of structural change and main structural attributes it affects

In economics, structural change is defined as “a complex, intertwined phenomenon, not only because economic growth brings about complementary changes in various aspects of the economy, such as the sector compositions of output and employment and the organization of industry, but also because these changes in turn affect the growth process” (Kiminori, 2008).

The complex nature of structural change makes it difficult to reach a common definition of this phenomenon even if there is agreement on some of its basic characteristics. Structural change encompasses both organizational and institutional changes, must be permanent and irreversible to qualify as structural and is a normal evolution in an economy (Goddard et al., 1993). Three characteristics of structural change adds complexity to the topic. First, structural change is a long term phenomenon that occurs over a relatively long period of time. Second, it affects several structural attributes of the sector at the same time. Third, the evolution of farm structure is part of a complex evolution of the farm sector and its role in a global economy (Chavas, 2001).

Brinkman and Warley (1983) delineate a number of attributes that can be affected by structural change. Structural changes in the farm sector is often considered as causing changes in number of farms, scale and intensity of farm business, and changes in farmers’ reliance on non-agricultural income sources (FPD Savills, 2001). This process is generally the result of recombining or redeploying of the factors of production used on the farm (i.e. land, labour and capital) (Lobley et al., 2002). The structure of agricultural production has changed drastically since the beginning of the twentieth century (Chavas, 2001). The first change is the out-migration of labour from the farm sector (Harris and Todaro, 1970). This processes have been associated with a sharp increase in farm labour productivity, the growth of the share of farm household labour employed off-farm, a trend towards mechanisation, significant increases in farm size and reductions in number of farms (Chavas, 2001). Farm exits cause resources (especially land) to be reallocated among the remaining farms allowing the processes of farm consolidation (Haynes-Young and McNally, 2001; Weiss, 1999). In this way, surviving farms have the opportunity to grow in size. Indeed, size growth is highly negatively correlated with the reduction of farm number (Tweeten, 1993).

These processes have also the consequence of increasing production and land concentration in a relatively small number of large size farms. This suggests that structural change also has implications on equity issues in agriculture as well as for regional development and rural employment, maintenance of rural landscapes, biodiversity and the protection of the environment (Piet et al., 2011).

Furthermore, in developed countries, farms have evolved toward greater product specialisation that can be the result of a strategy aimed at attaining size and scope economies or to reach a labour
organisation that is compatible with part-time farming (Chavas, 2001). Indeed, farm structural change occurred also through diversification as it is the case of on-farm diversification that has been defined as a strategy aimed at integrating farm household income and at reducing income risk.

Additional relevant changes are that the agricultural sector has been increasingly relying on trade and market mechanisms. Finally, it also worth to note the increasing role of contracts in agriculture that has also been associated with the development of vertical integration (Chavas, 2001).

3.3 Theories explaining structural change

The complexity of the topic is probably the reason why most of the empirical work on structural change in agriculture provide a very broad concept of structural change while the focus goes immediately to the forces driving it (Goddard et al, 1993; Harrington and Reinsel, 1995). However, because structural change is the result of recombining or redeploying of the factors of production used on the farm (i.e. land, labour and capital) (Lobley et al., 2002), it seems better to approach this topic by relying on theoretical models of economic behaviour that explain producers' decisions to change the structure of their firms and, in this way, generating structural change. A wide range of theories explore this issue and may shed light on the process of structural change.

This paragraph considers the main models of economic behaviour that explain producers' decisions to change the structure of their firm. A wide range of theories explore this issue and this paragraph provides a brief review of contributions from several theoretical areas including not just the neoclassical model, but also evolutionary economics, transaction cost economics and industrial organization. This is because these latter economic theories have shed light on the decision processes of producers and may shed light on the process of structural change.

3.3.1 The neoclassical model of structural change

The neoclassical model emphasises the relationships between farm size, returns to scale and efficiency. The focus is on whether returns to scale in production can help in explaining the relationship between farm size and economic efficiency and the identification of the “optimal” farm size (Chavas, 2001). Farm size growth can have positive consequences on farm competitiveness when this permits to reach economies of size and, in turns, to reduce production costs. In particular, under the assumption of free entry and exit, increasing returns to scale provide an incentive for farms to either exit the industry or expand (Chavas, 2001). Farm size may provide a further competitive advantage given that technical innovation is often biased in favour of large farms. This is because some new technologies (e.g. mechanical) are found to be convenient only in farms operating over a given scale of production (Glauben et al., 2006).

While the process of farm consolidation based on the exit of farms from the sector has been widely witnessed in the last century, it is also true that still there is a fairly wide range of farm sizes. This may be due to the fact that the average cost function has been found to have a L shape implying that there is a wide range of farm sizes where average cost is approximately constant (Kisley and Peterson, 1996). Furthermore, this may also result from the fact that farmers have the option of choosing among different technologies, each one adapted to particular farm sizes (Chavas, 2001).

Besides technology, it has been suggested to examine the role of imperfect resource mobility in order to understand size choice because this can strongly affect entry-exit decisions in agriculture (Chavas, 2001).

3.3.2 Alternative models of structural change

The economic factors able to influence structural change have been analysed by other alternative models. For example, Boehlje (1992) reviews four alternative models explaining structural change in agriculture other than the technology model that mainly refers to economies of size and adoption and diffusion of technology: the human capital model, the financial model, the sociological models and the institutional model. The first model is based on the assumption that managerial input is critical to underlying cost and production relationships of any firm and that managerial capacity can be a fixed
factor and is generally heterogeneous across firms. Therefore, the availability of such managerial input influences the ability to process information and to evaluate and implement new technologies (Boehlje, 1992). The financial model combines concepts of production theory and financial theory into an integrated model of firm behaviour. The basic idea is that the entrepreneur maximises wealth which is a function of annual income plus capital gains (or losses). The financial model thus allows to explore the possibility that the decision regarding the amount of durable (and nondurable) inputs used in the farming activities is not just a function of relative factor prices but also of the expected relative capital gains or losses (Boehlje, 1992).

The sociological model refers to the very common category of family farms. This model is described by the family firm life cycle that refers mainly to three important stages: the entry or establishment stage; the growth and survival stage; the exit or disinvestment stage. Two processes are involved in this latter stage: retirement and intergenerational transfer of property. The sociological model tries to explore the fact that farm family characteristics strongly influence farm decisions and economic results. Furthermore, this model explains why important decisions are not subject to frequent renegotiation. This provides a reason for restricted resource mobility (at least in the short run) in agriculture and for the fact that the dynamic adjustments of land, capital and farm labour tend to take place over many years in this sector (Chavas, 2001).

Boehlje (1992) refers to the institutional model as the structure-conduct-performance paradigm of industrial organization and its variants. However, the institutional model can be seen from a broader perspective than by referring only to this paradigm because in much of the industrial organization research based on it “The distribution of transactions between firm and market is mainly taken as a datum” (Williamson, 1975: page 8). Indeed, the institutional model is rooted on a wider set of theoretical bodies developed by the theory of the firm, transaction cost economics and evolutionary economics. Therefore, it seems important to at least briefly review these theories in order to improve the framework of structural change analysis.

3.3.3 Theory of the firm, transaction cost economics and evolutionary economics

A key aspect of New Institutional Economics is the role of transaction costs in determining behaviour within and between organisations (Hubbard, 1997). The theory of the firm explores the nature of the firm and analyses the reasons behind its existence, structure, behaviour and relationships. In doing so, Coase (1937) suggests that rationale for the existence of a firm under its current internal organisational form has to be found in the attempt to economising some of the transaction costs of using the price mechanism.

Transaction costs stem from several activities needed in order to participate in a market. These include: search and analysis of the information needed to establish a transaction, the process of bargaining to define the contract that refers to the transaction, policy and enforcement of the contract. Therefore, when the external transaction costs are higher than the internal transaction costs, the activities are better performed in the firm. However, if the opposite is true, the firm will prefer external transactions. It is worth noting that this may also explain change in the firm structure over time and, in particular, its size. Indeed, when the first situation occurs, the firm has an incentive to grow while in the other situation the firm could decrease its size by, for example, outsourcing.

The reasoning regarding transaction costs has been further developed in a body of theories named as Transaction Cost Economics (TCE) that have been used to analyse a number of different behaviours and topics. Indeed TCE has been developed further to consider the transaction as the basic unit of analysis and to enlarge this term to embrace several transactions apart from the “cost of using the price mechanism” to which Coase (1937) referred to.

TCE turns critically on two main attributes of the contracting process that are the behavioural assumptions of bounded rationality and opportunism (Williamson, 1987):

- Under bounded rationality, behaviour of human agents is only intendedly rational (i.e. limited by the information they possess) and comprehensive contracting is not a realistic organizational alternative. Under this condition, “the cost of planning, adapting, and monitoring transactions need expressly to be considered".
Opportunism “is a condition of self interest seeking with guile” (Williamson, 1987: page 3) that refers to incomplete or distorted disclosure of information and that is responsible for the well known condition of information asymmetry between economic agents.

These two assumptions distinguish TCE theory from the assumptions of rational and profit maximising behaviour and of complete information embedded in the neoclassical models. However, TCE theory is useful to understand that transactions are organised in order to economise on the implicit and explicit costs (time and effort) that arise from the transaction. Such costs arise because of bounded rationality while simultaneously safeguarding agents against the hazards of opportunism (Williamson, 1985: page 32).

TCE has been used to explain the economic reasons for organising different types of transactions in different ways, under the assumption that the magnitude of transaction costs is largely determined by the characteristics of the transactions. The three principal dimensions of transactions are asset specificity, uncertainty and frequency of the transaction (Williamson, 1987):

- **Asset specificity** refers to the fact that parties to a transaction commonly have a choice between special purpose and general purpose investments. While the former, in theory, could permit larger cost savings than the latter form of investment, special purpose investments are also risky. This is because, in the case the contract should be interrupted, specialised assets cannot be redeployed without sacrifice of productive value. This means that “exchanges that are supported by transaction-specific investments are neither faceless nor instantaneous” (Williamson, 1987: page 56). Indeed, asset specificity influences several firm choices including the structure of vertical relationships (Joskow, 1991).

- **Uncertainty** is an important characteristic of transactions because economic organizations adapt to changes in a process of adaptive and sequential decision process. Furthermore, TCE accounts not only for the uncertainty considered by the neoclassical economic theory arising from a simple and non-strategic lack of information. It also accounts for a strategic kind of uncertainty that is generated by lack of communication from one party to another. This kind of strategic uncertainty is motivated by opportunism and is referred to as behavioural uncertainty (Williamson, 1987).

- **Frequency** is another important dimension of transactions. The benefits of specialised governance structures are greater for transactions supported by considerable investment in transaction-specific assets. However, because such governance structures come at a cost that is generally greater than that of alternative structures, this cost will be easier to recover for large transactions of a recurring kind. Thus, ceteris paribus, more frequent is the transaction, more preferable is a specialised governance structure.

This very brief review of the basic aspects of TCE has focused on marketing decisions and contractual arrangements that have been the topics considered also in empirical and theoretical analysis related to the farm sector such as De Bruyn et al. (2001), Dorward (2001), Foltz et al. (2002), Goetz (1992), Gray (1994), Otsuka et al. (1992) and Vermimmen et al. (2000). However, this literature, while referring to the general problem of economic transactions, can also be usefully applied to better understand the specific problem of structural change in agricultural production. Indeed, because agricultural investments in human and physical capital can be location-specific, there are significant costs of moving capital and labour over space and this generates a situation of “asset fixity” (Johnson and Quance, 1972). This situation can be linked to the existence of sunk investment costs that arise if the unit value of investment is higher than the unit value of disinvestment. Such costs provide an incentive to avoid reversing any decision (Chavas, 2001). Furthermore, because the degree of sunk costs in the agricultural activity differ between farms with different production patterns, the impact of asset fixity should vary among types of farms.

The topic of the evolution over time of farm structural characteristics can also be analysed from the point of view of evolutionary economics (EVE). While other economic theories account for the evolution over time of economic institutions, EVE is inspired by evolutionary biology. Evolutionary economics deals with the dynamic analysis of economic phenomena that are characterised by an increasing variety due to innovations and a selection (or sorting) mechanism that works systematically on this variety (Nelson 1995, pp. 54-56). In particular, the radical evolutionary perspective proposed
by Schumpeter is focused on the process that transform firms, institutions, industries and generates growth by means of the introduction of innovations and the interactive actions of diverse agents. The basic idea is that the evolutionary process of economic institutions stems from generating and testing innovations that disturb the normal flow of economic life. This concept strongly resemble the evolutionary biology concept because it assumes that the evolution comes from those ideas which accumulate more relative survival values than alternative ideas.

In traditional economic models, the focus is on the stability of a steady state, which is an equilibrium characterised by constant structures. On the contrary, evolutionary economics looks at structural change as a feature of an equilibrium path in which structural change may be considered as an open process (Knottenbauer, 2001). In particular, the innovation process forces some of the existing technologies (and the used means of production) to become obsolete and is responsible for the evolution of the firms over time. In this competitive game, firms that are not able to innovate lose their market share, see their economic results to decline and have to either restructure or to exit the market. In this framework, because the capacity to innovate is strongly related to the quality and quantity of human capital, EVE seems to suggest that investments in farm human capital can be a very important way to enhance the ability to survive due to higher innovation capability.

### 3.4 Models to represent the role of agricultural policies and other factors

#### 3.4.1 Introduction

The previous paragraph has considered a wide range of theories that explain producers' decisions to change the structure of their firm. This has been done by looking at structural change from a broad perspective. This paragraph is more focused on specific models that seem to be useful in order to represent and discuss the role of agricultural policies on structural change. Indeed, this exercise is aimed at supporting the empirical analysis at least in two way: to select a set of possible explanatory variables that may be proved to affect structural change and to analyse from a theoretical point of view the likely impact of different agricultural policies.

The models presented in this paragraph have been selected considering two aspects. The first refers to the structural attributes on which the models are focused on the basis of what required by the evaluation questions. The second refers to the causative factors of structural change: the selected models specifically represent the role of agricultural policies.

Before moving into the details of the considered models, it seems useful to briefly discuss these two aspects in order to motivate our choices.

#### A. Structural attributes on which the models of structural change are focused

The considered models are aimed at identifying the forces affecting the evolution of specific attributes of structural change. The literature on structural change in agriculture generally considers a limited number of attributes of structural change.

The analysis of the literature has shown that the most considered attributes are: on and off-farm labour allocation decisions, number of farm, farm size, investment and substitution of capital for labour.

On and off-farm labour allocation decisions are important because when a given amount of farm household labour is used off-farm, the farm becomes managed on a part-time basis. This can have profound implications for farm investment decisions and the possibility to survive in the future (Weiss, 1999).

The outmigration of farm labour is perceived as one of the main causes of the declining number of farms. Indeed, when the amount of labour used on-farm reaches a given low critical level, it is more likely to quit farming generating a decline in the number of farms (Goetz and Debertin, 2001). This latter phenomenon is generally studied by considering the net exit rate that is the difference between exit and entry from the farm sector. However, in most cases, the entry into farming is way less important quantitatively than the exit from farming. Therefore, in many cases, the reduction of farm number over time is driven by farm exits.
The introduction of new technologies has often accelerated the substitution of capital for labour, a process that have been the focus of a large body of theoretical and empirical analysis. This is because it has relevant implications for the evolution of other structural attributes including farm size. Indeed, the reduction on the demand for labour resulting from such substitution requires farms to grow in order to justify a given level of management and labour costs (Weiss, 1999).

B. Causative factors of structural change

Structural change are caused by a large set of factors that have been classified by Brinkman and Warley (1983) in the following groups: sector factors, public factors, macro factors, other factors.

Given the topic of the evaluation, it has been decided to focus on those models that explicitly account for the role of agricultural policy. However, within this group of theories, it has been decided to select those models that allow for the inclusion of what are perceived as the most important non-policy drivers of structural change. In this way it is possible to consider a large set of drivers into a coherent theoretical framework suitable for analysing the role of agricultural policy and to separate the impact of this from the impact of non-policy factors.

A non negligible number of studies account for the role of agricultural policies. However, none of these theoretical studies explicitly account for the heterogeneity of forms characterising existing direct payments. In particular, it has not been found theoretical literature analysing separately coupled and decoupled payments. Therefore, the considered theories of structural change have been further developed in order to account for this aspect that seems relevant for the current evaluation.

On the basis of the previous considerations, it has been chosen to use two main models that explain the role of agricultural policies (including direct payments), as well as other non-policy factors, on the following two main aspects of structural change:

- labour allocation decisions and farm exit
- substitution of capital for labour and expansion of continuing farms.

3.4.2 Labour allocation decisions and farm exit

A special emphasis has been given by several Authors to the theory of net farm exits (e.g. Goetz and Debertin, 2001; Kimhi, 2000; Kimhi and Bollman, 1999). The approach proposed by Goetz and Debertin (2001) has a number of attractive characteristics. First, as it is generally done by the household economics literature, it considers the on/off-farm labour allocation decisions. Indeed, on/off-farm labour allocation decisions have direct consequences in shaping the whole organisation of the farm and, thus, its structure.

Second, it considers the role of several causative factors including: product and factor prices, riskiness of farming activities, government payments, off-farm wage level, non-pecuniary benefits of being self-employed, regional unemployment rate, off-farm work transaction costs due to, for example, transport costs from farm to off-farm working place. Note that the last two factors are linked to farm location. Farms located in very remote areas with high unemployment rate or where job opportunities are available only far away from the farm should have, all other things held constant, a relatively higher level of on-farm use of labour than similar farm households located in other areas.

Third, the considered model allows for a relatively simple representation of the problems at stake by considering farmer’s decision using a static diagram that highlights the effect of the previously described factors on on-farm and off-farm work choice and, in turn, farm exit. This can also have negative consequences on the total amount of labour used in the sector and, in general, to the decline of rural population and the viability of rural economies (Goetz and Debertin, 1996).

3.4.2.1 Description of the theoretical model

In deciding whether to quit or to continue farming, farm proprietors compare the utility derived from continuing to farm with the utility deriving from quitting and becoming fully employed off-farm, relocating, or retiring.
This decision can be presented by comparing the present value of expected utility in the following way. Let’s denote the present value of expected future utility derived from farming at time t as Vtf, while that from quitting as Vtq. The farmer quits if: Vtf < Vtq. He (she) continues to farm if: Vtf > Vtq. Note that in the following period (say, t+1), a new comparison should be made to decide whether to continue or quit farming.

Utility depends on consumption levels, which, in turn, depend on income or returns to labour (and capital) invested per unit of time in agriculture or in off-farm work. Utility is maximised subject to the following constraints:
- a budget constraint considering farm income (including direct payments), off-farm wage and non-labour income;
- a time allocation constraint that allows to use all available labour into farm, off-farm and leisure time;
- existing farm production technology.

The considered model focuses on farm allocation decisions considering that farm proprietor households maximise a utility function (U) containing as arguments: goods consumed (c), leisure time (dl), non-pecuniary benefits of being self-employed (su), and exogenous shifters (α) (i.e. other factors not explicitly accounted for that can affect the position of the utility function such as, for example, change in individual preferences):

\[ U = U(c, dl, su; α) \]

This function is maximised subject to the following income (2) and time (3) constraints:

\[ Q(K, df; β) + G - pk K + wm do - f(T) + A = c \]
\[ D = dl + df + do \]

Where:
- p denotes farm output price
- Q(K, df; β) is the farm production function in which: K is the quantity of variable non-labour inputs, df is the amount of days worked on-farm; β is a vector representing other fixed characteristics of the farm and its proprietor
- G denotes total farm government program payments such as direct payments
- pk is the vector of prices of variable non-labour inputs
- wm denotes the daily off-farm market wage
- do is the amount of days spent in off-farm employment
- f(T) is total transaction costs associated with working off the farm
- A denotes unearned (i.e. non labour) household income
- D is the total time available (days) \(^{16}\).

Non-pecuniary benefits of being self-employed are included in the representation of the utility function (By means of the parameter su in equation 1) because Hamilton (2000) finds that self-employed individuals behave as if there are sizeable nonmonetary benefits to work in a self-employed business. This is because the median earnings “are always less than the predicted starting wage (for zero job tenure) available from an employer” (Hamilton, 2000: page 606). This condition could be also found in the context of farming (Huffman, 1996).

Because consumption is expected to increase utility and its level is constrained by income (Constraint 2), it is likely that the farm proprietor households look to reach a satisfying level of income. Assume by now that their objective is to maximise their household income (Constraint 2). In this case the

\(^{16}\) Variables c, K, do, d, are restricted to be non negative.
optimal labour allocation requires to equate the marginal value product of the labour used on-farm (MVP) with the expected level of (off-farm) market wage.

Assuming decreasing marginal productivity of labour and a perfectly competitive market for the farm product (i.e. a price taker farm), the considered problem can be represented by the following diagram (Fig. 2).

The horizontal axis represent the total amount of available working days (D). A given point on this axis moving from the left to the right represents the amount of days worked on farm (df), while the remaining part of the axis at the right of this point represents the sum of the remaining days used for leisure and to work off-farm (do). Shifting the point to the left means reducing the amount of days worked on-farm and increasing the amount of days worked off-farm plus leisure days. Therefore, movements from the right to the left could involve the decision to shift the organisation of the farm from a full-time to a part-time basis. When the optimal allocation point reach the left corner, it means that no days are spent working on-farm (df = 0), thereby exiting from production agriculture.

The value of on-farm labour marginal product (MVP) (i.e. the increase of revenues coming from an additional day worked on-farm) assumes the following form:

\[
\text{MVP} = p \times \text{MPP}
\]

where \(\text{MPP} = \frac{\partial Q}{\partial df}\) represents the physical marginal productivity of farm labour. It is very common to assume decreasing marginal productivity (i.e. marginal productivity declines as the use of the input increases).

**Fig. 2 - Farm and off-farm labour allocation decisions. Baseline conditions**

![Diagram](image)

Under the previous assumption and assuming the farmer is a price taker (i.e. his/her behaviour cannot influence the level of market prices), MVP declines when increasing the number of days worked on-farm. The level of MVP is measured in the left-side vertical axis.

The right-side vertical axis represents the level of market wage (wm). Assuming that the level wmo represents the expected market wage, the optimal (i.e. to ensure the maximum income) labour allocation is represented by point A.

### 3.4.2.2 Effect of changes in farm product price and market wage

The diagram in Fig. 3 can be used to represent first the impact of changing the level of the farm product price. For example, increasing the farm product price shifts up and to the right the MVP (MVPp+). This, ceteris paribus, has the effect of increasing the amount of days worked on-farm (point B).
This diagram can also be used to show the impact of changing level of market wage. For example, considering the original level of the output price (i.e. the original MVP), an increase of the level of market wage (wm+) has the effect of decreasing the amount of days worked on-farm (point C), ceteris paribus (Fig. 3). Indeed, the difference between expected earnings from farming and from other economic activities has been claimed to be one of the main causes of outmigration of labour from the farm sector (Harris and Todaro, 1970). Empirical evidence has been provided that farm labour is responsive to changes in the returns to agricultural labour relative to non-farm labour returns (Barkley, 1990).

Thus, an increase of market wage (a commonly encountered effect of the general economic development), ceteris paribus, should have the effect of pushing some full-time farm households to organise their farms on a part-time basis. In other cases, this trend could push some farm households to quit farming. This is the main way in which economic development has been seen as reducing farm number and affecting the structural change of the sector.

3.4.2.3 Effect of factors affecting the access to off-farm labour market

The expected net market wage is affected by two additional factors: the conditions prevailing in the labour market in terms of unemployment rate; the transaction costs associated with working off-farm.

In the migration literature, the expected wage rate (E(w)) is estimated taking into account the market wage (wm) and the unemployment rate (ur) in the following way (Harris and Todaro, 1970):

\[
E(w) = (1 - ur) \times wm
\]

In this way, unemployment rate can be seen as a measure of the odds of finding work or remaining employed. Under this framework, the unemployment rate affects the expected wage rate and, in turn, labour allocation decisions.
For example, if a decline in economic growth causes the unemployment rate to increase, this reduces the expected wage to the level indicated as \( w_{muv} \) in Fig. 4. If compared to the original level (also considered in Fig. 2 Point A), this results in an increase of the amount of labour used on-farm as shown by point E (see Fig. 4).

Another aspect that may limit the access to off-farm labour are transaction costs associated with off-farm work \((f(T))\). These costs can be subdivided in fixed and variable transaction costs and can take the following form (Goetz and Debertin, 2001):

\[
f(T) = T_0 + \tau\]

where \( T_0 \) is fixed transaction costs and \( \tau \) is unitary (i.e. per day worked off-farm) variable transaction costs.

Fixed transaction costs do not depend very much on the number of days worked off-farm (Huffman, 1996). This is because they include expenses associated with job searches and interviews, as well as with acquiring transportation, wardrobe, etc. (Goetz and Debertin, 2001). This category of costs has important implications on the choice to start working off-farm (e.g. moving from full-time to part-time farming), but does not affect the amount of days worked off-farm when a decision to do so has been taken.

The other way round, variable transaction costs are positively correlated with the number of days worked off-farms and mainly include costs of commuting from the farm to the working place. Variable transaction costs have the impact of reducing the effective wage earned from off-farm employment. This reduces the amount of days worked off-farm and increases the days worked on-farm. The level of variable transaction costs is strongly influenced by farm location. Thus, a farm household located in a remote farm area where off-farm working opportunities are only available at a relevant travel distance from the farm is facing a relatively lower effective wage than better located farm households. Therefore, ceteris paribus, farm household members living in a remote area should have an incentive to work a larger share of their available days on-farm than a better located farm family. Furthermore, this category of costs may also influence the decision of quit farming if, for instance, relocating into a city or industrial area sufficiently reduces travel time and costs.

The effect of a change of variable transaction costs on labour allocation decision can be represented in Fig. 4 as the effect of a decrease of the effective wage rate (say at level \( w_{muvtc} \)). Therefore, the graphical representation is very similar to that previously described and referred to as an increase of unemployment rate (e.g. point F).
3.4.2.4  Effect of agricultural policies

Agricultural policies can affect labour allocation decisions in two main ways. The first is by decreasing the level of risk associated with farming. The second is by directly supporting farm income. Here the discussion is extended to cover two of the main categories in which agricultural policies are supporting farm income: price support and direct payments. Indeed, to keep the discussion simple, the analysis is developed by taking into consideration first a one-product farm model and then moving to the multi-product case.

A. Price policies

Price policies increase and stabilise the level of output prices. In this way they increase farm returns and income, and provide an incentive to increase production level. This latter increase is pursued by increasing the amount of resources (e.g. labour and land) used in the production process. Therefore, in general terms, this should have a non negligible impact on labour allocation decision, too. Indeed, given that the support can be seen as a supplement to unitary prices, this policy affects the original labour allocation optimal condition as an increase of product price. Indeed, the unitary price support provided by the price policy (pp) enters in the marginal value product of labour in the following way:

\[ \text{MVP}_{pp} = (p + ps) \text{ MPP} \]

Therefore, the impact of price support can be represented as an up-ward shift of the marginal value product as depicted in Fig. 5 (VMPpp).

In the considered simplified setting, a price support should result in an increase of the number of days worked on-farm (from point A to point H, in Fig. 5).

However, price policies also have the effect of reducing price variability because they generally prevent the prices from getting below given thresholds. Mishra and Goodwin (1997) show that, under given assumptions\textsuperscript{17}, a decrease of the variability of farm output price generates an increase of the amount of labour worked on-farm for a risk-averse farm proprietor. Because this type of economic agents generally discount the marginal value product of labour, for them price policies, by means of their stabilising role, further shift up the marginal value product curve (MVP\textsubscript{pp}') resulting in a further increase of the number of days worked on-farm (H') (Fig. 5).

\textbf{Fig. 5 - Farm and off-farm labour allocation decisions. Impact of price policies}

\textsuperscript{17} This is to assume farmers’ behaviour can be represented as the result of having a Neuman-Morgenstern utility function (Mishra and Goodwin, 1997).
B. Direct payments

Direct payments affect labour allocation decisions in a more indirect way than price policies. Furthermore, their effect changes according to the nature of direct payments. This is because direct payments can be coupled to the production level, to the amount of land or heads of livestock (i.e. partially coupled) or can be decoupled from production.

Let’s assume that the total amount of direct payment a farm receives \( G \) may be affected, directly or indirectly, by the amount of days worked on-farm \( (df) \) and by other farm specific characteristics \( (\gamma) \) (e.g. current and past production patterns, farm location) yielding the following generic and very simplified form:

\[
G = g(df; \gamma)
\]

If direct payments are coupled to production (coupled direct payment, cdp), this results in an incentive to produce and to use more resources, including labour.

Under this conditions, it is likely that increasing the use of labour on-farm may result in an increase of the total amount of direct payments received by the farm:

\[
(\partial G/\partial df > 0)
\]

In this case, the marginal value product of labour results to be:

\[
MVP_{cdp} = MPP + \partial G/\partial df
\]

Under such conditions, the coupled direct payments should result in an up-ward shift of the marginal value product \( (MVP_{cdp}, \text{in Fig. 6}) \). This, ceteris paribus, generates an increase of days worked on-farm say to level M in Fig. 6.

Very similar considerations can be made regarding those payments that are provided on the basis of the amount of cropped land or heads of livestock. In this case, the introduction of the payment induces the farmer to increase the cropped area or the number of heads. Given that some work is needed to do so, it is likely that, under the one-product farm assumption, this results in an increase of days worked on-farm.

Moving to the multiple-product farm case complicates the analysis. This is because the introduction of the payment (coupled or partially coupled) could result in a change of production mix. Under these circumstances, it is difficult to ascertain whether the payment induces the farmer to use a greater amount of labour on-farm. Indeed, if the payment provides an incentive to increase the level of an activity that is relatively less labour intensive than the other performed on-farm, this should result in a decrease of the overall number of days used on-farm.

Fig. 6 - Farm and off-farm labour allocation decisions. Impact of coupled and partially coupled direct aids
The case of a fully decoupled payment is easier to treat. Indeed, because a decoupled payment does not affect production choices, it is likely that the marginal value product of labour is not affected by the level of the payment. However, it is worth noting that decoupled payments in the EU are granted in full only if farmers retain land and fulfil conditionality requirements. This requires a minimum use of labour on-farm (even if all land is left idle) and requires to not quit farming.

Therefore, substituting a decoupled payment for a coupled payment can have an impact on labour allocation decisions. In particular, if the coupled payment has been inducing an increase of labour use, decoupling should induce a decline of the number of days worked on-farm. This can have the effect of reducing labour intensity (expressed as labour to land ratio) in the case farmers reduce the amount of available land to a lower extent than labour use. This may be very much the case when farmers decide to leave some land uncultivated but they keep it in order to receive the decoupled payment.

### 3.4.2.5 Hired vs. family labour

So far it has been considered only one type of labour. However, it is also interesting to extend the analysis by considering that labour can be provided by different sources. Indeed, while a large share of the labour in the EU farm sector is provided by family members, in some types of farming (e.g. large farms) the relative importance of hired labour is relevant. One of the labour related decisions on farm is to substitute hired labour for family labour or vice-versa. This choice could be influenced by several factors including the relative price of hired labour.

The factors affecting the level of use of labour on farm, including agricultural policies, can affect not just the total amount of labour used on farm, but also the relative importance of this two types of labour. In particular, it is possible that, if some external factors create an incentive to reduce the amount of labour to be used on-farm, this will affect more the hired workers than family members. Therefore, it could be useful to empirically analyse not only the total amount of labour used on farm (e.g. intensity of labour use per unit of land), but also the relative importance of hired labour on the total amount of labour used in the sector.

### 3.4.2.6 Synthesis of the main results derived from the model regarding labour allocation and farm exit

The theoretical analysis developed so far on the basis of the approach proposed by Goetz and Debertin (2001) suggests that, under the considered conditions:

- Higher off-farm wage levels decrease the amount of days worked on farm;
- Lower unemployment rates decrease the amount of days worked on farm;
- Higher off-farm work transaction costs increase the amount of days worked on farm;
- Higher farm product prices increase the amount of days worked on farm.

Regarding agricultural policy, the analysis shows that higher direct payments generate a less variable and higher income. In this way, it is plausible that these payments increase the share of days worked on-farm and, under the simplified conditions considered so far, this reduces the rate of exit from agriculture.

However, there is a difference between the effects of coupled and decoupled payments. Because the latter provide a very limited incentive to increase production level and/or the use of resources on farm, decoupled payments should result to have a more limited impact on labour allocation and farm exits.

The role of both types of direct payments should be analysed also from a different perspective. Indeed, direct payments provide additional income that could be invested on farm. This topic is developed in the next sections that consider the determinants of investment behaviour and the process of substitution of capital for labour and growth of farm size.

### 3.4.3 Substitution of capital for labour and expansion of continuing farms

This section deals with the impact of farm policies in the substitution of capital for labour. The substitution of capital for labour is one of the main topic considered by the literature on agricultural structural change. Indeed, Tweeten (1989, page 9) writes: "Among the numerous elements identifying
the structural transformation of American agriculture, none is more basic than the substitution of capital for labour”. This topic is clearly linked to investment process. Therefore, this section starts with a paragraph that briefly explains the determinants of investment behaviour while the following paragraph explores the process of substitution of capital for labour and link this to the expansion of continuing farms.

### 3.4.3.1 Determinants of investment behaviour

This section briefly introduces some concepts referring to the process of farm investment and to the main determinants of this process, including agricultural policy. The investment process is one of the main factors affecting structural change and the determinants of farm structure are to a large extent the same that affect investment (Atwood et al., 2002). Indeed, because “land and capital are to some extent complements and land itself is commonly included among investment options, ..., much of the reasoning concerned with farm structure is applicable to explaining the choice of capital stock.” (Gallerani et al., 2008: page 34). In particular, when capital stock is allowed to change, investment decisions allow for the entry and exit from the sector, for the change in farm size, for the introduction of innovations on the farm and for the substitution of capital for labour. This latter topic is further developed in the next section, while the following paragraphs focus on the factors affecting investment decisions strongly relying on the work developed by Gallerani et al. (2008), Viaggi et al. (2011a, 2011b, 2011c).

Farmers have to take a number of decisions regarding investments, including: which investment to undertake, when, with what intensity, where, how investments are funded (Gallerani et al., 2008). This decision process may be represented as a cyclical process influenced by the external business environment including government policies (Hay and Morris, 1991). Indeed, many are the factors that can affect investment behaviour and a review of empirical work on this topic is provided by Gallerani et al. (2008: page 27). These factors can be grouped into investment characteristics, farm characteristics, product and factor markets, household characteristics and farmer’s attitudes, and policy. The review by Gallerani et al. (2008) shows that a very limited number of empirical work explicitly account for this latter factor even if policies affect product and factor markets through coupled and decoupled measures, general taxation and government farm payments that, according to Serra et al. (2008), are found to discouraging off-farm investment.

The issue of investment behaviour is dealt by the literature that has been classified by Gallerani et al. (2008) under the following different aspects: Multiple objectives of investment decisions; Farm perspectives; Household perspectives; Financial perspectives; Other issues.

The first perspective deals with the fact that decision-makers may pursue objectives other than profit maximisation such as, for example, risk reduction and household-oriented objectives. The investment literature explaining the sluggishness observed in the adaptation of capital over time can be classified under two broad branches (Gardebroeck and Oude Lansik, 2004): analysis based on adjustment costs and analysis based on asset fixity. Adjustment costs is one way to explain why firms in each period only partially adapt their capital stock to the optimal level (Gallerani et al., 2008). Their size can be affected by a number of interlinked factors including transaction costs. As already discussed earlier, asset fixity is caused by the existence of a difference between the acquisition cost and the salvage value of capital. This difference can be due to the specificity of the investment and to the transaction costs that arise from such specificity. This explains why investment decisions have been considered also in studies on the contract theory of investment to explain phenomena such as the incentive provided by long-term contracts or the reasons for vertical integration. Uncertainty affects investment decisions. The literature on investment-related uncertainty has supported the idea that “increasing uncertainty can lead to reduced investment” (Gallerani et al., 2008: page 33). The problem of uncertainty is also linked to investment irreversibility, to the description of the investment process as a learning process and to efficiency issues (Gallerani et al., 2008).

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18 However, Abel and Eberly (1994) combine the two approaches in a unified model of farm investment under uncertainty.
Few recent studies have focused on the effect of agricultural policy on investment and most of these focus on decoupling (Gallerani et al., 2008). Decoupling can have at least three potential effects that are relevant for investment behaviour (Andersson, 2004). It can: a) increase the propensity to invest if this relaxes financial constraints, b) increase the propensity to consumption, c) decrease the propensity to technological innovation relative to coupled support that can provide a stronger incentive than decoupled support. The extent of the first effect largely depends on the degree of imperfection in the credit market. Indeed, under imperfect capital markets (e.g. binding debt constraints for farmers willing to invest), policies that increase income translate into a higher propensity to invest (Gallerani et al., 2008).

A recent body of empirical analysis has investigated the effects of decoupling on investment decisions (OECD, 2005a, 2005b, 2005c; Sckokai and Moro, 2006; Viaggi et al., 2001a, 2011b, 2011c). These studies ascertain that policies have a significant impact on investment in machinery, buildings and equipment and confirm the risk aversion hypothesis. However, different policy designs may lead to contrasting effects on investment. Additional complexity arises from the fact that different farmers can use the funds provided by decoupled subsidies in a different way. Goodwin and Mishra (2005) found that a large share of decoupled payments is generally used on the farm. However, only part is used for farm investment and the remaining share of decoupled support is used for other purposes including household consumption.

Policies affect farm investment decisions also by changing farmer’s policy expectations and the degree of certainty involved in future policy settings (Gallerani et al., 2008). As an example, Lagerkvist (2005) studied how farmland investments can be affected by the uncertainty regarding an expected policy reform considering the case of the introduction of a single farm payment.

### 3.4.3.2 Substitution of capital for labour and expansion of continuing farms

Several factors, including the evolution of relative factor prices, technological change and agricultural policy, affect this process. Given the topic of this evaluation, this section of the theoretical analysis considers all these three factors placing more emphasis on the impact of agricultural policies.

The substitution of capital for labour has been incentivised by the growing opportunity cost of labour relative to the price of other factors of production (Tweeten, 1989). The rise of non-farm incomes serves as an incentive to leave agriculture while the remaining land is left to fewer but larger farms. Therefore, out-migration of farm labour and the growth of farm size are two aspects of the same economic process (Kislev and Peterson, 1982). Technological innovations have made available labour saving technologies and have made easier to substitute other factors for labour. The change in the relative weight of labour vs. capital represents one of the main aspects of structural change not only per-se, but also because it could induce growth in farm size.

The increase of farm size has also been claimed to be caused by the goal of exploiting scale economies. While some doubts have been raised on the real magnitude of such scale economies (Goddard et al., 1993), it is also true that technological innovation is biased in favour of large farms because some new technologies (e.g. mechanical) are found to be convenient only in farm operating over a given scale of production (Weiss, 1999). Indeed, the adoption of such labour-saving technologies has been easier for larger farms (Glauben et al., 2006) that are often characterized by a low labour/capital ratio.

The following section deals with the role of farm policies in the substitution of capital for labour, technical innovation and growth in farm size. This is done by considering first a single farm model. Given the heterogeneity of farm structures (e.g. in terms of size) and the fact that agricultural policies affect a large share of farms in the sector, the analysis is than extended to consider these two aspects.

#### A. Effects of agricultural policies in the substitution of capital for labour and investment decisions at the farm level

Both Pillar 1 and Pillar 2 policies of the CAP affect investment decisions. In particular, some measures of Pillar 2 policy directly provide an incentive to farm investments by way of reducing the investment
costs. When this allows for the introduction of labour-saving technologies, it could also reinforce the substitution of capital for labour, thus increasing capital intensity (i.e. per annual work unit).

Other measures of Pillar 2 policy provide an incentive to move to a more extensive use of land that may cause a decrease of capital intensity in terms of capital per utilized agricultural area. However, given that the evaluation focuses on direct payments, the analysis is focused on Pillar 1 policies.

The analysis is based on a theoretical model on capital and labour utilisation on farm presented by Goetz and Debertin (1996) that explicitly accounts for the role of farm policies. Fig. 7 represents an hypothetical equilibrium reached by a single-product profit-maximizing farmer in terms of the use of the only two factors: labour (L) and capital (K).

Let’s assume that the farmer operates in a perfectly competitive market framework in which product, capital and labour prices are exogenously determined (i.e. not influenced by farmer’s behaviour) and denoted by \( p_y \), \( p_L \), \( p_K \). For example, the level of labour and capital prices, reported in the axes of the third quadrant (lower left side) of the Fig. 7 could be placed at the levels \( p_{La} \) and \( p_{Ka} \).

Fig. 7 - Capital and labour utilisation on a single farm

![Diagram of capital and labour utilisation on a single farm]

Under these conditions, marginal value products for labour and capital take the following form:

\[
MVPL = MPPL \, p_y \\
MVPK = MPPk \, p_y
\]

Where \( MPPL \) and \( MPPK \) represent the marginal physical product of labour and capital (i.e. \( \partial Q/\partial L \) and \( \partial Q/\partial K \) where \( Q \) denotes the quantity produced). Assuming a decreasing marginal product of both inputs, the graphical representation of \( MVPL \) and \( MVPK \) could be those represented in the second (lower right) and fourth (upper left) quadrants of Fig. 7.

Assuming that there is not government intervention, the optimal is reached when labour and capital reach the levels that satisfy the following equilibrium condition:
MVPaL / paL = MVPaK / paK

Graphically, this requires the use of labour and capital at the levels indicated by La and Ka respectively on the x-axis and on the y-axis of the first quadrant (upper right side) in Fig. 7. This initial equilibrium corresponds to the capital-labour ratio ([K/L]a) represented in the first quadrant as a straight line exiting from the origin.

The initial effect of a direct payments, when converted into euros per unit of output (f), is to shift both labour and capital MVPs schedules upward to the levels indicated by MVPa’L and MVPa’K (Fig. 8). This is because:

\[
\text{MVPL} = \text{MPPL} (py + f) \quad \text{and} \quad \text{MVPK} = \text{MPPK} (py + f)
\]

As already pointed out by Johnson (1991), this results in an increase of farm income and of the use of both factors that now reach the levels indicated as ‘La’ and ‘Ka’ (Fig. 8).

**Fig. 8 - Direct impact of farm program payments on capital and labour utilisation**

The introduction of a direct payment does also have an additional effect. The area between MVPa’L and MVPaL as well as the area between MVPa’K and MVPaK (Fig. 8) represent surpluses available to the farmer for his/her needs including for reinvestment in the following production periods. This generates a further outward shift in the MVP curves of both inputs (MVPbL and MVPbK) (Fig. 9).

However, empirical evidences suggest that farmers are more likely to invest in labour-saving equipment (e.g. machinery) (Johnson, 1991; Tweeten, 1989). Thus, the reinvestment is likely going to introduce labour-saving technologies that increase the optimal capital-labour ratio. This phenomenon is represented by a rotation to the left of the capital-labour ratio line from [K/L]a to ([K/L]b) (Fig. 9).
Fig. 9 - Final impact of farm program payments on capital and labour utilisation

The forces that lead to the adoption of labour-saving technologies are also interconnected with the often observed trend of increasing the relative price of labour over time (Kisley and Peterson, 1982). Indeed, as observed by Johnson (1991, page 89): “The flow of innovations available to agriculture will not diminish so long as such innovations offer prospects for profit. Since it is inevitable that farm labour will continue to become more expensive relative to output prices, there will be a continuing incentive for the creation of innovations that will provide effective substitutes for labour”. Thus, it is likely that this process drives the labour price up as it is represented by the new level pLb in Fig. 9.

All these elements result in a reduction of labour utilization to level Lb and in an increase of capital utilization to level Kb (Fig. 9).

On the basis the results derived by using the theoretical model developed by Goetz and Debertin (1996), it is possible to conclude that, in the short-run, direct payments may contribute to maintaining a level of labour used on-farm higher than in the case such payments were not granted.

However, in the longer run, direct payments may contribute to a reduction in farm labour use over time because they generate a surplus available for the farmer to invest in new labour-saving technologies. This increases the speed of the restructuring of the farm in terms of labour use and farm number. Investing in labour-saving technologies reduces the labour to capital ratio and, when a family farm is not able or willing to lay off family members, this creates pressure to purchase or rent more land and expand production. This provides an incentive to increase farm size and to reduce the number of farms in a region. This is consistent with the results of empirical analysis that have found positive relationships between government payments and farm size (Ahearn et al., 2005; Key and Roberts, 2007; Yee and Ahearn, 2005).

So far, we have considered that all surplus generated by direct support policies will be reinvested on farm. However, it is important to stress that this is not necessarily true given that farm households have a multiple set of possible uses for this surplus. Furthermore, it seems that the way such support is given can influence this choice. In particular, it is important to consider possible differences in the impact of coupled and decoupled payments.

The support provided by direct payments (as well as by other measures of support) positively affects farm income. This increases the capacity to consume and to invest according to the amount of
payments and the time horizon in which these payments will be granted. However, the choice of how much to increase consumption and investment depends on household preferences and characteristics. A graphical representation of the possible use of the income in farm households is provided by Fig. 10.

**Fig. 10 - Possible use of the income in farm household**

Only a share of the surplus provided by direct payments is directed towards investment and only a share of this is used to invest on-farm. The amount of resources invested on-farm depends on several factors including the relative profitability of farming and the way the support is provided. Investing on-farm is a way to decrease production cost and to increase farm economic performances. However, if the opportunities to increase farm income are not very attractive, a large share of resources could be used for off-farm investments. The possibility to rely on a flow of direct payments (even if decoupled) clearly enhances the possibility to invest on farm. This is particularly true when the farm is facing financial constraints that may have reduced on-farm investments in the past. While this increases the self-financing possibility, it also increases the possibility of access to credit because the possibility to count on a relatively constant flow of payments increases farm income, reduces income variability and the riskiness of farm investments. All these factors provide an incentive to increase on-farm investments and positively influence the likelihood of farmers to obtain credit.

The amount of surplus to be used for on-farm investment can also be affected by how the support is provided. Here, the difference between coupled and decoupled direct payments is important to be mentioned.

If direct payments are coupled to production, farmers can increase the amount of payments received by increasing the production level (if the payment is proportional to production level) or by increasing the amount of land or the number of livestock heads on which the payments are granted. This provides an incentive to use the surplus generated by the policy on farm. Indeed, this strategy allows for increasing the amount of payments the farmer receives in the future. Therefore, direct payments provide an incentive to invest on farm that is additional to the usual forces that may drive on-farm investments.

However, if the payments are decoupled from production, there is a lower incentive to invest on farm. While investing on farm could generate an increase of farm economic performance, it is not going to increase the amount of payments received\(^{19}\). On the basis of this reasoning, a given amount of

\(^{19}\) When decoupled payments are tradable, the farmers could use the surplus to buy additional entitlements. While this is going to increase the amount of payments the farmer will receive, it is likely that he/she will pay each entitlement a price that is approximately the discounted value of future flow of payments each entitlement will generate (considering also the uncertainty on the future level of payments and the fact that the entitlement will expire as a new CAP reform will take place). Therefore, the scope for this peculiar investment seems relatively limited (Swinnen et al., 2010).
decoupled payments could not generate an incentive strong enough as the one that is provided by the same amount of coupled payments. Moreover, in those farms where the profitability is limited, the availability of decoupled payments could provide an incentive for investing off-farm in order to accelerate the reorientation of farm resources out of a relatively less attractive farm business.

B. Substitution of capital for labour: implications for the farm sector

So far, the analysis has focused on the implications of direct payments on the restructuring of a single farm. Here the analysis is extended to consider that in the sector there is a large heterogeneity of farm structures (e.g. small and large farms), that farms compete for the available resources, and that the adjustment process affect a large number of farms at the same time. This latter aspect underlines that agricultural policies can affect the markets for all inputs used on-farm, noticeably, the land market.

Farms can have different size, therefore the forces behind their restructuring can act in a very heterogeneous way. In particular, Robinson (1975) has supported the idea that agricultural policies can preserve the inefficient farms, reducing the number of farms that could have quit without such policies. Following this reasoning, it is possible to say that agricultural policies reduce the pace of structural change. This theory relies on the hypothesis that smaller farms are less efficient and have higher costs than larger farms due to the presence of economies of scale (Robinson, 1975). For this reason, periodic (i.e. recurring over time) low farm product prices cause farms with limited net income to exit and to make available their resources including land. These resources could be consolidated into larger farms that could continue to grow in size. Agricultural policies such as price policies prevent the reduction of the income of all farms but, according to Robinson (1975), their impact is more relevant for small farms. Indeed, such policies prevent the periodic wringing out of less efficient farms and, in turns, retard the consolidation process.

A very different conclusion stems from the so called “cannibalization” mechanism proposed by Cochrane (1979). When policy support is positively correlated with farm size, the residual profits generated by this support may be larger for larger farms. This allows larger farms to bid resources away from smaller farms and raises the value of assets, primarily farm-land, beyond the bidding ability of smaller farms. This mechanism seems consistent with what has been described in the previous section regarding the impact of agricultural policies on the substitution of capital for labour at the farm level. Indeed, larger and more efficient farms may obtain larger surpluses from subsidy programs because they have relatively higher market income levels.

The “cannibalisation” mechanism is very likely to be present when support is provided by price policies, given that the support is proportional to production and that a larger share of production is generated by large farms. However, according to Harrington and Reisel (1995), the tendency to “cannibalisation” remains also when the support is decoupled from current production because it is based on historical production and it is still capitalised into the value of land, a topic that is developed further in the next paragraph. The main implication of this theory is that support, especially if coupled to production, accelerates farm structural change. However, given that most of the support provided by direct payments is decoupled, it is important to empirically test how influential they are.

The very different conclusions from the previous two mentioned theories come with no surprise, given the complexity of the process of structural change. Indeed, empirical evidences have been found supporting both the Robinson’s and the Cochrane’s hypotheses (Harrington and Reinsel, 1995). While in the short-run agricultural policies keep smaller or less efficient farms from being forced out of business, in the long run the same policies may accelerate farm structural change in terms of reducing the number of small farms and increasing the size of surviving farms.

An additional component of structural change comes from the implications of farm investment decisions on market prices. Two cases are considered here: the implications of agricultural policies on product prices and on land price levels.

The Cochrane “technological treadmill” theory is a well-know explanation of structural change that focuses on the adoption and diffusion of technology (Cochrane, 1958). An innovation reduces the expected production cost shifting the farm’s marginal cost function down and/or to the right. This provides an incentive to adopt the innovation because, as output prices remain unchanged, this results...
in temporary benefits for early adopters. However, diffusion of the innovation increases market supply making farm commodity prices fall. This forces other farmers to adopt the innovation even if this allows them only to remain competitive. However, some of these farms may not succeed in making the required changes, thus becoming uncompetitive and, in the long run, exiting from the sector. Furthermore, the resulting decline of output prices reduces the benefits for early adopter.

To summarise, the “technological treadmill” theory supports the idea that each individual farmer has an incentive to adopt the new technology, even though their collective adoption decisions will make them no better off. The support provided by agricultural policy may accelerate this process providing resources to invest in the new technology and by increasing production level. However, this latter element applies only to coupled policies such as price support and coupled payments and not to decoupled payments.

A large body of literature suggests that a share of the benefits deriving from agricultural policies are capitalised into the value of land (see, for example, Johnson (1991), Cochrane (1965)). The farm based model previously discussed has shown that the surplus generated by direct payments is used to reinvest on-farm. This means that it could also be used to acquire more land. This increases the demand for land and, given that the supply of land is relatively fixed at the local level, this could lead to an increase in land prices and rental rates (Harris, 1977)

Increasing land prices has direct implications for structural change. High land prices increase the funds needed to expand farm size and, according to Johnson (1991), this leads to less farm consolidation and a larger farm population. Thus, agricultural policies that increase land prices are expected to slow down the reduction in farm number, retard farm labour out-migration and structural change (Goetz and Debertin, 1996).

However, some counterarguments have been provided against this way of reasoning. First, the capitalisation of farm program benefits into land prices could constitute a barrier to entry into farming and this increases the net exit rate and leads to more rapid farm consolidation given that entry farms are often relatively small in size. Second, given that farms can have a very different bidding ability, the increase of land price does not affect all farms in the same way. In particular, this may negatively affect the position of small farms provided they often have a bidding ability smaller than larger farms. This could support the restructuring of the sector.

It is worth noting that, while this process could have positive consequences on the competitiveness of the farm sector, the reduction of the number of farms and the increase of their size, increases the concentration of production and land (Roberts and Key, 2008) on a relatively small number of large farms. A recent work by Piet et al. (2011) has analysed the role of different drivers, including agricultural policies, on the concentration of land in France. The main findings of this study are that policy measures significantly affected farm size inequality. In particular, the analysis has shown that CAP direct payments, as well as agro-environmental and LFA payments, have contributed to decreasing the inequality of the distribution of farm size in the considered period (Piet et al., 2011). This process has been claimed to threaten the existence of family farming in Europe (CSA, 2011).

The impact of agricultural policies changes according to how the policies are designed. For example, recent analysis have discussed and produced some qualitative evidences on the influence of CAP on the EU land market (OECD, 2011; Swinnen, Ciaian, d’Artis, 2010). While it is difficult to draw general conclusion, due to high heterogeneity of conditions and the effect of many relevant factors affecting land prices (e.g. the institutional and legal framework), Swinnen et al. (2010) suggest that the capitalisation of direct payment support into land prices: is higher with hybrid than historical models of implementation; is stronger in marginal less fertile lands (e.g. grassland); affects rental rates more than it affects sale prices.

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20 This mechanism could apply to fixed assets other than land. However, the case of land is the more relevant.
3.4.3.3 Synthesis of the main results derived from the model regarding substitution of capital for labour and farm growth

The support provided by direct payments increases the capacity to consume and to invest as well as the likelihood to access credit. In this way, direct payments provide an incentive to invest on farm. Given the labour-saving bias of innovations introduced through investments, it seems logical to expect an increase of capital over labour ratio and a decline in the demand for farm labour. This latter phenomenon requires farms to grow in size in order to justify a given level of management and labour costs (Weiss, 1999). While both coupled and decoupled payments increase the possibility to invest on-farm, the incentive provided by decoupled payments is expected to be lower in comparison to the one provided by coupled payments.

The introduction of innovations has relevant implications for the overall farming sector. Provided that such innovations decrease the marginal costs of production, the resulting increase of supply should cause a decline in output prices.

This adds an additional pressure on small farms, that generally perform less well than for larger farms. and lessens their possibility to invest on-farm. According to the “cannibalization” mechanism proposed by Cochrane (1979), the support provided by agricultural policy could accelerate this process, provided that the residual profits generated by this support being larger for larger farms. In this case, larger farms can bid resources away from smaller farms. This could increase the demand for land and land prices (sale price or rental rate) even if this process is again expected to be more pronounced for coupled than for decoupled forms of support.

The increase of land price induced by farm policies can have different implications for structural change. Therefore, theoretical analysis is not able to provide a unique answer to the role of these policies on structural change. For this reason, the effect of these policies should be analysed empirically on a case by case approach.

Most of the elements considered so far are likely to accelerate the process of structural change in the direction of a reduction of the labour over capital ratio, a strong decline in the number of small farms and a consolidation of large farms. However, it is important to recall that in the short-run agricultural policies can preserve the inefficient farms reducing the number of exiting farms. Furthermore, small farms can survive provided that they use off-farm income (Gardner, 1992) and/or that, as it is often the case in small farms and in semi-subsistence farm households, farmers have a more complex set of objectives than maximising profit (Fritzsch et al., 2010).

The role of direct payments in supporting on-farm investment can differ according to whether these payments are coupled or decoupled to production. The former type of payments are perceived to provide a stronger incentive to on-farm investment than decoupled payments. Moreover, in those farms where profitability is limited, the availability of decoupled payments could provide an incentive for investing off-farm in order to accelerate the reorientation of resources off-farm.

Furthermore, if decoupled payments are granted under the condition that farmers should hold a given amount of land, this could result in a decrease of capital intensity in terms of capital per unit of utilized agricultural area. It is worth noting that the impact of decoupling in terms of capital intensity per unit of work cannot be assessed theoretically because decoupling also changes the use of labour.

3.5 Other themes covered by the evaluation

The theoretical analysis has served to develop a consistent framework considering together several factors affecting structural change and its main attributes. Particular emphasis has been given to labour allocation, number of farms, substitution of capital for labour, farm size growth because these are considered to be the most important structural attributes. However, because the evaluation questions focus on several structural attributes, it seems useful to develop further the discussion covering some themes that, although linked to the topics covered by the theoretical models, have not been directly analysed so far. In particular, this section analyses the organisation of labour on-farm and farm competitiveness. This allows to consider relevant topics including the organisation of part-time and pluriactive farmers, and the role of specialisation and diversification.
3.5.1 Organisation of labour used on farm: part-time and pluriactive farmers

The out-migration of farm labour could cause a decline in farm numbers but also an increase of part-time farming. While part-time farming is very important because it represents one way in which farm families can survive on their holdings (Gasson, 1991), it is also true that the analysis of part-time farming does not benefit from a universally agreed definition of this term (Martens, 1980). This is because it is a multivariate construct depending on, at least, three main actors: the farm, the household, the farm holder/manager (Martens, 1980). Furthermore, part-time farming can be defined according to the length of time spent on farm or according to the relative importance of on-farm income on the overall farm household income (Lund, 1991).

Analysis of part-time farming often focuses on the occupational status of the farm holder/manager. This is first due to data availability limitations, as an harmonised EU database on farm household is not available. Second, it is not easy to define who is belonging to the farm household. This is because the household should be considered as formed not just by those family members living under the same roof, but by those members who also put their resources in common (Martens, 1980).

The analysis of part-time farming is also linked to two topics that are important for the structural change of the farm sector: age structure of farm holders/managers and pluriactivity.

The out-migration of farm labour could be strongly biased towards specific classes of farmers. Given that off-farm employment opportunities are generally higher for younger farmers than for older farmers, this could result in an increase of the share of farms managed by older farmers. In this case the farm can be managed by using a limited amount of the available working days but the remaining days may not be fully used in off-farm occupations. A particular case of it is that of retired persons who manage small farms that require a limited amount of work. In this case, the farms result managed on a part-time basis but farmers do not have additional income coming from off-farm occupations. This is a very different category of part-time farming if compared with part-time farmers having off-farm employment therefore it should be analysed as a sub-category of part-time farming, if possible.

The age structure of farmers is also very important for structural change because life-cycle decisions may be important to farmers’ choices regarding on and off-farm labour and investment decisions (Kimhi, 2000). Indeed, it is worth noting that some agricultural policies in Pillar 2 are specifically aimed at fostering the intergenerational transfer of holdings providing an incentive: a) for older farmers to pass their farms to younger farmers; b) for young farmers to enter in the farm business.

Another important aspect of part-time farming is pluriactivity (Gasson, 1991). This is a strategy that the farm sector has developed in order to adapt to changes in the economic and social conditions including the declining relative remuneration of farm labour and the impact of labour-saving technologies. While this often refers to the participation of farm family members to the off-farm labour market (Huffman, 1980), the availability of off-farm income can influence farm strategies including investment decisions on-farm (McNamara and Weiss, 2005). This clearly interacts with the decision to run a farm on a part-time or full-time basis (Gasson and Errington, 1993).

The possibility to pursue a pluriactivity strategy depends on several factors including:

- the availability of a surplus of labour to use off-farm. This factor is strongly affected by the structural and productive characteristics of the farms.
- the ability of farm family members to meet the needs of the off-farm demand for labour in terms of labour characteristics. This is mostly influenced by specific education, skills and age structure of the farm family members.
- the presence of a strong enough demand for non-farm labour. This is mainly influenced by general economic conditions.

Note that not having the possibility to find off-farm employment may result in an increase of the use of labour on-farm even if it receives a very limited remuneration in this activity.

A large body of literature has been developed on the role played by part-time farming on structural change. The shift from full to part-time farming offers a source of off-farm income that can have a stabilising influence and can prevent a more rapid disappearance of small farms (Weiss, 1999).
However, it is still not clear if part-time farming is a stepping stone on the way out of the farm sector or not. Some studies support the idea that off-farm work is seen as a stable long-run combination with farming rather than a step towards exiting the sector (Kimhi, 2000). The relative stability of part-time farming has been seen by its opponents as having a negative impact because part-time farmers occupy land and delay land consolidation (Martens, 1980). In this sense, any factor, including policy, increasing the number of part-time farmers can be seen as detrimental to structural change.

Agricultural policy can also influence the extent of part-time farming. The theoretical model of labour allocation already discussed has shown that the support provided by direct payments can increase the amount of work used on farm and delay the exit of farms, also allowing part-time farming to survive. However, as already pointed out, the impact of direct payments depends very much on how these payments are granted. In particular, the decoupling of payments may encourage the move to part-time farming. Because the payments are granted only if land is available, but their level is not influenced by the production level, a farmer can choose to run the farm on a part-time basis. Indeed, this allows to allocate a larger share of his/her time to off-farm occupations and to maintain the land in order to continue receiving the payments.

3.5.2 Farm competitiveness: specialisation and diversification

The concept of competitiveness is linked to the capability of a farm to maintain the necessary conditions for staying in business whilst carrying on its activities. The conditions for staying in business are determined by cost and revenue balances from farming activities, also taking into account farm subsidies. The role of direct payments on investment decisions has been already discussed considering the substitution of capital for labour in the farm production process that is also connected with the process of technological innovation. Therefore, here the concept of farm competitiveness is approached in a broader sense.

Indeed, the possibility to continue farming can also be influenced by the amount of income generated by non-farming activities carried out both on-farm and off-farm. In particular, it seems relevant to consider whether direct payments have influenced farm business strategies in terms of specialisation and diversification.

Specialisation has been claimed to be another way of exploiting economies of scale and scope. Indeed, given that increasing farm size is often constrained by several factors (e.g. land market imperfections and financial constraints), scale economies can be reached by farm specialisation. However, this has implications on the organisation of work and in the use of capital. Furthermore, specialisation can have the effect of increasing farm risk. Agricultural policies supporting specific products (i.e. coupled) can induce further specialisation on farm. This is particularly the case when such policies also provide a way of stabilising farm returns such as it is the case for price policies and direct payments. However, decoupled payments should not provide an incentive for specific production and, thus, for specialisation.

Alternative farm business strategies (marketing or diversification) could be an instrument to develop farming activities in order to reach economic viability.

The concept of diversification has been defined in different ways. The definition by OCSE (2009) is based on a net distinction between on and off-farm activities and on the analysis of allocation decisions of land, capital and labour. However, other studies place more emphasis on farm business strategies. The concept of diversification by Van der Ploeg and Roep (2003) considers both conventional and unconventional activities carried out by farm families referring to 3 mains strategies:

- Deepening: it refers to strategies of valorisation of unconventional farm productions (e.g. organic farming, typical products) or different marketing strategies and forms of transformations of farm products.
- Broadening: it refers to strategies aimed at enlarging the number of activities that may not be linked to the production of farm products (e.g. farm tourism, landscape management)
- Regrounding: the allocation of family-owned factors also in off-farm activities.
3.6 List of References

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