



Comparative Analysis of Factor Markets  
for Agriculture across the Member States

245123-FP7-KBBE-2009-3



**WORKING PAPER**



**No. 31, October 2012**

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# **The Labour Allocation Decisions of Farm Households: Defining a theoretical model**

## **ABSTRACT**

This paper presents a theoretical model for the analysis of decisions regarding farm household labour allocation. The agricultural household model is selected as the most appropriate theoretical framework; a model based on the assumption that households behave to maximise utility, which is a function of consumption and leisure, and is subject to time and budget constraints. The model can be used to describe the role of government subsidies in farm household labour allocation decisions; in particular the impact of decoupled subsidies on labour allocation can be examined. Decoupled subsidies are a labour-free payment and as such represent an increase in labour-free income or wealth. An increase in wealth allows farm households to work less while maintaining consumption. On the other hand, decoupled subsidies represent a decline in the return to farm labour and may lead to a substitution effect, i.e. farmers may choose to substitute non-farm work for farm work. The theoretical framework proposed in this paper allows us to examine these two conflicting effects.

FACTOR MARKETS Working Papers present work being conducted within the FACTOR MARKETS research project, which analyses and compares the functioning of factor markets for agriculture in the member states, candidate countries and the EU as a whole, with a view to stimulating reactions from other experts in the field. See the back cover for more information on the project. Unless otherwise indicated, the views expressed are attributable only to the authors in a personal capacity and not to any institution with which they are associated.

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ISBN 978-94-6138-238-2

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# **The Labour Allocation Decisions of Farm Households: Defining a theoretical model**

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## **1. Introduction**

Well-functioning factor markets are a necessary condition for the competitiveness and growth of agriculture and for rural development. At the same time, the functioning of the factor markets themselves is influenced by changes in agriculture, in the rural economy and in EU policies. Member state regulations and institutions affecting land, labour and capital markets may cause important heterogeneity in the factor markets, which in turn may impact the functioning of factor markets and the interactions between factor markets and EU policies.

The overall objective of the Factor Markets project is to analyse the functioning of factor markets for agriculture in the EU-27, including the candidate countries. Furthermore, the objective is to compare the different markets, their institutional framework and their impact on agricultural development and structural change, as well as their impact on rural economies in the member states, candidate countries and the EU as a whole.

The objective of this deliverable is to set out a conceptual framework for the empirical analysis of labour markets. A theoretical model that can be used to describe farm households' labour allocation decisions will be presented and this model will be used in subsequent work packages to empirically test the factors that are hypothesised to affect labour allocation decisions.

The paper begins by presenting a brief review of previous farm household labour allocation studies. A theoretical model is identified from this review and the model is then described in more detail. The paper concludes by discussing the role of agricultural policy in labour allocation decisions and how such policies can be represented in the theoretical farm household model.

## **2. Review of labour allocation studies**

Given the increased incidence of off-farm employment i.e., farmers engaged in gainful non-farm employment, and the importance of non-farm income to farm households, the decision of farmers to participate in off-farm employment has been the subject of many studies and research papers. Lee (1965) was among the first to extend the standard labour leisure model to consider the special situation of farm operator households. Since then many studies of labour allocation by farmers and other members of farm households have been conducted. The empirical literature on estimating off-farm labour participation and supply covers a variety of issues. Huffman (1980) was the first to estimate off-farm labour supply and participation models for farm households. Since then, there have been many methodological improvements. Advances have included: the incorporation of a test for Heckman's sample selectivity bias and analysis with disaggregated data (Sumner, 1982); a recognition of the role

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of the spouse's decision-making and off-farm labour participation and the joint decision-making process between spouses (Huffman & Lange, 1989; Gould & Saupe, 1989; Lass & Gempesaw, 1992); the inclusion of local labour market considerations (Tokle & Huffman, 1991; Ahearn & El-Osta, 2002; Lass & Gempesaw, 1992); the impact of government payments on off-farm labour supply (El-Osta & Ahearn, 1996); the impact of the decoupling of direct payments on labour supply (Hennessy & Rehman, 2007); and the role of farm income risk in explaining off-farm labour supply (Mishra & Goodwin, 1997) are some notable studies.

A survey of the literature suggests that previous empirical studies of labour allocation decisions have generally focused on the characteristics of and the factors affecting off-farm labour supply and participation decisions. These studies identify the diverse variety of factors that influence the labour allocation decision. The general findings are the significant effects of human capital on labour demand and supply and the life-cycle effects of human capital. Huffman (1977 and 1980) presented evidence that investment in education and agricultural extension services increases farmers' off-farm labour supply by increasing the reallocative ability of farmers. Other studies have supported the significant influence of local labour market conditions, on the probability of supplying labour off-farm, focusing on the distance from a metropolitan area and the local rate of unemployment, among other factors. Sumner (1982) showed that urbanization positively influences the participation rate because of the increase in off-farm job opportunities. Tokle & Huffman (1991) proved the significant effect of local economic conditions such as the anticipation of labour demand growth, unemployment rates and share of employment in services.

The importance of farm characteristics and farm family structure in the decision to participate in off-farm work has also been the subject of a number of studies. Kilkenny (1993) and Kimihi (1994) present evidence that participation in off-farm labour markets differs across farm type and family structure. Several papers showed that farm system and size, that is type of farm enterprise, affects the labour decision for example Lass, Findeis & Hallberg (1989). Some studies have established the significance of the number of dependents on the farm income. Mishra & Goodwin (1997) have found a negative effect between the number of children and the number of hours worked off farm by farmers' spouses. The effect of children on farmers' time allocation is less clear. Lass, Findeis & Hallberg (1991) explain that on the one hand childcare may require a husband's time, but on the other hand the presence of more children may generate greater pressure to obtain additional income to meet the consumption needs of a larger family.

There are a number of particularly interesting studies that focus on the role of government subsidies in the allocation of labour. The first study conducted by Ahearn, El-Osta & Dewbre in 2002 involved an assessment of the effect of decoupled payments on labour allocation. They analysed the effect of the US FAIR Act of 1996 on farmers' labour allocation decisions, six years after its establishment. The FAIR Act introduced production flexibility contract payments that were designed to be decoupled from production. Ahearn et al explored the impact of decoupled payments on labour allocation with a view to understanding what effect decoupled payments have on production. They reviewed earlier studies that showed that coupled direct payments had a negative influence on the participation in off-farm employment (Mishra & Goodwin, 1997). Ahearn et al.'s empirical analysis did not show any difference in the effect of direct payments, either coupled or decoupled, on the decision to participate in off-farm employment, but differing effects on the decision of how many hours to supply to off-farm work. They found no difference in the effect between payments that varied in their degree of 'decoupledness' on the marginal probability of working off the farm. But where farmers received decoupled payments for example, those payments resulted in farmers reducing their supply of off-farm work less than when they received coupled payments.

Another study of interest is the one conducted by Keeney (2002). She modelled the time allocation decision of Irish farm households. Her study showed that coupled direct payments significantly affect the farmer and spouses' labour allocation decisions. The results show that when a farm operator takes an off-farm job, he will increase the number of hours worked on

farm if significant coupled premia payments are present. She concluded that premia payments influence farm production and labour allocation decisions. Hennessy & Rehman (2007) modelled the effect of decoupled payments on the off-farm labour allocation decisions of Irish farmers. They suggested that decoupled payments could be viewed as a source of low risk non-labour income and they used the agricultural household model to examine the effect of non-labour income on off-farm labour supply. They concluded that the decoupling of direct payments was likely to increase the probability of off-farm employment and the amount of time allocated to off-farm employment.

The majority of the studies reviewed have followed a similar approach. The labour allocation decision is examined in the context of the theoretical agricultural household model. Econometric participation models are developed where the decision to work off-farm is usually binary and in some cases determined jointly with the spouse's decision in a bivariate probit framework. Once the probability of participation has been established, a labour supply model is usually developed to estimate the number of hours supplied by those who choose to participate in the off-farm employment market. Within this framework, the various factors that are hypothesised to influence labour allocation decisions can be tested. The following section of this paper describes the theoretical framework.

### 3. The theoretical framework

Becker (1965), in his seminal paper, assumed that households behave to maximise the household's utility function defined over consumption commodities and that time is allocated between work and leisure so as to maximise that utility function. The allocation of farm labour can be modelled using an agricultural household model that integrates agricultural production, consumption and labour supply decisions into a single framework and operates to maximise Becker's utility function. The agricultural household model developed by Singh, Squire & Strauss (1986) has been frequently applied to the study of labour allocation for example (Huffman & Lange, 1989; Gould & Saupe, 1989; and Weersink, Nicholson & Weerhewa, 1998).

Here, we are specifically concerned with the labour allocation decisions of the farm operator and so a reduced form of the agricultural household model is used that only represents the decisions of the farm operator. Furthermore, the analysis here is simplified by ignoring many of the complexities of the model and extensions that have been developed, for example the interdependence of the labour allocation decision between spouse and operator, the utility of others in the household, commuting costs to off-farm jobs and household savings.

If we consider the labour allocation decision from a farm operator's perspective only, then we assume that the farm operator maximises his utility function,  $U$  which, drawing from Becker (1965), is assumed to be a function of consumption  $C$  and leisure time  $L$ , as expressed by equation 1.

$$\text{Maximise } U = f(C, L) \quad (1)$$

subject to

$$T = L + O + F \quad O \geq 0 \quad (2)$$

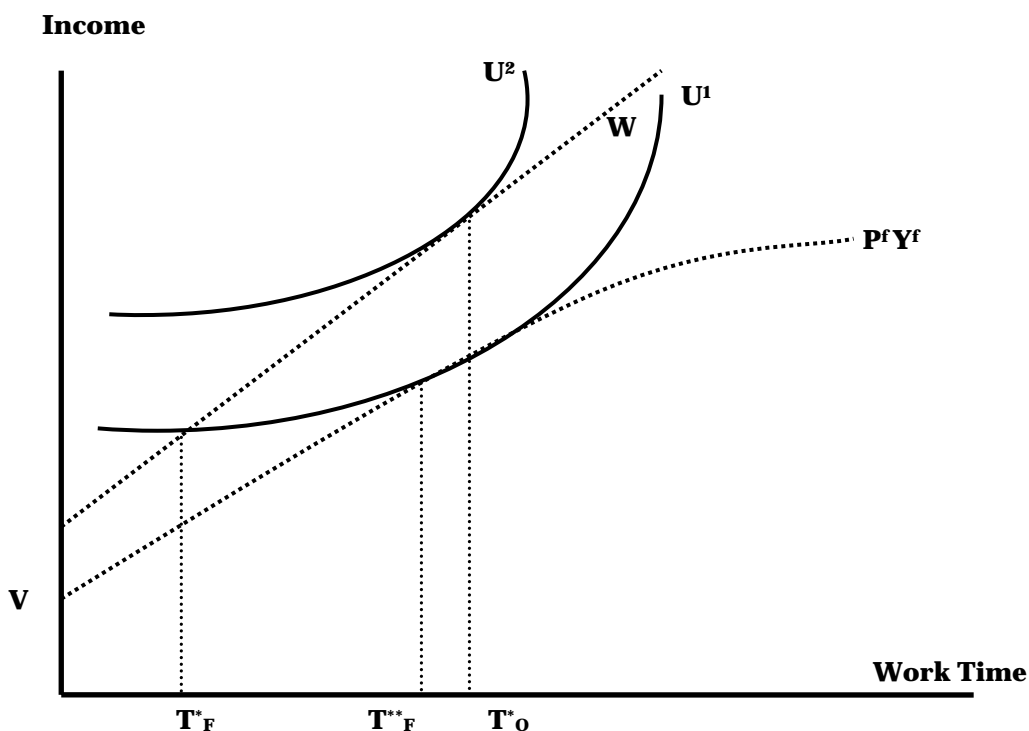
$$C P_c = w O + (P_f Y_f - I_f X_f) + V \quad (3)$$

$$W = W(H, Z) \quad (4)$$

Utility is maximised subject to time and budget constraints. The farmer's total time endowment  $T$  is finite and is allocated between leisure ( $L$ ), off-farm work ( $O$ ) and farm work ( $F$ ). It is normally assumed that time allocated to leisure and farm work is positive but for some individuals the time allocated to non-farm work may be zero, hence the inequality in

equation 2. Drawing from the neo-classical labour theory, the framework assumes that an individual maximises utility by choosing hours of farm labour, off-farm labour and leisure so that at the optimum, the marginal utilities of these hours are equal. Consumption goods,  $C$ , are the reward for labour and are purchased at price  $P_c$ . Total consumption is constrained by the budget constraint (equation 3) which states that consumption equals total income. Income is derived from the off-farm work wage,  $w$  by the hours worked off-farm  $O$ , the farm profit, that is price of farm goods produced  $P_f$  by the volume of production  $Y_f$  less the cost of production, i.e. the cost of farm inputs  $I_f$  by the volume of output  $Y_f$  and exogenous household wealth  $V$ ; that is wealth that is not derived from farm or off-farm labour. The off-farm wage rate  $W$  that the farm operator faces is a function of  $H$  the farmer's human capital and  $Z$  the local labour market conditions.<sup>1</sup> The trade-off between time spent farming and time spent off the farm has been conceptualised diagrammatically by Sumner (1982) and is recreated in Figure 1.

Figure 1. Diagrammatic representation of farm and non-farm work decisions



Source: Based on Sumner (1982).

The diagram presents the trade-off between time and income while  $U^1$  and  $U^2$  represent an individual's indifference curves measuring their utility.  $U^2$  is preferred to  $U^1$  as more income can be earned for less work time and hence more time is available for leisure. The two curves  $P_f Y_f$  and  $W$  measure the income returned to time worked in farming and off-farm employment, respectively. The point  $V$  on the income axis represents household wealth; that is income earned at zero hours worked. The marginal return to hours spent farming is measured by the slope of the  $P_f Y_f$  curve, as can be seen the slope flattens as time increases,

<sup>1</sup> The household model can also include a technology constraint on farm output to be a function of farm labour, human capital and farm specific factors. This is excluded in this reduced form of the agricultural household model presented here, as the interest of this research lies in the empirical evaluation of the effect of government subsidies on the allocation of farmers' time and the interplay between farm and off-farm work.

which implies that there are diminishing returns to hours spent farming. Slope  $W$  is linear; implying that the payment per hour worked off farm is constant, assuming a standard hourly wage. If there are no off-farm opportunities the optimal time spent farming is  $T^*_F$ ; that is where the marginal returns to farming curve intersects the indifference curve. If off-farm work is available, the optimal time spent farming decreases to  $T^*_F$ , that is where the marginal returns to off-farm employment are equal those to farming. The optimal time spent working off-farm is equal to  $T^*_O - T^*_F$ . The option with off-farm employment is preferred as a higher indifference curve is achieved.

The decision to participate in off-farm employment is binary. Rational individuals are expected to participate when the off-farm wage offered exceeds their reservation wage. This can be expressed as follows,

$$E[I_i|X] = P(O_i = 1) = P(w^r < w^i) = \beta'X \quad (5)$$

where  $P(O_i = 1)$  is the probability of  $O_i = 1$ , that is participating in off-farm employment, which occurs if  $w^r < w^i$  that is the reservation wage rate is less than the wage offered off-farm. The probability of participating in off-farm work is estimated using a vector of exogenous variables  $X$  that are hypothesised to influence the latent reservation wage and off-farm wage rates and therefore the participation decision. Variables that increase the off-farm wage rate relative to the reservation wage increase the probability of off-farm work and the opposite is true for variables that decrease the off-farm wage rate (Huffman, 1988).

The supply function for off-farm work is determined by the optimal level of leisure hours and off-farm work hours, as described in equation 6.

$$O = T - L - F = f(w^i, P_f, I_f, V, H, Z) \quad (6)$$

The number of hours supplied to off-farm work  $O$  is a function of the off-farm wage  $w^i$ , farm profit, i.e. output less costs  $P_f$ ,  $I_f$ , exogenous household income  $V$ , the farm operator's human capital  $H$  and local employment market conditions  $Z$ .

#### 4. The role of government subsidies in the theoretical model

Economic theory suggests a number of avenues by which government subsidies may affect farmers' labour allocation decisions: 1) by increasing the marginal value product of farm labour or increasing farm profit, 2) by increasing household wealth,  $V$ , 3) by reducing income variability or reducing farmers' reliance on 'risky' revenue generated from the market. If a payment is coupled to production it will increase the marginal value of time spent farming but if it is decoupled it will not. A coupled payment requires that farmers produce a certain product to receive the subsidy and therefore it is equivalent to an increase in the farm wage rate; this is known as an income effect. Decoupled payments do not require production and therefore the introduction of a decoupled payment can be considered a source of non-labour income or exogenous household wealth that does not affect the marginal value of farm work. This is known as the wealth effect.

Replacing coupled payments with decoupled payments is likely to affect the relative return to farm work. When payments were coupled to production in the EU, as they were throughout the 1990s and the early 2000s, the value of farm labour increased as the payments were included in the return to production and therefore the return to farm labour. When these payments were decoupled under the medium-term review (MTR) of the CAP in 2005, there are two distinct consequences. First the return to farm labour declines significantly as the payments are removed from the production-related profit, and second, direct payments form a new source of non-labour household wealth.

The role of decoupled payments within the agricultural household model is interesting. As these payments are a source of household wealth,  $V$ , exogenous household wealth increases following decoupling. Burfisher & Hopkins (2003) suggest that decoupled payments impact on the farm household's labour-leisure choice. If an individual receives an increase in non-labour income, i.e. wealth, the household budget constraint is relaxed and, other things being



equal, the individual can work less and enjoy more leisure while maintaining consumption; that is a move to a higher indifference curve. On the other hand, decoupled payments are likely to change the relative returns to farm and off-farm labour. If the returns to farm labour decrease relative to non-farm labour, then the household model suggests that the individual will increase the number of hours allocated to off-farm labour, which is referred to as a substitution effect. Therefore, decoupling is likely to result in both a wealth and substitution effect, whichever effect is greater will determine the impact of decoupling on labour allocation. It is only by observing the behaviour of individuals that the two effects can be measured.

A further extension of the agricultural household model hypothesises that the mean and variance of the variables specified in equation 6 also influence the allocation of farmers' time. In other words, the variability of the farm wage, farm profit, output and input prices all affect a farmer's decision to work off-farm. The theory is that farmers are risk averse and in order to reduce their exposure to income risk, farmers will allocate more time to less risky activities, for example waged off-farm employment. This theory is often cited as an explanatory factor for the increased incidence of off-farm employment (Barlett, 1991). Many studies have highlighted the effect of decoupled payments on farmers' exposure to risk. Hennessy (1998) explored the interplay between decoupled payments, farmers' risk preferences and production decisions. He concluded that if farmers display a *declining absolute risk aversion preference*, that is their aversion to risk declines as income increases, then an increase in wealth as a consequence of the decoupled payment can induce them to take riskier production decisions, and thus increase output and time spent farming, compared to the situation in which no decoupled payment is made. This finding can be extended to conclude that the reduction in farmers' risk exposure as a result of the introduction of decoupled payments, known as the insurance effect, may result in farmers taking more risks and allocating less time to relatively 'riskless' off-farm employment.

## 5. Conclusions

The agricultural household model developed by Singh, Squire and Strauss can be used to explain the labour allocation decisions of farmers. As outlined in this paper, the model can also be extended to hypothesise how agricultural subsidies may affect the labour decision. The decoupling of direct payments has resulted in a reduction to the marginal value of farm labour that would lead one to believe that, other things being equal, utility-maximising farmers will allocate less time to farm labour and more time to off-farm labour, the so-called substitution effect. However, decoupling has also led to an increase in non-labour income, which means that farmers can allocate less time to labour and more time to leisure, while still maintaining consumption levels. This is known as the wealth effect. Subsequent work packages in this project will conduct empirical analyses to determine which one of these two effects dominates and hence provide some insight into the effect of agricultural policy on labour allocation decisions.



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