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DELIVERABLE 7.1
"A conceptual model on labour adjustments"

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Abstract

Deliverable 7.1 presents a conceptual model to analyze labour adjustments in the agricultural sector in the Central and Eastern European Countries (CEECs). In a first approach the labour supply and demand decisions are considered to be taken separately. However although in some CEECs agricultural work is still organised in large corporate farms, there is a trend towards more individual farming and when considering this trend it is no longer appropriate to assume labour supply and demand decisions to be taken separately.

Another important trend that is considered in this conceptual model is the growing trend towards more off farm labour combined with on farm labour. In the empirical work in Deliverable 7.4. "A comparative analysis of rural labour markets", a multinomial / conditional logit approach will be used to examine not only the factors that will influence the decision to leave the agricultural sector but also the factors that influence the decisions to engage in off farm employment. The empirical analysis will also focus on the relationship between off farm labour and farm size as this relationship is not straightforward. On one hand, a larger farm is likely to require more labour and hence divert labour away from off-farm employment. The income effect of farm size on the demand for leisure can also reduce off-farm labour participation. On the other hand, farms can grow by investing in labour-saving technologies and thereby release labour to alternative uses.

SCARLED Consortium

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LIST OF ABBREVIATIONS

AKI	Research Institute for Agricultural Economics
COA	Centre of area method
COG	Centre of gravity method
CUB	Corvinus University Budapest, Department of Agricultural Economics and Rural Development
IAMO	Leibniz Institute of Agricultural Development in Central and Eastern Europe
KU Leuven	Catholic University Leuven
MOM	Mean of maxima method
SCARLED	Structural change in agriculture and rural livelihoods
SLF	Sustainable Livelihood Framework
UL	University of Ljubljana
UNEW	University of Newcastle upon Tyne, Centre for Rural Economy
UNIKENT	University of Kent, Kent Business School
UNWE	University of National and World Economy
USAMVB	Banat's University of Agricultural Sciences and Veterinary Medicine Timisoara
WUDES	Warsaw University, Department of Economic Sciences

1 INTRODUCTION

In this section we present the theoretical framework which we will apply in the empirical analysis (Deliverable D 7.4 "A comparative analysis of rural labour markets"). We combine findings of two strands of literature for developing the conceptual model on labour adjustments. First, in section 2 and 3 we will consider the labour supply and demand decision separately, assuming an agricultural worker to take the labour demand decision and an agricultural firm to take the labour supply decision.

However in an individual farm the demand and supply decisions are taken jointly as will be discussed in section 4. Section 4 will also deal with the relationship between the labour supply and the farm size. Literature findings discussed in sections 2 and 3 suggest that farm size is jointly determined with labour allocation decisions. Therefore we formally introduce in this section a joint decision-making framework that characterises the relationships among farm structure variables and labour supply.

Finally, we discuss in the last section the key econometric considerations.

2 INTER-SECTORAL WORK OFFER DECISION: LABOUR SUPPLY

We start with worker (household) work offer decisions, as these determine the aggregate sectoral labour supply. An extensive literature has addressed issues pertaining to the time allocation decisions of farm households. This line of research has taken on new importance in recent years with an increasing focus on the economic status of the entire farm household and the ever-increasing dependence of farm households on non-farm employment opportunities. The main question of these studies is the trade-off of individuals to allocate their time among competing work and leisure activities according to the relative returns offered by each activity. These returns, in turn, are determined by individual's ability. An individual's time allocation decisions will reflect these returns and will be made on the basis of an individual's preferences, wealth, risk attitudes, and other factors pertinent to utility maximisation choices. According to the general theory of labour supply of considering worker choices among multiple job opportunities, more time spent in one activity usually implies less time available for others. In the case of agricultural households, more time spent working off the farm or in consuming leisure generally will imply that less time will be spent in farming.

Numerous empirical studies of the off-farm labour supply of farmers have been conducted in the last few decades, starting with the seminal work of Huffman (1980). Similarly, a number of empirical studies have considered the relationship of individual farm and operator factors to the allocation of time by farm households. Many of them noted that off-farm employment was an important mechanism by which farm households could diversify their income. Typically these studies have considered various demographic factors that are relevant to time allocation decisions of farm operators and their spouses. Factors such as age, farm and non-farm work experience, education, and household size have been found to be significantly related to the extent of off-farm work (see, for example, Sumner 1982; Huffman and Lange 1989; Lass and Gempesaw 1992; Bojnec and Dries 2005). Most of these studies looked at the effect of demographic variables and farm attributes on the off-farm labour supply decisions. Several extensions have been made to deal with joint husband-wife decisions (e.g. Huffman and Lange 1989), local labour market conditions (e.g. Tokle and Huffman 1991), joint farm and off-farm labour participation decisions (e.g., Goetz and Debertin 2001) and farm income variability (Mishra and Goodwin 1997). Mishra and Goodwin (1997) found that farmers with significant farm income risk were more likely to pursue off-farm employment opportunities. Most of these studies have relied on cross-sectional data. The use of longitudinal data sets to analyse farmers' off-farm labour supply decisions in developed countries is still rare, although Sumner (1982) has pointed it out as one of the most promising extensions of farm household labour supply models

Most of the existing studies on CEE transition countries model labour supply in a static framework. Yet, the assumption of static labour supply behaviour has been rejected by numerous studies that find strong evidence for true state dependence in the labour supply behaviour (e.g. Heckman 1981). There exists a large body of literature modelling and estimating the labour supply behaviour in an intertemporal context (e.g. Nakamura and Nakamura 1985), including multi-period two-stage budgeting models, dynamic labour supply models based on approximate decision rules or structural forward looking optimization models of life cycle employment.

Of particular interest for this study are those few studies that focus on the dynamics of the labour supply behaviour in the CEE transition economies. Juvančič and Erjavec (2005) test to what extent the individuals' employment decisions are influenced by their previous employment status ('state dependence') and to what extent to other reasons and

preferences ('heterogeneity'). They find evidence of asymmetrical and irreversible participation of farmers at the labour market. Despite intensive restructuring of agriculture and profound changes in non-farm labour market in the analysed period, off-farm labour supply of farmers remains rigid.

Next, we formalise the labour supply[1] decision of agricultural workers. As in some CEECs large corporate farms still represent an important share of the agricultural sector, we can assume for now that the labour supply decision is made separately from labour demand decisions[2].

We assume that the economy is divided in two sectors: the non agricultural sector and the agricultural sector. To simplify the analysis we assume that agricultural workers have three feasible options:

(i) Stay in agriculture (L_A^* in Figure 2.1);

(ii) Leave agriculture and switch to a higher wage off-farm sector (L_{NA}^* in Figure 2.1);

(iii) Allocate part of the time to agriculture and part to non-agriculture[3]

Thus, the worker (household) has to choose whether he will continue working in the agricultural sector or whether he will switch to another sector. The worker can also combine the two options and work part time in farming and part time in another sector. In this first approach where labour supply and labour demand decisions are considered to be taken separately we will not include part time farming in the model. However, we will consider the decision to work part time in the agricultural sector in section 4, when modelling simultaneous labour supply and demand decisions of farm households.

The decision to leave the agricultural sector can be analysed in a two sector model of Todaro (1969) and Harris and Todaro (1970). Harris and Todaro model for analysing the migration of labour from one region to another based on income differences, can be used to analyse the migration from one sector to another in the economy. Indeed, Harris and Todaro model is widely used in analysing work offer decisions in the agricultural sector (e.g. Barkley 1990, Goetz and Debertin 1996).

[1] We will only consider the static labour supply, but in reality the income which is relevant is not necessary current income but rather the total of current and discounted future income streams over the period of employment, which is a more dynamic approach.

[2] However as in the CEECs individual farming gains in importance we must consider labour supply and demand decisions to be made simultaneously, as is the case in the USA and West European countries (see section 4).

[3] The conceptual model allows us to include part time off farm work, as the income in both sectors is defined by the number of hours worked in the sector. The utility, $U = U^A+U^{NA}$, is defined as hours in agriculture, h_A, and hours worked in the non agricultural sector, h_{NA}.

According to Todaro (1969); Harris and Todaro (1970), the utility of an individual working in agriculture (non agriculture) can be defined as follows:

Equation 1: Utility of an individual working in agricultural (non agricultural) sector

$$U^{A} = U(Y_A, h_A) \quad \text{Agricultural sector}$$
$$U^{NA} = U(Y_{NA}, h_{NA}) \quad \text{Non-Agricultural sector}$$

where Y_A (Y_{NA}) is the income of employment in the agricultural sector (non agricultural sector). The agricultural (non agricultural) income can be represented by:

Equation 2: Agricultural (non agricultural) income

$$Y_A = \Phi_A W_A h_A$$
$$Y_{NA} = \Phi_{NA} W_{NA} h_{NA}$$

Income depends on earnings in each sector, which depends on the wage rate, w_A (w_{NA}) and the hours worked, h_A (h_{NA}) in the agricultural (non agricultural) sector, accounting for the probability, Φ_A (Φ_{NA}), of finding employment in the agricultural (non agricultural) sector. This probability is related to economic conditions, such as local employment conditions, and non economic conditions, such as human capital variables.

An individual will make a decision based on his utility differential, ΔU, represented by:

Equation 3: Net utility of agricultural and non agricultural workers

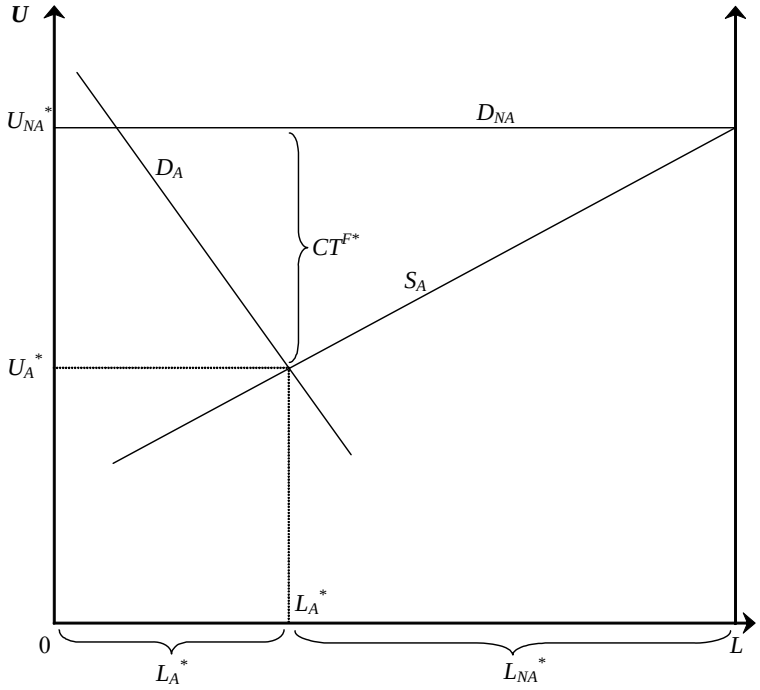
$$\Delta U = U_A (Y_A, h_A) - U_{NA} (Y_{NA}, h_{NA})$$

There is a cost associated with switching from agricultural sector for the non agricultural sector. The cost of switching from agriculture to non agriculture (from non agriculture to agriculture) is presented by $CT_{A,NA}$ ($CT_{NA,A}$).

The inter-sectoral relocation costs, $CT_{A,NA}$, will include search costs of finding another employment and the costs of the loss of the agricultural skills in another sector. As a worker leaves the agricultural sector his farming skills in that sector are of no use in another sector and when he switches employment he will have to accumulate new skills. In order to capture the skill effect, we will use the personal characteristics of the worker. Education level and age will have an effect on the transaction costs associated with leaving the sector. A higher educated worker will have more opportunities in the non agricultural sector and therefore education will lower the transaction costs associated with leaving the sector (Rizov and Swinnen 2004, Bojnec and Dries 2005). Several studies note a non linear impact of age on employment (Goetz and Debertin 2001, Rizov and Swinnen 2004, Bojnec and Dries 2005).

If $\Delta U < 0$ and $| \Delta U | > CT_{A,NA}$ a worker will decide to leave the agricultural sector for the non agricultural sector. If $\Delta U < 0$, but $| \Delta U | < CT_{A,NA}$ a person will stay because the cost of leaving the sector is higher than the net utility that he would get from switching between the sectors. The number of workers staying in (moving to) agriculture determines the aggregate agricultural labour supply. This is shown in Figure 2.1, where total labour supply (L) is on the *x* axis and utility (represented by wage) (U) is on the *y* axis.

Figure 2.1 Worker inter-sectoral labour allocation equilibrium



Given that workers are heterogeneous in their abilities, the agricultural labour supply curve, S_A, is upward sloping. Given that switching to non-agriculture is costly, only those workers with costs lower than the expected utility increase of moving to non-agriculture, $|\Delta U| > CT_{A,NA}$, will leave agriculture for the non agricultural sector. Together with agricultural labour demand, D_A, they determine the equilibrium agricultural and non-agricultural employment, L^*_A and L^*_{NA}, respectively.

3 FARM GROWTH AND DECLINE: FARM LABOUR DEMAND

The second strand of literature, which contributed to the conceptual model on inter-sectoral labour adjustments, studies determinants of farm growth and decline, as these determine farm labour demand. Usually if farm specialisation is the same, larger farms require more labour than smaller farms. However, farm specialisation is not the same across farms. Therefore, farm specialisation is important too.

Similarly to agricultural workers, a farmer (farm operator) has three options for improving his/her income:

(i) Farm can produce agricultural goods but adjust farm size by hiring additional workers or by firing some workers;

(ii) Farm can leave agriculture and switch to another sector;

(iii) Farm can produce both agricultural and non agricultural goods.

The decision of the farmer (farm operator) whether to stay either in agriculture or to leave the sector can be represented in a similar way as the decision of the worker to supply labour. However, as in the case of the worker (labour supply), there is also a third alternative, namely part time employment off farm or diversification into an off farm activity. In this first approach where labour supply and labour demand decisions are considered to be taken separately we will not include this decision in the model. Nevertheless we will consider the decision to work part time in the agricultural sector in section 4, when modelling simultaneous labour supply and demand decisions of farm households.

The economy is divided in two sectors, an agricultural sector and a non agricultural sector. The farmer (farm operator) has to choose whether he will continue producing agricultural goods or whether he will switch to non agricultural production. In a highly stylised model agricultural (non-agricultural) firm profits, π_A (π_{NA}), can be presented as follows:

Equation 4: Profits of agricultural and non agricultural firms

$$\pi_A = P_A f_A(L) - W_A L + G_A \qquad \text{Agricultural sector}$$

$$\pi_{NA} = P_{NA} f_{NA}(L) - W_{NA} L \qquad \text{Non-Agricultural sector}$$

where P_A (P_{NA}) is the producer price in the agricultural sector (non agricultural) sector. W_A (W_{NA}) is the wage that the management of the agricultural (non agricultural) firm has to pay to their workers. The production function with only one input in the agricultural (non agricultural) sector is given by $f_A(L)$ ($f_{NA}(L)$). The level of agricultural support is represented by G_A (government transfers).

Farmer (farm operator) will make a decision based on the net profit differences between agricultural and non agricultural sectors:

Equation 5: Net profit differential of the firm

$$\Delta\pi = \pi_A - \pi_{NA}$$

As above, we assume that there is a transaction cost for the farm associated with re-specialising from agricultural to non agricultural production, represented by $CT^F_{A,NA}$. In a similar way to worker costs, we can define the transaction costs of firms associated with leaving the non agricultural sector for the agricultural sector as $CT^F_{NA,A}$. The transactions costs from switching to the non agricultural sector ($CT^F_{A,NA}$) are largely determined by firm characteristics, such as farm size, production type (livestock or crops) and the share of owned land. These transaction costs will be discussed in the next section.

Firm Size

The opportunity cost of quitting is larger for large firms compared to small firms (Kimhi and Bollman 1999). Therefore large firms are less likely to leave agriculture. However as the (market) value of the fixed assets, e.g. land, is bigger it is possible that firm size facilitate the exits from the agricultural sector. However, empirical evidence in Western Germany suggests that with the effect of the increasing opportunity costs is the most important effect and that farm size diminish the agricultural outflow of labour (Breustedt and Glauben 2007).

When we study the effects of farm size in transition countries we must make some important remarks. Before transition, labour was not used in the most efficient way as the management of the farm was not facing hard budget constraints due to heavy subsidising (Swinnen, Dries and Macours 2005, Macours and Swinnen 2000, Commander 1998). Following transition state farms have been transformed in corporate farms and familiy farms. The effect on labour use in those two types of farms is rather different. In the large corporate farms inefficient labour use was no longer tolerated and "hidden unemployment" was revealed. In small family farms there were different effects: an decrease of scale economies, an increase in the labour efficiency due to the reduction of moral hazard associated with hired labour and credit market imperfections[4]. The decrease of the scale economies will induce an increase in the labour demand, whereas an increase in the labour efficiency will decrease the labour demand. The problem of inaccessible farm credits due to asymmetric information problems is rather universal. Nevertheless, the problems associated with asymmetric information even deteriorated in transition

[4] Credit market constraints on the financial markets are related with a farmer's ability to get a loan that he will pay back with future profits. There are many problems related with agricultural credit. These problems concern asymmetric information, more specific moral hazard and adverse selection, two terms that mostly appear in insurances. Moral hazard indicates that the borrower, after that he got his loan, will have an undesirable behaviour regarding the project he proposed to the lender (and based on which he got the loan). This may lead to an increase in the risk of the borrower's ability to repay the loan. Adverse selection occurs because of potential borrowers, who are most likely to produce a negative outcome, are more searching for a loan. Lenders on their turn don't have enough information to distinguish "good" from "bad" borrowers.

economies. For banks it was risky to accord loans to farmers because the low profitability[5] and the problems concerning collateral due to uncertainly defined property rights. As the access to capital is limited, the individual farmer may substitute capital and other variable inputs by labour.

In D 7.4 we will investigate which effect is dominant in the first years after transition and what will be the effect of farm size in future. In our latter analysis we will also investigate the relationship between off farm work and farm size as this relationship is not as straightforward as it may appear on the first sight (see section 4).

Farm specialisation

Farm specialisation matters, as there are higher sunk costs related to the production of livestock compared to the production of crops (Breustedt and Glauben 2007, Goetz and Debertin 1996). Livestock can also be considered as a proxy for wealth and in this way important to overcome the credit market imperfections that farmers face during the transition. Livestock can also be used as collateral for getting a loan for farming activities. Therefore the share of livestock is expected to be positively correlated to the transaction costs.

Share of owned land

The share of owned land will increase the transaction costs of leaving agriculture. In the case of a family farm there is also an emotional tie attached to land ownership. Moreover, owned land also means that a farmer can get credit more easily because the owned land can serve as collateral. Therefore we can expect that if land is privately owned, there will be less land market constraints and fewer outflows from agriculture.

If $\Delta\pi < 0$ and $|\Delta\pi| > CT^{F}_{A,NA}$ the management of the firm will decide to leave the agricultural sector for the non agricultural sector. If $\Delta\pi < 0$, but $|\Delta\pi| < CT^{F}_{A,NA}$ the management of the firm will decide to stay in agriculture because the cost of leaving the sector is higher than the net profit that the firm would gain from leaving the sector.

[5] In years after the transition there was a drastic decline in the agricultural output due to the effects of the privatisation (Macours and Swinnen 2000).

4 SIMULTANEOUS LABOUR SUPPLY AND DEMAND DECISIONS OF FARM HOUSEHOLDS

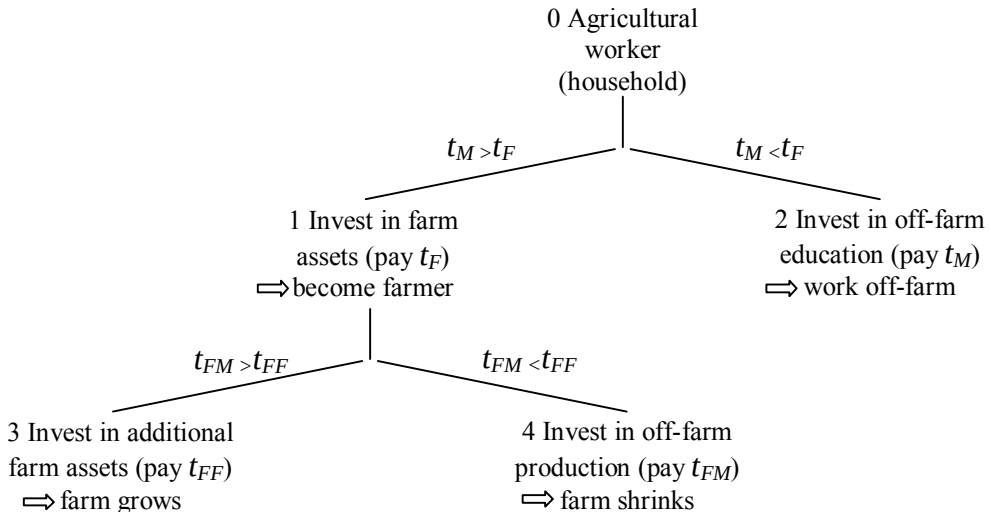
The third and the most recent strand of farm household literature recognises that farm operation decisions and inter-sectoral labour supply decisions are made jointly (see Figure 4.1), unless rural labour markets are perfect, which is far from reality in CEES (Swinnen *et al*. 2005). However, the theory does not give a clear prediction of whether off-farm labour and farm size are positively or negatively correlated. On one hand, a larger farm is likely to require more labour and hence divert labour away from off-farm employment (choice 1 in Figure 4.1). The income effect of farm size on the demand for leisure can also reduce off-farm labour participation. On the other hand, farms can grow by investing in labour-saving technologies and thereby release labour to alternative uses (a specific case under choice 3 in Figure 4.1).[6] Farms can also invest in non agricultural activities (choice 4 in Figure 4.1).

The empirical literature addressing both issues, ie. farm household inter-sectoral labour supply and farm growth/decline decision (which determines on-farm labour demand) simultaneously demonstrates that a number of farm characteristics is significantly related to farm and off-farm work decisions. Factors such as farm size, tenancy, enterprise choice, diversification, and financial leverage have all been found to be related to time allocations decisions (see, for example, Mathijs and Swinnen (1998); Swinnen (1999), Rozelle and Swinnen (2004), Juvančič and Erjavec (2005), Gould and Saupe (1989) and Weiss (1997) used two-period panel data sets to account for state dependence[7] in off-farm labour participation decisions. Corsi and Findeis (2000) tried to distinguish between true state dependence and unobserved heterogeneity in a dynamic model of off-farm labour participation. Kimhi (2000) linked the decisions on off-farm participation and farm exit, while Weiss (1999) linked the decisions on off-farm participation and farm growth. Note that all these studies have treated farm attributes as exogenous or at least pre-determined to the off-farm labour decision.

[6] The correlation is also likely to depend on farm specialisation. For example, field-crop farms require very little labour even when they are very large, while vegetable farms need more labour as they increase their size.

[7] In the present study, state dependence is defined as the past employment choices. For a more general discussion on state dependence see Heckman (1981).

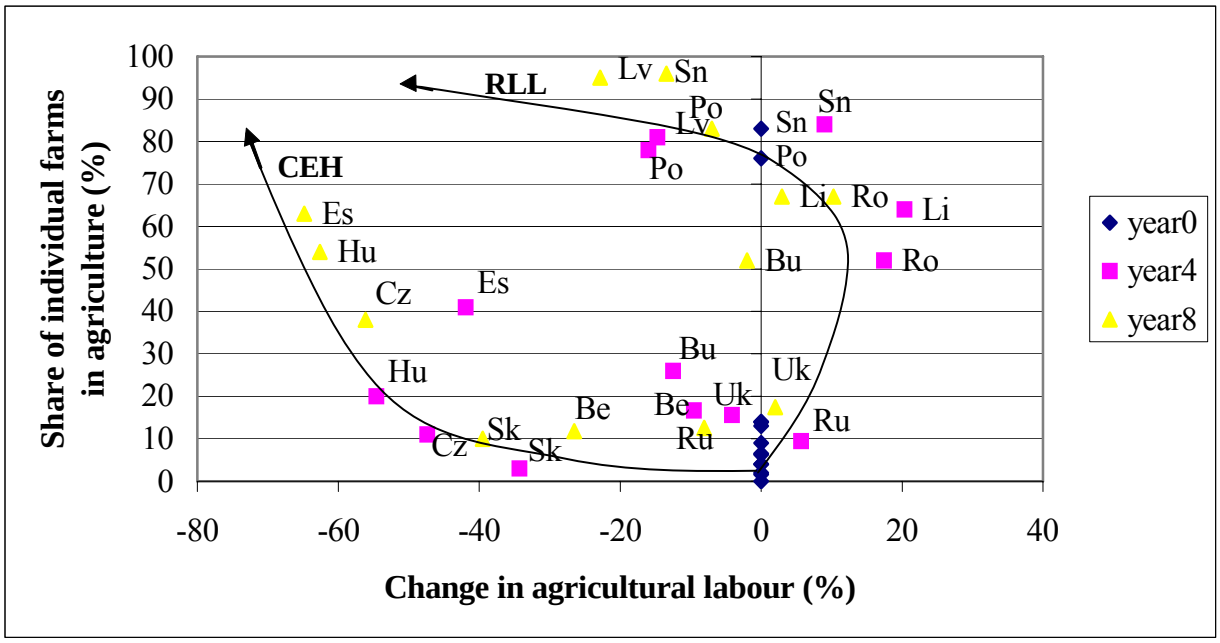
Figure 4.1 Agricultural household response options to macro-economic shocks



The potential for farm size and other characteristics of farming operations to be endogenous to off-farm labour decisions has received considerably less attention in the empirical literature. The work of Ahituv and Kimhi (2002) is one of the first attempts to treat farm attributes as endogenous in a farm-level analysis. They used a two-period panel data set to jointly analyse off-farm labour participation and level of farm capital stock. They found that off-farm work and farm capital are strongly correlated. In particular, the observable part of the model showed a strong negative dependence in both directions between these variables. However, unobserved heterogeneity seemed to point at a positive correlation, meaning that there seemed to be a group of high ability farmers who could concurrently participate in off-farm labour activities and maintain a capital-intensive farm enterprise. Phimister and Roberts (2002) used farm panel data to model farm input and output decisions as dependent upon off-farm labour participation of the farmer and his spouse in a dynamic setting. However, they considered the farmer's off-farm participation as endogenous but not the spouse's. Ahituv and Kimhi (2006) found that farm activity and non-farm work effort were jointly determined and that farmers that had increased the scale of their operation have tended to work less off the farm. In contrast, farms that had downsized the scale of their farm operation had tended to work more off the farm.

In order to account for simultaneity in farm household decisions, from now on we will consider labour supply and labour demand decisions jointly. Although in some CEECs the majority of the agricultural production is hands of a few big farms there is a clear trend toward individual farming. Adopted from Swinnen *et al*. (2005) this trend is illustrated in Figure 4.2.

Figure 4.2 Change in labour allocation and organisation in agriculture for 8 transition economies 8 years after the start of the reform (Swinnen *et al*. 2005)



From Figure 4.2 we can see that the different paths of transition that can be followed by the different countries. The authors make a distinction between two groups of countries: Czech Republic, Estonia and Hungary (CEH)) and Romania, Lithuania and Latvia (RLL). In these groups the paths of transition differs where as in CEH there was first an increase in the efficiency of the firms and in a second stage an increase in the share of individual farms, there was in the RLL first an increase in the share of individual farms and in the second stage an increase in the efficiency of these farms. These differences can be explained by the different initial situation of the country. However disregarding the path that is followed the effect of the transition towards a more market orientated agricultural sector is largely the same. There is a decrease the number of persons working in agriculture and there is an increase in the number of individual farms.

Given the increasing share of individual farms in CEE and the theoretical advantages discussed above, in the present study we analyse labour adjustments using an augmented farm household model. This will allow us to bring together the decision of the worker and the firm in one conceptual model.

Normalising the amount of labour available to each household to 1 unit per period, the total utility stemming both from labour remuneration and farm profits is subject to the following income constraint of each household:

Equation 6: Total farm household utility

$$w_{NAt}L_{NAt} + p_{At}Q_{At} - PC_{At} - P_{it}Q_{it} - w_{At}L_{At} + R_t + DP_{At}$$

where $w_{NAt}L_{NAt}$ represents the non-farm income of the household, $p_{At}Q_{At}$ is the value of the agricultural production, PC_{At} are the total production costs associated with agricultural production, $P_{it}Q_{it}$ represents the value of the consumption, $w_{At}L_{At}$ is the total amount of agricultural wages paid, R_t represents the non labour income (e.g. income from rents or deposits) and DP_{At} stands for the direct payments.

Equation 7: Determinants of P_{At}, Q_{AT}, PC_A

$$P_{At} = P_{At}(P_{At}/P_{It}, P_{NAt}/P_{It}, w_{At}, w_{NAt}, A_{At}, G_{At})$$
$$Q_{At} = Q_{At}(X_{At}, L_{At}, F_{Ft}, V_t)$$
$$PC_A = PC_{At}(X_{At}, L_{At}, F_{Ft}, V_t)$$

where X_{At} represents variable factors of production, F_{Ft} represents production inputs that are fixed in the short run but variable in the long run (these are the transaction costs for that are described in the previous part), V_t represents time-invariant factors such as climate, and P_{At} represents farm output prices, which are determined by output prices and production linked policy support, G_{At}, and the level of used technology in the agricultural sector, A_{At}. Wages, w_t, are affected by worker characteristics, such as education and experience. Given that our empirical analysis is limited to current farmers and their spouses, we assume that variables representing human capital and other wage factors are predetermined and thus define a standard wage equation to relate wages for a household to exogenous characteristics of farmers and spouse. In the previous part the characteristics of the workers and so also the household wages will be determined by F_{Ft}:

Equation 8: Determinants of the wages

$$w_t = w_t(F_{Ft})$$

Finally, equations that describe the adjustment process of those factors that are fixed in the short run take the general form of:

Equation 9: Adjustment process of semi-fixed inputs

$$F_{Ft+1} = F_{Ft} + \gamma(F^*_{Ft}(V) - F_{Ft})$$

where F^*_{Ft} represents the optimal long run level of semi-fixed factors. Depending on the time scale of the analysis, equation (9) can be adjusted to reflect labour or other factors required for adjustment. In the long run farm households choose the values of L_{NAt}, X_t, L_{At} and F_{Ft} in order to maximise the long run sum of the expected utility of profits.

5 ECONOMETRIC SPECIFICATION

Given that we are interested in examining the relationships between farm size and time allocation decisions, we define a structural empirical model that relates the economic farm size to inter-sectoral labour supply decision and vice versa. The estimable equation of farm size, F_{Ft}, takes the following general form:

Equation 10: Estimation of the farm size

$$F_{Ft} = f(L_{NAit}, V_i, G_{it}, R_{it}, P_{At}/P_{It}, P_{NAt}/P_{It}, w_{At}, w_{NAt,} DP_{At})$$

The estimable equation of off-farm labour supply, L_{NAit}, takes the following general form:

Equation 11: Estimation of off-farm labour

$$L_{NAit} = f\ (CT_{Ait}, F_{Ft}, R_{it}, P_{At}/P_{It}, P_{NAt}/P_{It}, w_{At}, w_{NAt})$$

Because of endogeneity and unobserved heterogeneity, as well as due to data limitations, equations (10) and (11) need to be estimated using a simultaneous equation approach with discrete choice variables.

In order to estimate the probability of switching to the non agricultural sector we will use a combination of a multinomial logit model, used by Sorm and Terrel (2000) and Bojnec and Dries (2005) and a conditional logit model. A conditional logit model is an extension of the multinomial logit model that is particularly appropriate for modelling the behavioural choice where the explanatory variables may include attributes of choice alternatives as well as the characteristics of individuals making the choices. First, we introduce the multinomial model and the conditional logit model separately and then we will consider a combination of both models (Rodriguez 2008).

Multinomial Logit model

We assume that Y_i is the discrete choice of J+1 alternatives (remain in the same occupation (0) or move to one of the J alternatives) and U_{ij} is the utility of an individual j of the choice of alternative J. We will consider U_{ij} as an independent random variable with a systematic component μ_{ij} and a random component e_{ij}, such that

Equation 12: Utility of an individual

$$U_{ij} = \mu_{ij} + e_{ij}$$

As individuals always try to maximise their utility, an individual will choose alternative j if U_{ij} if the largest of U_{i0}, …, U_{iJ}. In Equation 13 will indicate the probabilities of switching between sectors for an individual i.

Equation 13: Matrix of probabilities of switching between sectors

$$P = \begin{bmatrix} P_{FN} & P_{FO} & P_{FF} \\ P_{ON} & P_{OO} & P_{OF} \\ P_{NN} & P_{NO} & P_{NF} \end{bmatrix}$$

with P_{FN} representing the probability that an individual i is observed being a full time farmer at time t conditional upon being out of the labour force in period t+1. P_{FO} represents the chance of being a full time farmer in period t and being a part time farmer in period t+1 and so on.

In the usual multinomial logit model, the expected utilities μ_{ij} are modelled in terms of the characteristics of the individuals (x_i) , so that

Equation 14: Expected utilities in the multinomial logit model

$$\mu_{ij} = \beta'_j x_i$$

The multinomial logit model allows us to estimate a β_j corresponding to each outcome category:

Equation 15: Multinomial logit model

$$P(Y_i = j) = \frac{e^{\beta' j x i}}{\sum_{k=0}^{J} e^{\beta' j x i}}$$

The estimated equations provide a set of probabilities for the J+1 choices. The model, however, is unidentified in the sense that there is more than one solution for the β_j, that leads to the same probabilities for Y = j. A convenient normalisation that solves the problem is to assume that $\beta_0 = 0$. The remaining coefficients β_j measure the change relative to the Y = 0 group. The probabilities are now given by:

Equation 16: Normalisation of the multinomial logit model

$$P(Y = j) = \frac{e^{\beta' j x i}}{1 + \sum_{k=0}^{J} e^{\beta' j x i}}$$

$$P(Y = 0) = \frac{e^{\beta' j x i}}{1 + \sum_{k=0}^{J} e^{\beta' j x i}}$$

Conditional logit model

The difference between a multinomial logit model and a conditional logit model is that in the latter the expected μ_{ij} are modelled in terms of characteristics of the alternatives rather than attributes of the individuals (z_j):

Equation 17 Expected utilities in the conditional logit model

$$\mu_{ij} = \gamma'_j z_j$$

Multinomial / Conditional logits

A more general model can be obtained by combining the multinomial and conditional logit formulations, so the underlying expected utilities μ_{ij} depend both on characteristics of individuals as well as attributes of choices. The general model is formulated as:

Equation 18 Expected utilities in the multinomial / conditional logit model

$$\mu_{ij} = \beta'_j x_i + \gamma'_j z_j$$

where x_i represents characteristics of the individuals that are constant across choices and z_{ij} represents characteristics that vary across choices (whether they vary by individual or not).

6 CONCLUSION

In this deliverable we present a conceptual model for analysing labour adjustments in the agricultural sector in the CEECs. First we introduce labour supply and demand decisions separately. We assume that the economy is divided in two sectors: an agricultural sector and a non-agricultural sector. Workers have three possible choices, namely to leave the agricultural sector, to stay in agriculture or to engage in both. Leaving the sector is associated with monetary looses captured by transaction costs. Although in some CEECs agricultural work is still organised in large corporate farms, there is a general trend towards more individual farming and when considering farm households, we can not longer assume labour supply and demand decisions to be taken separately.

Another important trend that deserves our attention is the growing off farm labour decisions, which are increasingly studied in the empirical literature. In order to examine not only those factors that will influence the decisions to leave the agricultural sector but also the factors that influence the decisions to engage in off farm employment, we adopt a multinomial logit approach. In the empirical analysis we will also focus on the relationship between the farm size and the off farm decisions, two decisions that are made jointly in farm households. According to previous literature findings, this relationship is not straightforward, it may be both either positive or negative. The theory does not give a clear prediction of whether off-farm labour and farm size are positively or negatively correlated. On one hand, a larger farm is likely to require more labour and hence divert labour away from off-farm employment. The income effect of farm size on the demand for leisure can also reduce off-farm labour participation. On the other hand, farms can grow by investing in labour-saving technologies and thereby release labour to alternative uses. These and related questions will be studied in Deliverable 7.4, where we will empirically estimated the developed multinomial / conditional logit model.

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