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What Motivates Farm Couples to Seek Off-farm labour? A Logit Analysis of Job Transitions

Erik Biørn
and Hild-Marte Bjørnsen

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Department of Economics
University of Oslo

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P. O.Box 1095 Blindern
N-0317 OSLO Norway
Telephone: + 47 22855127
Fax: + 47 22855035
Internet: http://www.sv.uio.no/econ
e-mail: econdep@econ.uio.no

Gaustadalleén 21
N-0371 OSLO Norway
Telephone: +47 22 95 88 20
Fax: +47 22 95 88 25
Internet: http://www.frisch.uio.no
e-mail: frisch@frisch.uio.no

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WHAT MOTIVATES FARM COUPLES TO SEEK OFF-FARM LABOUR?
A LOGIT ANALYSIS OF JOB TRANSITIONS

ERIK BIØRN

Department of Economics, University of Oslo,
P.O. Box 1095 Blindern, 0317 Oslo, Norway
E-mail: erik.biorn@econ.uio.no

HILD-MARTE BJØRNSEN

Norwegian Agricultural Economics Research Institute,
P.O. Box 8024 Dep, 0030 Oslo, Norway
E-mail: marte.bjornsen@nilf.no

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Abstract: In this paper some labour market consequences of transitions in the agriculture sector are examined by combining a 20-year unbalanced panel data set from Norwegian farm couples (households) and logit modeling of one-period transition probabilities. The multi-dimensionality of the problem follows from two decision makers (partners) having four possible choices in each period: the farm operator and spouse can be working fully on the farm or having supplementary outside occupation. Transition probabilities are modeled by five alternative logit models. State dependence is represented to different extent. The most flexible model has a high number of parameters. Overall, the results indicate that transitions have mainly bee directed towards the state where both partners work off the farm. An increasing livestock reduces the probability of moving to states with substantial off-farm labour participation. Increased farm size tends to have the opposite effect. Recent on-farm investments come out with ambiguous effects, and the pattern seems to change during the observation period. Having children seems to motivate operators to withdraw from off-farm labour and spouses to stay in or entering off-farm employment.

Keywords: Labour market transitions. Agriculture. Panel data. Markov chain. Logit analysis. State dependence. Multiple job-holding.

JEL classification: C23, C25, C33, C35, J43, J62

1 Introduction

During the last 20 years, major transitions have occurred in the economic structure of the agricultural sector in Norway. These changes are not least visible in the labour market. The process describing how the population of farm units/farm couples evolves has been far from stationary. The purpose of this paper is to examine aspects of the *dynamics* of this process, by combining a twenty-year panel data set from Norwegian farms with discrete response modeling relying on *transition rates*. This framework has been frequently used to describe labour market transitions, *e.g.*, transitions to and from unemployment states for *individuals*, but to the authors' knowledge it has been rarely used for labour supply transitions in *agriculture* and especially not for bivariate transitions relating to farm *couples*.

In response to the on-going and increasing entry of farmers in the off-farm labour market, partly accompanied by exits from agriculture, the literature concerning the labour decisions in farm households has flourished in the last 30 years. Numerous aspects of both the decision to *participate in off-farm labour* [Alasia, Weersink, Bollman and Cranfield (2009)] and of the *supply of on- and off-farm labour hours* are covered [Huffman and El-Osta (1997), Kimhi and Rapaport (2004)], sometimes modelled simultaneously with farm production and investment decisions [Ahituv and Kimhi (2002), Phimister and Roberts (2006)]. The literature includes longitudinal analysis addressing problems of heterogeneity and state dependence in off-farm labour participation [Ahituv and Kimhi (2006), Corsi and Findeis (2000), Bjørnsen and Biørn (2010)] but utilisation of panel data spanning more than two periods is rare. State dependence is invariably modelled by use of a dummy variable representation of first-period labour participation in a bivariate choice situation.

In modelling discrete transitions, the 'multi-dimensionality' of the problem calls for attention: First, we have the two data dimensions: period (year) and unit (farm couple, farm household). Second, the existence of two decision makers in each unit (farm couple) motivates a model with at least two equations. Third, in each period, *four states* are available, since each partner (operator and spouse) has the choice of being 'in' or 'out', *i.e.*, either having only one job, on the farm, or being involved in supplementary occupation outside the farm as well.

Several strategies for *modelling transitions between states* in this setting, can be imagined. One is to include lagged covariates, another is to include lagged discrete responses as explanatory variables. The latter approach is often followed in single equation *binary* response situations; see Hyslop (1999), Carro (2006), Honoré and Kyriazidou (2000), and Browning and Carro (2010).[1] Our setting with a four-dimensional vector of binary responses would in principle require that *four lagged responses* to be accounted for. The solution might be a non-linear vector autoregressive (VAR) model of order 1, the non-linearity being due to the restricted range of

[1] Honoré and Kyriazidou (2000, Section 4.3) also discuss multiple responses.

the set of choice probabilities. Modeling transition probabilities by including *state dependent coefficients* for the covariates, or by parametrizing them as simple functions of time is a third, and somewhat simpler, solution. This third solution is to some extent followed here. The transition probability framework we consider may be related to the *Markov chain* model class, and syntheses of logit models and Markov structured models have been proposed, see *e.g.*, Ordine (1992) for a fairly simple setup and Bartolucci and Farcomeni (2009) for a more elaborate one.[2]

The basic framework is presented in Section 2, while the data are described in Section 3. The selected models of transition probabilities are presented in Section 4. In Section 5 we discuss the results and give some concluding remarks in Section 6.

2 Basics and notation

The *farm household* is the primary unit and is represented by a *farm couple*: *i.e.* farm operator and his/her spouse, in the following often denoted as *partners*.[3] The farm operator is, by definition, occupied in farm labour while the spouse may or may not contribute on the farm. We do not address the modeling of spouses' on-farm labour; working on the farm is a conditioning event for the operator, but not for the spouse. Off-farm labour is optional for both partners in any year t. Both farm operators and spouses thus have the binary choice of participating in off-farm labour or not, and the farm household can choose between four different off-farm labour states in every period: *neither works off the farm* (00), *only the spouse works off the farm* (01), *only the operator works off the farm* (10), or *both work off the farm* (11).

We exploit only information on discrete responses in examining the transition probabilities, and the dynamic structure is captured by conditioning the probability of being in a labour state in year t on the state in year t–1. A static representation of the probability of participating in off-farm labour and the mutual dependencies between the partners' decisions, giving state probabilities, is explored in Bjørnsen (2006), while in Bjørnsen and Biørn (2006, 2010) farm couples' labour supply is analysed by using static Tobit models with unobserved heterogeneity accounted for.

Let the partners' available states be indicated by

$$\begin{aligned} a &= \mathbf{1}\{\text{Operator works off-farm in previous year}\}, \\ b &= \mathbf{1}\{\text{Spouse works off-farm in previous year}\}, \\ c &= \mathbf{1}\{\text{Operator works off-farm in current year}\}, \\ d &= \mathbf{1}\{\text{Spouse works off-farm in current year}\}, \end{aligned}$$

where $\mathbf{1}\{\mathcal{A}\} = 1$ and $= 0$ if $\mathcal{A}$ is true, respectively untrue. Let $Z_{it} = B$ denote the event that couple i in year t chooses state c and d, state $B = (cd)$ for short, and $Z_{i,t-1} = A$ the event that it in year $t-1$ chooses state a and b, state $A = (ab)$ for

[2]Examples of axiomatic model frameworks rooted in stochastic utility, extreme value distributions, logit modeling in combination with ideas from the Markov chain literature can be found in Dagsvik (1988, 2002).

[3]We label the partners 'the operator' and 'the spouse' in order to uniquely define them as *the farmer* and *the spouse of the farmer*, respectively. These definitions do not say anything about gender and we apply the term *spouse* solely in this sense.

short. We refer to A and B as the couple's *exit* and the *entry state*, respectively. The distribution of $Z_{it}|Z_{i,t-1}, Z_{i,t-2}, \ldots, Z_{i1}$ is assumed not to depend on $Z_{i,t-2}, \ldots, Z_{i1}$, *i.e.*, Z_{it} depends on the past via $Z_{i,t-1}$ only. The transition probabilities

$$p_{ABi}^{t-1,t} = P(Z_{i,t-1}=A, Z_{it}=B|Z_{i,t-1}=A), \qquad A, B = 00, 01, 10, 11,$$

are related to biannual *state probabilities*, $q_{ABi}^{t-1,t} = P(Z_{i,t-1}=A, Z_{it}=B)$, as follows:[4]

$$(1) \qquad p_{ABi}^{t-1,t} = \frac{q_{AB}^{t-1,t}}{\sum_B q_{AB}^{t-1,t}}, \quad A, B = 00, 01, 10, 11.$$

If events Z_{it} and $Z_{i,t-1}$ are independent, $q_{ABi}^{t-1,t} = P(Z_{i,t-1}=A)P(Z_{it}=B)$ for any A, B, it follows that $p_{ABi}^{t-1,t} = P(Z_{it}=B)$ irrespective of A.

Table 1: Transition probabilities. Overview

O_+, O_- = 'operator out, in'. S_+, S_- = 'spouse out, in'

		# partners affected:	
From state 00:	$p_{(00)(00)}^{t-1,t}$:	0 :	
	$p_{(00)(01)}^{t-1,t}$:	1 :	S_+
	$p_{(00)(10)}^{t-1,t}$:	1 :	O_+
	$p_{(00)(11)}^{t-1,t}$:	2 :	O_+S_+
From state 01:	$p_{(01)(01)}^{t-1,t}$:	0 :	
	$p_{(01)(00)}^{t-1,t}$:	1 :	S_-
	$p_{(01)(11)}^{t-1,t}$:	1 :	O_+
	$p_{(01)(10)}^{t-1,t}$:	2 :	O_+S_-
From state 10:	$p_{(10)(10)}^{t-1,t}$:	0 :	
	$p_{(10)(00)}^{t-1,t}$:	1 :	O_-
	$p_{(10)(11)}^{t-1,t}$:	1 :	S_+
	$p_{(10)(01)}^{t-1,t}$:	2 :	O_-S_+
From state 11:	$p_{(11)(11)}^{t-1,t}$:	0 :	
	$p_{(11)(01)}^{t-1,t}$:	1 :	O_-
	$p_{(11)(10)}^{t-1,t}$:	1 :	S_-
	$p_{(11)(00)}^{t-1,t}$:	2 :	O_-S_-

For a panel that spans T consecutive years, the number of possible one-year transitions is $n_T = 2^4(T-1) = 16(T-1)$, while the number of combinations, $Z_{i1}, Z_{i2}, \ldots, Z_{iT}$, is $s_T = (2\times2)^T = 4^T$. The $2^4 = 16$ one-year transition probabilities are listed in Table 1. For $T = 20$, which is the length of the present panel, $n_T = 304$ and $s_T = 4^{20} (> 10^{12})$. The matrix of transition probabilities for couple i, years $(t-1, t)$ is

$$(2) \qquad \boldsymbol{P}_i^{t-1,t} = \begin{bmatrix} p_{00,00,i}^{t-1,t} & p_{00,01,i}^{t-1,t} & p_{00,10,i}^{t-1,t} & p_{00,11,i}^{t-1,t} \\ p_{01,00,i}^{t-1,t} & p_{01,01,i}^{t-1,t} & p_{01,10,i}^{t-1,t} & p_{01,11,i}^{t-1,t} \\ p_{10,00,i}^{t-1,t} & p_{10,01,i}^{t-1,t} & p_{10,10,i}^{t-1,t} & p_{10,11,i}^{t-1,t} \\ p_{11,00,i}^{t-1,t} & p_{11,01,i}^{t-1,t} & p_{11,10,i}^{t-1,t} & p_{11,11,i}^{t-1,t} \end{bmatrix}, \quad i = 1, \ldots, N; \ t = 2, \ldots, T.$$

[4] Bjørnsen (2006) is a related analysis of *state probabilities*, $P(Z_{it}=B)$, for farm households.

The primary aim of the paper is to explore the dependence of $\boldsymbol{P}_i^{t-1,t}$ on covariates, when parameterizing them as logit probabilities.

3 Data

The data set is obtained from the Norwegian Farm Accountancy Data Survey, administered by the Norwegian Agricultural Economics Research Institute (Norsk institutt for landbruksforskning, NILF). This comprehensive survey[5] includes annual data for 800–1000 farm units, representing different regions and produce, and includes management accounts drawn from tax accounts and additional information about the use of farmland, yields obtained and labour input. Most farm households report between 1800 and 3100 on-farm work hours yearly (including forest labour), while a standard man-labour year in the agricultural sector is set to 1875 hours. On-farm work hours have a bell-shaped distribution with mean and median of approximately 2500 hours. On average, farm operators supply 2000 and spouses 550 on-farm hours annually.

The original panel data set, as well as our final sample, is unbalanced. Some five percent of the respondents are replaced each year. The extracted sample covers 20 years, 1989–2008, and 17 605 observations of a total of 19 972 are kept. The attrition, of almost 2400 observations, mainly reflects the exclusion of single adult households without spouse. A minor part of the attrition comes from exits from farming (or from the survey) or from change of ownership. The panel includes 1791 unique households, reporting in between 3 and 20 years, on average 9.8 years. We find no evidence for potential endogenous sample selection to influence the results but some self-selection bias may, anyway, occur from voluntary participation in the survey.

Definitions

Particularly important is the definition of working off-farm. Multi-employment is common amongst both farm operators and spouses, and even operators may have their main source of income from outside farming. Most operators report off-farm work in at least some years, but many supply only a marginal number of hours. As many as 20 per cent of them work less than 37.5 hours annually, which is not surprising as many farmers are known to take on small commissions, *e.g.*, from neighbours (road mending, snow clearing, holiday relief). Working off the farm is therefore defined as having *more than 37.5 annual working hours*, the equivalent of one standard labour week, outside the farm. Operators who work less outside the farm, are defined as not working off-farm. A way of rationalizing this 'truncation' is that it contributes to reducing the impact of measurement errors or misclassification: many respondents may take one standard labour week as the smallest 'accounting unit' when reporting. Moreover, the supply structure for 'small jobs' may depart from the one we intend to analyse. Although the problem of few reported off-farm hours occurs less frequently

[5] The survey is the Norwegian equivalent to the European Farm Accountancy Data Network (*FADN*).

for spouses, we choose the same definition of off-farm work for both partners. The dependent variable is, as explained above, participation on four mutually exclusive off-farm work regimes, not the number of off-farm hours. Because of the large number of possible transitions, the number of explanatory variables has to be restricted. The covariates used are listed and defined in Table 2.

Two variables represent the size of the farm unit: *Area*, total utilised agricultural area, and *Livestock*, the number of animals converted into livestock units, using the weights defined in the *FADN* calculations. *A priori*, we would assume that larger farms, measured in either way, means more labour spent on the farm, and consequently, fewer hours available for off-farm work. The means of the two measures of farm size are 22 hectares and 40 livestock units, but the variation, measured by the standard deviations, is considerable.

Also the investment to capital ratio (*Investment*) is included as a farm-related covariate. On average this ratio is 8 %, with a standard deviation of 13 %. Household characteristics accounted for are the operator's age (*Age*) and the number of children younger than school-age (*Child6*). Presumably, the eldest farmers are less likely than younger ones to participate in off-farm work, and having small children is likely to affect negatively the work hours of at least one parent. The average age of farm operators is 46 years and the average number of small children is 0.2.

Table 2: Definitions and means of variables
obs= 17605, # farm couples=1791

Symbol	Definition	Mean
Area	Total agricultural land in 100 decares	2.244
Livestock	Total number of animals converted into 100 livestock units	0.406
Investment	Investment to capital ratio	0.084
Age	Age of farm operator divided by 10	4.607
Child6	Number of children aged 0-5 years	0.229
Employrate	Regional employment to labour force ratio	0.747

Table 3: Summary statistics by variable

		Std. Dev.	Min	Max
Area	overall	1.4489	0	17.38
	between	1.5002		
	within	0.4738		
Livestock	overall	0.6217	0	14.404
	between	0.4716		
	within	0.4652		
Investment	overall	0.1253	0	1.3057
	between	0.0590		
	within	0.1155		
Age	overall	0.9685	1.8	7.9
	between	0.8668		
	within	0.4763		
Child6	overall	0.5670	0	4
	between	0.3982		
	within	0.3969		
Employrate	overall	0.0807	0.41	1.07
	between	0.0766		
	within	0.0340		

Table 4: Means and standard deviations by labour state

State		Area	Livestock	Investment	Age	Child6	Employrate
00	mean	2.057	0.510	0.072	4.804	0.218	0.727
	sd	1.127	0.816	0.111	1.175	0.566	0.074
01	mean	2.247	0.458	0.078	4.718	0.214	0.744
	sd	1.354	0.723	0.115	9.804	0.555	0.077
10	mean	2.232	0.443	0.083	4.530	0.232	0.738
	sd	1.465	0.669	0.118	1.026	0.588	0.079
11	mean	2.297	0.344	0.089	4.553	0.236	0.757
	sd	1.540	0.479	0.135	0.860	0.561	0.083
Total	mean	2.244	0.406	0.084	4.607	0.229	0.747
	sd	1.44 9	0.622	0.125	0.968	0.567	0.081

Table 5: Frequency and stability index by labour state

State	No. of observations		No. of households		Stability index
	Freq.	Percent	Freq.	Percent	Percent
00	2211	12.56	573	31.99	38.68
01	2911	16.54	706	39.42	41.35
10	4036	22.93	905	50.53	42.47
11	8447	47.98	1375	76.77	64.96
Total	17605	100.00	3559	198.72	50.32

Table 6: Number of one-year transitions

↓ $t-1$ → t	State 00	State 01	State 10	State 11	Total
State 00	1 376	175	373	98	2 022
State 01	144	1 836	65	606	2 651
State 10	350	73	2 688	555	3 666
State 11	64	517	485	6 409	7 475
Total	1 934	2 601	3 611	7 668	15 814

Table 7: No. of farm households by state and year

Year	State 00	State 01	State 10	State 11	Total
1989	194	146	250	263	853
1990	189	168	260	288	905
1991	196	169	265	308	938
1992	183	170	238	352	943
1993	170	184	241	376	971
1994	140	175	238	415	968
1995	128	172	234	423	957
1996	124	159	206	434	923
1997	115	151	194	450	910
1998	92	151	185	472	900
1999	85	143	194	471	893
2000	80	136	189	470	875
2001	78	133	192	452	855
2002	100	137	199	425	861
2003	85	138	175	445	843
2004	64	144	175	467	850
2005	54	127	172	473	826
2006	49	113	167	517	846
2007	42	99	146	488	775
2008	43	96	116	458	713
Total	2 211	2 911	4 036	8 447	17 605

The off-farm labour market situation is represented by the ratio between regional employment and regional labour force (*Employrate*), calculated for each (of 162) labour market regions annually, and can be read as a proxy for the relative size and centrality of the actual local labour market. The regional differences in distances (in terms of travel time) to regional centres/markets are not directly reflected in this variable, although the ratio does indicate whether the municipalities are in- or out-commuting. Summary statistics by off-farm work regime are given in Table 4.

The traditional farm where neither operator nor spouse participates in off-farm work is smaller in area but holds a higher number of livestock compared to the other work regimes. One average, the farm operators are older and the investment ratio is lower on these farms. The relatively low employment rate also indicates a less central location. The more modern farm households where both operator and spouse work off-farm, manage larger farm units but have fewer livestock units and are generally younger than farm operators in the other three regimes. These households also have the highest investment ratio and are more centrally located.

Area, *Age*, and *Employrate* are relatively stable, and the between variation exceeds the within variation; see Table 3. *Investment* shows stronger within than between variation. Most households invest at some point during the twenty-year observation period, and the debt burden varies over time. Both the between and the within variation (standard deviation) of *Livestock* exceed its mean.

Overview of the transitions

Table 5 shows the variation in households' labour status for the whole observation period. The first two columns gives information on the total number of observations in each of the four labour states while columns three and four show the corresponding number of households. The sum of households in each of the four states (3559) exceeds the total number of individual households (1791) because households move between states, *i.e.*, labour state transitions. The fifth column presents the within household variation which can be interpreted as the households' stability *within* states, *i.e.*, the fraction of years in which a household chooses to remain in any of the four states. On average, the households remain in one state for half of the observation period.

State 11 (both partners working off-farm) is the state with the highest stability index: a household remains in this state for 65 % of the years. The 'traditional' farming state, state 00 (neither working off-farm) is the least stable state in this sense: a household remains in this state for less than 40 % of the years.

Table 7 shows annual frequencies for the four off-farm labour states. The number of yearly observations varies between 713 households (in 2008) and 971 households (in 1993). In all years, most households belong to state 11, and almost 50 per cent of the observations relate to such households. The number of households in state 11 increases strongly, while there is a negative trend, although with minor fluctuations, in the number of households in the other three labour states. The share of households in state 00 is for example reduced from 22 % in 1989 to 6 % in 2008.

The one-year transitions between labour states are shown in Table 6. Most households stay in the same state from one year to the next. Of the 15814 year-to-year observation pairs only 3505 contains different states. Households where neither operator nor spouse work off the farm in year $t-1$ (state 00) tend to move to states 10 or 01, *i.e.*, only one person changes status, in year t. Households where the spouse works off-farm (state 01) mainly move towards state 11, while some also withdraw from off-farm labour entirely. This is true also for households where only the operator works off-farm (state 10). Households being in state 11 are most likely to move to a state where only one partner works off-farm. Hardly any household moves from state 11 to state 00, and overall, very few households change the status of both partners simultaneously (see Table 1). As many as 40 per cent of the one-year transitions concern households who stay in state 11 from one year to the next. However, few households stay in the same state throughout the observation period, see Table 5.

4 Models

We now present the models of the transition probabilities selected. The choice of covariates (Table 2) is 'heuristically' motivated, rather than relying on a theory of optimizing agents, for example a discrete choice dynamic programming model, as in Keane and Wolpin (2009). In modeling transitions, the farm units are assumed to start 'anew' in each period, conditional on the decisions in the previous period. Some models, however, let the farm couples' preferences, represented by the coefficients, be conditional on the initial labour state without being endogenised. The models may be regarded as approximations to an underlying behavioural model, with very different number of parameters. Structuring transitions by one-year *transition* probabilities – *i.e.*, an associated Markov chain (conditional on covariates) of first order – imposes strong restrictions on the underlying $q_{AB}^{t-1,t}$ type *state* probabilities, see (1). Five models are selected, of which the results from the most and the least parsimonious ones will be given less attention than the results from the three intermediate ones.

Let $V_{Bti}^{A,t-1}$ be the deterministic part of the utility of choosing state B in year t, given that A has been chosen in year $t-1$. Equivalently, $V_{Bti}^{A,t-1}$ is the log-odds of state B in year t given state A in year $t-1$. In model versions accounting for latent heterogeneity (*Models 2–5)*, this is an additive part of $V_{Bti}^{A,t-1}$ as described below. We can write the prototype expression for the transition probability as

$$(3) \qquad p_{ABi}^{t-1,t} = \frac{e^{V_{Bti}^{A,t-1}}}{\sum_B e^{V_{Bti}^{A,t-1}}}, \qquad A,B=00,01,10,11.$$

In Models 1 through 4 we let this deterministic utility have the form

$$(4) \qquad V_{Bti}^{A,t-1} = \boldsymbol{x}_{it}\boldsymbol{\beta}_{B|A}^{t-1},$$

where $\boldsymbol{x}_{it}$ is a row vector of covariates for farm household i in year t, *common to all states*, and $\boldsymbol{\beta}_{B|A}^{t-1}$ is a coefficient column vector, in general depending on both the exit period $t-1$ and the exit and entry states A and B. Some elements of $\boldsymbol{x}_{it}$ may well be time invariant. The form of $\boldsymbol{\beta}_{B|A}^{t-1}$ defines the model.

Model 1: Multinomial. Year and state dependent coefficients:
In the first model $\boldsymbol{\beta}_{B|A}^{t-1}$ is unrestricted, which implies that the probability describing couple i's transition from state A in year $t-1$ to state B in year t is

$$p_{ABi}^{t-1,t} = \frac{e^{\boldsymbol{x}_{it}\boldsymbol{\beta}_{B|A}^{t-1}}}{\sum_B e^{\boldsymbol{x}_{it}\boldsymbol{\beta}_{B|A}^{t-1}}}, \qquad A,B=00,01,10,11. \tag{5}$$

State dependence is indicated by the $|A$ subscripts and the $t-1$ superscript on the coefficients. The coefficient sets are, for each t, subject to one normalization, say $\boldsymbol{\beta}_{A|A}^{t-1}=0$, $A=00,01,10,11$.

Actually, we do not allow the coefficients to change value each year in the 20-year period, which would have given 19 coefficient shifts in this, most parameter-rich model. To economise, we *allow the coefficient set to shift at most three times during the data period*, in the years 1993, 1998 and 2003. Hence, with four 'coefficient regimes', $4\times4 = 16$ multinomial logit estimations are required and the number of coefficient vectors becomes $3\times4\times4 = 48$. For simplicity, we do not adjust the coefficient notation to account for this modification, which implies that any $\boldsymbol{\beta}_{B|A}^{t-1}$ takes the same value in five successive years. If the coefficients had been allowed to shift each year, the number of coefficient vectors would have been $3\times4\times(T-1)$, which for $T=20$ equals 228. Considering the moderate panel size, this would have given a grossly overparametrised model.

The properties of this model can be exemplified as follows:

$$V_{Bti}^{A,t-1} - V_{Cti}^{A,t-1} = \boldsymbol{x}_{it}(\boldsymbol{\beta}_{B|A}^{t-1} - \boldsymbol{\beta}_{C|A}^{t-1})$$

represent the log-odds ratio between choosing in year t state B against state C when having in year $t-1$ chosen A, while

$$V_{B,t+1,i}^{A,t} - V_{Bti}^{A,t-1} = \boldsymbol{x}_{i,t+1}(\boldsymbol{\beta}_{B|A}^{t} - \boldsymbol{\beta}_{B|A}^{t-1}) + (\boldsymbol{x}_{i,t+1} - \boldsymbol{x}_{it})\boldsymbol{\beta}_{B|A}^{t-1}$$

is the log-odds ratio of choosing state B in year $t+1$ given state A the previous year against choosing the same states one year earlier. Hence, in general, changes in coefficients and changes in covariates will both contribute to changes in the response probabilities. Some models eliminate certain components *a priori*. The same holds true when time invariant variables are included.

Model 2: Multinomial. Year invariant, state dependent coefficients
This is obtained by omitting the time (exit year) superscripts on the prototype transition probabilities. Formally, we impose on (4) the restrictions

$$\boldsymbol{\beta}_{B|A}^{t-1} = \boldsymbol{\beta}_{B|A} \quad \forall t, \qquad A,B=00,01,10,11.$$

Here state dependence is indicated by the '$|A$' subscripts. Each model is subject to one normalization, say $\boldsymbol{\beta}_{A|A} = 0$, $A = 00,01,10,11$. Only 4 multinomial logit estimations are required, the number of coefficients vectors being $3\times4=12$.

Model 3: Multinomial. State invariant, year dependent coefficients

This is obtained by omitting from the logit response coefficients the $|A$ (exit state) subscripts. Formally, we impose on (4) the restrictions

$$\boldsymbol{\beta}_{B|A}^{t-1} = \boldsymbol{\beta}_{B}^{t-1} \quad \forall\, t, \qquad A, B = 00, 01, 10, 11.$$

State dependence is now indicated by the $t-1$ superscript on coefficients. The model is for each t subject to one normalization, say $\boldsymbol{\beta}_{00}^{t-1} = 0$. With 4 multinomial logit estimations (confer the coefficient shift convention described above), the number of distinct coefficient vectors is $3 \times 4 = 12$.

Model 4: Multinomial. State and year invariant coefficients

This is obtained by omitting from the logit response coefficients both the $|A$ subscript and the $t-1$ superscript on the coefficients. We impose on (4) the restrictions

$$\boldsymbol{\beta}_{B|A}^{t-1} = \boldsymbol{\beta}_{B} \quad \forall\, t, \qquad A, B = 00, 01, 10, 11.$$

The model is subject to the normalization $\boldsymbol{\beta}_{(00)} = 0$ and requires only one multinomial logit estimation with 3 coefficients vectors. Removing any dependence on the exit state assumed, we here model state probabilities.

Model 5: Binomial. Year and state dependent coefficients

This model, like Model 4, also exemplifies a way of strongly economising on parameterisation. It distinguishes only between stay ($B = A$) and move ($B \neq A$). Being 'non-informative' about the entry state of the transitions, it also describes a 'degenerate' pattern. With this model, the expressions for the probabilities of moving from B to B^*(= not B) take the form

$$p_{BB^*i}^{t-1,t} = \frac{e^{\boldsymbol{x}_{it}\boldsymbol{\beta}_B^{t-1}}}{1 + e^{\boldsymbol{x}_{it}\boldsymbol{\beta}_B^{t-1}}}, \qquad B = 00, 01, 10, 11;\; B^* = 00^*, 01^*, 10^*, 11^*,$$

where $00^* = (01,10,11)$, $01^* = (00,10,11)$, etc., and $4 \times 4 = 16$ estimations are required. State-specific latent heterogeneity is allowed for by the inclusion of random intercepts.

5 Results

The results will be discussed primarily in terms of estimated marginal effects (sample mean derivatives of response probabilities). For multinomial models these estimates may differ in sign from the coefficient estimates and are easier to interpret. Before considering the results the primary models, Models 2, 3 and 4, we give examples to illustrate what can be achieved by using the most coefficient-rich model Model 1.[6] The models which have coefficients depending on the exit state, confer (4) and (5), allow examination of the factors which motivate the couples to stay in the same state in years $t-1$ and t, *i.e.*, $B = A$. In the comments below, *'staying in'* relates to transition probabilities, while *'being in'* relates to state probabilities.

[6]The full set estimates for all the 16 possible transitions in each of the four five-year periods from this model are given in Appendix Table A.2, while the coefficient estimates and given in Table A.1.

Examples based on a coefficient-rich parametrisation, Model 1

The result examples from Model 1, given in Table 8, relate to exits from the boundary states, 00 and 11. They indicate, for all the four periods, that increasing *Age* significantly increases the probability of staying in state 00 (column 1). In all periods, increasing age has a positive effect on the probability of moving from state 11 to state 01, and in three of the periods the effects are significant (column 6). An increase in *Children* has, in three of the four periods, a negative impact on the probability of moving from state 00 to state 10 (only operator taking off-farm employment), although its impact on the probability of moving to states where both or only the spouse works off-farm is positive. Although these effects are only exceptionally statistically significant at common levels, they indicate a positive relationship between having young children and at least one partner being engaged in off-farm employment. While increased *Regional employment rate* has ambiguous effects in most cases, there are signs that an increase affects negatively the probability of moving from state 11 to state 10 (although the effect is significant in the second period only).

The farm-related covariates – *Area*, *Livestock* and *Investment* – are all supposed to indicate dedication to farming. This does not, however, imply that a larger value implies more hours dedicated to the farm. *Investment*, for example, depending on its nature, may motivate either more or less time spent on the farm, so its effect on the transition patterns is *a priori* ambiguous. To some extent, the results from Model 1 support these expectations. For most periods increasing *Area* affects positively transitions into states where the operator works off the farm. *Livestock* comes out with a positive effect on the choice of staying in state 00, while its effect on moving to this state from state 11 is negative (and in three periods the effect is significant). Having performed a large *Investment* tends to increase the probability of quitting state 00 in all periods, column 1), but the effect is not significant at 5 % level. On the other hand, the probability of staying in state 11 is reduced (Table 8, column 8). Neither is this effect significant at common levels. In the last period, however, the marginal effect of investment on exiting from state 11 to state 00 is significantly positive (0.1133), while being significantly negative for exit to state 01 (-0.0832). Since having invested substantially in the farm recently on the one hand indicates dedication to farm production, on the other hand may require a higher cash-flow to repay the loan, these finding are not surprising. In the last decade, many Norwegian farmers have invested heavily to increase scale and productivity, which may explain the positive effect of investment on the state 11 to state 00 transition.

More parsimonious parametrisation: Models 2, 3 and 4

Model 2 'tightens' parametrisation by imposing coefficient invariance to the exit year. Marginal effects are given in Table 9, with underlying coefficient estimates given in Table A.3.[7] *Model 3* 'tightens' parametrisation by imposing coefficient invariance

[7] Here we, for convenience, let the base state coincide with the exit state for all variants.

to the exit state, yet represents state dependence through the exit year dependence of the coefficients. Table 10 gives marginal effects, with the underlying coefficient estimates reported in Table A.5. *Model 4* 'tightens' parametrisation further and gives coefficients that are invariant to both exit year and exit state. Its parsimony allows estimation of only 16 coefficients from the full sample of 17 605 observations. We find that the coefficient estimates, in Table A.7, on which the marginal effects to be discussed below are based, are all significant at the 1% level, except the coefficients of investment and number of children for state 01.

Below, we comment on the results, variable by variable.

AREA: The *Model 2* estimates (Table 9) imply that increased farm area reduces the probabilities of staying in states 00 and 01 and the effects are statistically significant. The effect on the probability of moving to state 11 – by far the most frequent state to belong to – from any of the others is positive. The probability of moving to state 10 from any of the others is also positive, irrespective of the exit state. The results from *Model 3* (Table 10) supplement the results from Models 1 and 2 by indicating that an increased farm area reduces the probability of *being in* state 00 and increases the probability of *being in* states where at least one partner goes off-farm, the only exception is *being in* state 11 in the first period. The results from *Model 4* imply that an increased area has a positive effect on the probability of *being in* state 11 and a negative effect on being in all other states. The effects are small but significant for states 00 and 11.

LIVESTOCK: The *Model 2* estimates indicate that an increased livestock has a negative effect on staying in state 11 and on transitions to state 11 irrespective of the exit state, while the probabilities of moving to state 00 and 01 are positively affected irrespective of the exit state. The estimates are generally small, the largest marginal effect in absolute value, −0.0332, occurring for transitions from state 00 to state 11, *i.e.*, a 0.3 % reduction induced by a 1 % increase in livestock. The *Model 3* results support the results from Models 1 and 2: in all periods increased livestock strengthens the probability of *being in* state 00 and weakens the probability of *being in* state 11. *Model 3* gives estimated marginal effects that are mostly significant, unlike the findings from Models 1 and 2. The *Model 4* results indicate that increased farm size in terms of livestock units affects negatively the probability of *being in* state 11 and affects positively the probability of *being in* states where at least one partner only works on the farm.

INVESTMENT: The results from *Model 2* (Table 9) indicate (although most estimates are not statistically significant at usual levels) that increasing *investment* on the farm increases the probability of the household moving to state 11 whatever its exit state, while the probability of moving to any other states varies with the exit state. When the exit state is 00, increased investment strengthens the probability of one or both partners entering off-farm work. Given that either operator or spouse already work off-farm, increased investment makes the couple more likely to move to either state 00 or 11. Again, however, the Model 2 effects are relatively small and only exceptionally significant. The *Model 3* results (Table 10) support the conclusion that the effect of increased investment changes over time, yet the results are not so easily interpreted when contrasting them with the results from Model 1. Increased investment increases the probability of operator taking off-farm work and particularly of the couple moving to state 11. Its impact on the probability of choosing state 10 comes out as negative in the last two periods, supporting the finding from Model 1, while its effect on choosing state 11 is negative in the first period only. This result agrees with the Model 1 results conditioning on exit state 00, but contrasts with results conditioning on exit state 11. The significantly negative estimate of the marginal effects of *being in* states 00 and 01 and the significantly positive estimate of the marginal effect of *being in* state 11 obtained from the parsimonious *Model 4* indicate that an increased *investment* on the farm tends to increase the probability of choosing an off-farm state, at least for the operator.

Age: From the *Model 2* estimates increasing age of the operator has a negative effect on the probability of moving from states 00 or 01 to states 11 or 10 (both with operatoring working off-farm). Likewise, the probabilities of choosing state 00 and 01 increase with age, with two exceptions: increasing age has a negative effect of moving from state 00 to 01 and from state 11 to 00. Mostly, these marginal effects are highly significant and quite strong. We find, *e.g.*, that a one per cent increase in age reduce the probability of moving from state 00 to 11 and from 01 to 11 by 2.3 and 3.6 per cent, respectively. The *Model 3* results imply that the marginal effect of age is unambiguous and significant with one exception: aging increases the probability of *being in* states 00 and 01 and reduces the probability of *being in* state 11. The estimates from *Model 4* confirm the negative impact of increased age on the probability of *being in* states where the operator works off-farm and its positive effect on being in states where both only work on-farm, or only the spouse works off-farm. The effect, although significant, is quite small, however.

Children: According to *Model 2*, the effect of having an additional young child in the household seems to vary with its exit state, but its impact is rather small. For a farm couple exiting from state 00, an increased number of children increases the probability of moving to state 01 or 11, *i.e.*, states where the spouse works off the farm. If, however, the couple was in state 01, having more children would increase the probability of choosing state 00 or 10, where the spouse *withdraws* from off-farm work. If the couple initially were in state 10 or 11, an increased number of children will increase the probability of moving to another state. The *Model 3* results indicate that more young children increase the probability of at least one parent staying at home (states 00, 01, 10) except in the last period when the probability of *being in* state 11 increases. The results from *Model 4* support the conclusion that having more children weakens the probability of *being in* states 10 or 11 (operator working off-farm) and increases the inclination to be in states 00 and 01 (operator working only on-farm). However, the marginal effect is significant only for states 00 and 11.

Regional unemployment rate: The results from *Model 2* indicate that an increased regional employment increases the probability of moving to state 11 from any other states, and the effect is significant except when the exit state is 00. Also, when the exit state is 00, we find that its impact on the probability of moving to *any* other state is positive. Households are less inclined to move *towards* state 00 and the effect is significant for exits from states 01 and 10. Except for state 00, the probability of *staying* in the same state from one year to the next is negative when the employment rate increases. The results from *Model 3* supports the conclusion that increased regional employment rate increases the probability of *being in* state 11, the effects being significantly positive in all periods. Likewise, its impact on the probability of *being in* state 00 is negative in all periods. *Model 4* confirms that increased regional employment tends to increase the probability of *being in* state 11. A one percentage point increase in the employment rate has a large impact according to all models. From the Model 4 results, we find, for example, that it reduces the probability of being in state 00 by 37 % and increases the probability of being in state 11 by 76 % per cent. The huge impact of this variable, relative to the other covariates, must be interpreted in light of a very high employment rate in all regions in the observation period. For this variable, all estimates of marginal effects from the parsimonious Model 4 are significant.

A binomial, stay-move, model: Model 5

The final model is flexible in the sense of allowing for exit state and period coefficient dependence and hence deserves some interest in this study. However, representing choices only as 'stay' or 'move', it disguises a lot of the information in the data. Table 12 gives the marginal effects for staying in each of the four states from one year to the next, based on data for each of the four periods. The corresponding coefficients are presented in Table A.9. Briefly, the results indicate: (i) Increased *Area* reduces the probability of remaining in state 00 and increases the probability of remaining in state 10. (ii) Increased *Livestock* increases the probability of staying in state 00, while reducing the probability of remaining in state 11. (iii) Increased *Investment* tends to reduce the probability of remaining in the same state; 12 of the 16 estimates are negative. (iv) Increasing *Age* significantly strengthens, in all periods, the probability of staying is states 00 and 01, and weakens the probability of staying in state 11. (v) The impact of *Children* concurs largely with the results from Model 2, implying change of state except for the first period and for couples being in state 11 in the last period. (vi) Increased *Regional employment rate* increases, in all periods, the probability of staying in state 11 while reducing the probability of staying in state 00. The latter result largely agrees with those obtained from Models 1–4. Between 10 and 50 per cent of the variation in the binominal stay-move model can be explained by farm-specific latent heterogeneity. Table A.9 specifies properties of the distribution of heterogeneity in this model. Heterogeneity seems to be stronger for labour regimes when the operator works off the farm.

Summary

While the results of the least restrictive model, *Model 1*, gave partly opposing and not highly significant effects of the coefficients depending on period and departing state, tightening the parametrisation, either by letting coefficients be invariant, respectively, to the exit year (*Model 2*), to the exit state (*Model 3*), or to both (*Model 4*), increased the efficiency of the coefficient estimates and eased interpretation. One important gain from this modeling technique is thus to identify the most robust results (we have focused on marginal effects rather than coefficient estimates) across the different model versions. Each of the three farm characteristics show some dominant effects on the transition probabilities. An increased *area* in particular seems to have a positive effect on moving to or staying in states 10 and 11, *i.e.*, states where the operator chooses to work off-farm, and a negative effect on moving to state 00 where neither operator nor spouse works off the farm. The effects with highest statistical significance are found in Models 3 and 4. An increased *livestock*, on the other hand, seems to reduce the off-farm work attachment by reducing the probability that a farm couple moves to state 11, while increasing the probability of moving to state 00. Broadly speaking, area and livestock thus have opposite effects on the choice of labour regime, as anticipated. *Investment on the farm* comes out with more ambiguous effects, varying both between periods and between exit states. In the first two periods in the data set (1989–1993 and 1994–1998) the effect is mostly positive for moving to state 00 while in the two last periods (1999–2003 and 2004–2008), the influence changes towards movements to state 11 where both operator and spouse work off the farm. It seems that, in general, investment induces a change of labour state for the partners.

6 Concluding remarks

This analysis of Norwegian farm households' labour market transitions, based on five logit type models, leads to several unambiguous conclusions with respect the impact of demographic, farm-related and regional variables. The most unambiguous *age* effect is that farm operators seem likely to withdraw from off-farm work with growing age. Increased age in particular has a negative effect on moving to the state where both partners work off the farm (state 11), and a positive effect on moving to states where at least the operator works only on the farm (states 00 and 01). A high proportion of these results are statistically significant across model versions, including the least restrictive *Model 1*. An increased number of small *children* also seems to motivate movement from state 11 towards states where at least one partner only works on the farm. It also leads to a change of state, which, in the first two periods, goes towards states 00 and 01, while in the last period tending towards state 11. Higher *regional employment rate*, the sole labour market characteristic accounted for, increases the probability of moving to, being in or staying in state 11, and reduces the probability of choosing state 00. This result holds true across model versions, except that *Model 1* seems to give some spurious effects, reflecting a certain overparametrisation.

The overall robustness of the results supports our expectation about how Norwegian farm households' respond to changes in the chosen covariates. The operator's age and livestock farming have the expected negative impact on off-farm participation of operators (in particular), while increased farm area and higher regional employment rate affects participation positively. We also find evidence that changes in preferences have taken place over the observation period. This may be most evident for the impact of farm investment. In the first five year periods it tended to increase off-farm participation, while in the latest period it seemed to be accompanied by increased professionalism in farming. These qualitative results are confirmed by the results from the binominal stay-move model (*Model 5*) and by the results for supplementary versions of *Models 2, 3 and 4*, in which household specific heterogeneity is allowed for through random slack in the logit exponents. The latter estimates are obtained from the `gllamm`-extension of logit software, see Rabe-Hesketh, Pickles and Skrondal (2001, Chapter 9) and Rabe-Hesketh and Skrondal (2008, Chapter 3); see, respectively Table A.4, Table A.6 and Table A.7.

While there is very likely that farm households' preferences have undergone changes over a 20-year period, their effects can only be detected with some precision in non-parsimonious models allowing for year dependent coefficients. In an ideal world with respect to data availability, we should definitely focus on *state dependent year to year transitions*. In our context this would have given a total of 19 coefficient shifts, a non-attainable ideal given the rather modest sample size. Further, the limited length of the coefficient vector, which leaves a large part of the variation unexplained, is chosen to keep the number of parameters to be estimated tractable and also provides a motivation for accounting for *latent random heterogeneity* in Models 2, 3 and 4. When we must discard the more coefficient-rich model as tending to be overparametrised, we are left with the more parsimonious versions, all of which in some sense lack adequacy in addressing the problem of modeling transition probabilities. Overall, *Model 2* seems to be the more appropriate compromise. It allows for state dependence (although not year dependence) and renders us in a position to make inference about year-to-year *movements* between states. *Model 3* can only assist in finding the probabilities of *being in* one of the four states in either of the four periods and does not really address questions related to transitions between states, while *Model 4*, which is the most parsimonious model considered, is of limited relevance to the address the core problem in itself. Even so, these models have contributed in the process of analysing transition probabilities by underpinning the robustness of the parameter estimates and marginal effects of the less parsimonious Models 1–2. Generally, the estimates of Models 3–4 are significant at a statistically higher level than the estimates of Models 1–2 and are consequently more efficient.

Table 8:

Model 1: Marginal effects in state dependent transition probabilities

	Exiting from state 00				*Exiting from state 11*			
	00 → 00	00 → 01	00 → 10	00 → 11	11 → 00	11 → 01	11 → 10	11 → 11
	Observations from 1989–1993, 742 obs.				*Observations from 1989–1993, 1186 obs.*			
Area	-0.0465	0.0114	0.0326	0.0025	-0.0037	-0.0025	0.0051	0.0012
	(0.0159)	(0.0082)	(0.0127)	(0.0083)	(0.0098)	(0.0077)	(0.0064)	(0.0023)
Livestock	0.0280	0.0051	-0.0105	-0.0226	-0.0249	0.0178	0.0051	0.0020
	(0.0226)	(0.0074)	(0.0169)	(0.0213)	(0.0141)	(0.0092)	(0.0103)	(0.0025)
Investment	-0.0905	0.0514	0.0214	0.0177	-0.1129	0.0269	0.1263	-0.0404
	(0.1660)	(0.0865)	(0.1438)	(0.0706)	(0.1162)	(0.0890)	(0.0691)	(0.0513)
Age	0.0603	-0.0005	-0.0308	-0.0290	-0.0007	0.0177	-0.0125	-0.0045
	(0.0141)	(0.0079)	(0.0118)	(0.0081)	(0.0133)	(0.0102)	(0.0091)	(0.0037)
Child6	0.0373	0.0066	-0.0446	0.0007	-0.0439	0.0252	0.0128	0.0058
	(0.0289)	(0.0150)	(0.0259)	(0.0111)	(0.0197)	(0.0152)	(0.0131)	(0.0032)
Employrate	0.0206	-0.0344	0.2187	-0.2050	0.0875	-0.0838	-0.0574	0.0537
	(0.2611)	(0.1441)	(0.2182)	(0.1283)	(0.1747)	(0.1334)	(0.1208)	(0.0459)
	Observations from 1994–1998, 632 obs.				*Observations from 1994–1998, 1976 obs.*			
Area	-0.0163	-0.0019	0.0124	0.0058	0.0040	0.0002	-0.0027	-0.0015
	(0.0177)	(0.0120)	(0.0144)	(0.0062)	(0.0066)	(0.0048)	(0.0047)	(0.0016)
Livestock	-0.0050	-0.0060	0.0261	-0.0151	-0.1712	0.0960	0.0648	0.0103
	(0.0824)	(0.0547)	(0.0687)	(0.0330)	(0.0329)	(0.0244)	(0.0233)	(0.0060)
Investment	-0.1622	-0.0065	0.1999	-0.0313	-0.0366	0.0867	-0.0412	-0.0089
	(0.1769)	(0.1180)	(0.1416)	(0.0815)	(0.0667)	(0.0449)	(0.0515)	(0.0165)
Age	0.0799	-0.0258	-0.0373	-0.0167	-0.0018	0.0163	-0.0164	0.0019
	(0.0157)	(0.0102)	(0.0136)	(0.0071)	(0.0096)	(0.0074)	(0.0067)	(0.0017)
Child6	-0.0189	0.0065	-0.0044	0.0167	-0.0479	0.0245	0.0217	0.0017
	(0.0346)	(0.0203)	(0.0295)	(0.0091)	(0.0118)	(0.0093)	(0.0077)	(0.0019)
Employrate	0.0971	0.1987	-0.3200	0.0241	0.3410	-0.1208	-0.2412	0.0209
	(0.2836)	(0.1798)	(0.2415)	(0.1141)	(0.1195)	(0.0911)	(0.0844)	(0.0216)
	Observations from 1999–2003, 387 obs.				*Observations from 1999–2003, 2111 obs.*			
Area	0.0034	-0.0048	-0.0064	0.0079	0.0014	0.0056	-0.0062	-0.0008
	(0.0239)	(0.0144)	(0.0207)	(0.0114)	(0.0056)	(0.0034)	(0.0044)	(0.0020)
Livestock	0.1433	-0.0103	-0.0590	-0.0740	-0.1102	0.0846	0.0214	0.0042
	(0.0888)	(0.0500)	(0.0774)	(0.0505)	(0.0262)	(0.0160)	(0.0198)	(0.0094)
Investment	-0.1208	0.1268	-0.0868	0.0808	0.0759	-0.0222	-0.0483	-0.0053
	(0.1935)	(0.0930)	(0.1735)	(0.0751)	(0.0671)	(0.0469)	(0.0488)	(0.0222)
Age	0.0917	-0.0023	-0.0680	-0.0213	-0.0233	0.0298	-0.0091	0.0026
	(0.0240)	(0.0144)	(0.0205)	(0.0129)	(0.0103)	(0.0073)	(0.0072)	(0.0034)
Child6	0.0068	0.0196	-0.0667	0.0404	-0.0117	-0.0041	0.0097	0.0061
	(0.0487)	(0.0243)	(0.0446)	(0.0164)	(0.0152)	(0.0120)	(0.0097)	(0.0042)
Employrate	-0.0010	0.0706	-0.2754	0.2058	0.0656	0.0016	-0.0454	-0.0219
	(0.3180)	(0.1817)	(0.2730)	(0.1620)	(0.0971)	(0.0678)	(0.0694)	(0.0331)
	Observations from 2004–2008, 261 obs.				*Observations from 2004–2008, 2202 obs.*			
Area	-0.0153	0.0061	0.0057	0.0036	-0.0053	0.0015	0.0037	0.0001
	(0.0207)	(0.0155)	(0.0180)	(0.0118)	(0.0035)	(0.0024)	(0.0025)	(0.0008)
Livestock	0.1753	-0.0396	-0.0735	-0.0622	-0.0184	0.0215	-0.0082	0.0050
	(0.0575)	(0.0455)	(0.0539)	(0.0486)	(0.0144)	(0.0079)	(0.0122)	(0.0022)
Investment	-0.2165	0.1771	-0.0173	0.0567	0.1133	-0.0832	-0.0243	-0.0058
	(0.2264)	(0.1439)	(0.1965)	(0.1005)	(0.0491)	(0.0387)	(0.0317)	(0.0121)
Age	0.0808	-0.0381	-0.0109	-0.0318	-0.0000	0.0029	0.0037	-0.0066
	(0.0291)	(0.0229)	(0.0257)	(0.0177)	(0.0091)	(0.0061)	(0.0065)	(0.0030)
Child6	-0.1124	0.0302	0.0531	0.0291	0.0046	-0.0033	0.0006	-0.0019
	(0.0550)	(0.0344)	(0.0418)	(0.0192)	(0.0132)	(0.0094)	(0.0095)	(0.0030)
Employrate	-0.1679	-0.1048	0.2098	0.0628	0.0669	0.0105	-0.0732	-0.0042
	(0.4520)	(0.3395)	(0.3803)	(0.2342)	(0.0863)	(0.0597)	(0.0621)	(0.0235)

Extract from Appendix Table A.2. Standard errors in parentheses

Table 9: Model 2: Marginal effects. Year invariant, state dependent

	$00 \to 00$	$00 \to 01$	$00 \to 10$	$00 \to 11$	$01 \to 00$	$01 \to 01$	$01 \to 10$	$01 \to 11$
Area	-0.0326	0.0082	0.0170	0.0075	0.0011	-0.0108	0.0007	0.0090
	(0.0087)	(0.0051)	(0.0071)	(0.0040)	(0.0031)	(0.0065)	(0.0023)	(0.0059)
Livestock	0.0477	0.0008	-0.0153	-0.0332	0.0044	0.0141	-0.0034	-0.0151
	(0.0202)	(0.0101)	(0.0166)	(0.0164)	(0.0066)	(0.0177)	(0.0070)	(0.0169)
Investment	-0.1949	0.1042	0.0356	0.0550	0.0188	-0.0414	-0.0035	0.0261
	(0.0907)	(0.0493)	(0.0779)	(0.0358)	(0.0365)	(0.0758)	(0.0264)	(0.0687)
Age	0.0666	-0.0103	-0.0336	-0.0227	0.0085	0.0408	-0.0129	-0.0364
	(0.0090)	(0.0056)	(0.0077)	(0.0047)	(0.0049)	(0.0099)	(0.0037)	(0.0090)
Child6	-0.0026	0.0085	-0.0232	0.0173	0.0201	-0.0165	0.0004	-0.0040
	(0.0186)	(0.0104)	(0.0163)	(0.0062)	(0.0077)	(0.0172)	(0.0048)	(0.0158)
Employrate	-0.2482	0.1538	0.0233	0.0711	-0.1166	-0.2123	0.0712	0.2578
	(0.1384)	(0.0842)	(0.1170)	(0.0649)	(0.0583)	(0.1160)	(0.0400)	(0.1050)
Observations	2022	2022	2022	2022	2651	2651	2651	2651

	$10 \to 00$	$10 \to 01$	$10 \to 10$	$10 \to 11$	$11 \to 00$	$11 \to 01$	$11 \to 10$	$11 \to 11$
Area	-0.0044	-0.0010	0.0039	0.0014	-0.0001	0.0010	0.0002	-0.0011
	(0.0037)	(0.0017)	(0.0053)	(0.0042)	(0.0007)	(0.0018)	(0.0019)	(0.0026)
Livestock	0.0121	0.0040	0.0091	-0.0253	0.0041	0.0296	0.0087	-0.0425
	(0.0074)	(0.0030)	(0.0152)	(0.0147)	(0.0013)	(0.0052)	(0.0066)	(0.0089)
Investment	0.0021	-0.0096	-0.0234	0.0309	-0.0096	-0.0257	-0.0214	0.0567
	(0.0397)	(0.0198)	(0.0587)	(0.0463)	(0.0097)	(0.0234)	(0.0227)	(0.0322)
Age	0.0105	0.0028	0.0211	-0.0344	-0.0009	0.0117	-0.0082	-0.0026
	(0.0050)	(0.0025)	(0.0077)	(0.0062)	(0.0013)	(0.0036)	(0.0035)	(0.0050)
Child6	0.0006	0.0081	-0.0213	0.0126	0.0032	0.0083	0.0112	-0.0227
	(0.0093)	(0.0034)	(0.0128)	(0.0096)	(0.0016)	(0.0054)	(0.0047)	(0.0071)
Employrate	-0.1454	0.0424	-0.0687	0.1717	0.0045	-0.1309	-0.1089	0.2352
	(0.0624)	(0.0295)	(0.0935)	(0.0753)	(0.0127)	(0.0358)	(0.0349)	(0.0492)
Observations	3666	3666	3666	3666	7475	7475	7475	7475

Standard errors in parentheses.

Table 10: Model 3: Marginal effects. State invariant, year dependent

	Observations from 1989–1993, 3757 obs.				*Observations from 1994–1998, 4658 obs.*			
	00	01	10	11	00	01	10	11
Area	-0.0021	0.0043	0.0007	-0.0029	-0.0178	0.0038	0.0004	0.0136
	(0.0059)	(0.0057)	(0.0066)	(0.0071)	(0.0046)	(0.0046)	(0.0052)	(0.0061)
Livestock	0.0236	0.0167	0.0268	-0.0671	0.1840	0.0318	0.1643	-0.3801
	(0.0071)	(0.0072)	(0.0086)	(0.0136)	(0.0208)	(0.0250)	(0.0268)	(0.0335)
Investment	0.0368	-0.0744	0.1699	-0.1323	-0.0886	-0.0416	0.0749	0.0554
	(0.0679)	(0.0718)	(0.0735)	(0.0854)	(0.0473)	(0.0513)	(0.0535)	(0.0641)
Age	0.0515	0.0239	-0.0374	-0.0380	0.0571	0.0329	-0.0204	-0.0696
	(0.0066)	(0.0064)	(0.0072)	(0.0078)	(0.0055)	(0.0062)	(0.0067)	(0.0079)
Child6	0.0370	0.0238	-0.0072	-0.0536	0.0141	0.0168	-0.0049	-0.0260
	(0.0118)	(0.0113)	(0.0130)	(0.0147)	(0.0098)	(0.0105)	(0.0115)	(0.0136)
Employrate	-0.1173	0.2849	-0.3897	0.2222	-0.0489	0.1106	-0.4152	0.3534
	(0.1004)	(0.0985)	(0.1124)	(0.1208)	(0.0740)	(0.0831)	(0.0931)	(0.1078)

	Observations from 1999–2003, 4327 obs.				*Observations from 2004–2008, 4010 obs.*			
	00	01	10	11	00	01	10	11
Area	-0.0127	0.0009	0.0005	0.0113	-0.0027	-0.0027	0.0034	0.0020
	(0.0038)	(0.0040)	(0.0046)	(0.0055)	(0.0021)	(0.0032)	(0.0036)	(0.0045)
Livestock	0.0876	0.1177	0.0190	-0.2243	0.0454	0.0623	-0.0114	-0.0963
	(0.0132)	(0.0164)	(0.0214)	(0.0261)	(0.0062)	(0.0108)	(0.0155)	(0.0181)
Investment	-0.0561	0.0081	-0.0353	0.0833	-0.0244	-0.0523	-0.0336	0.1103
	(0.0391)	(0.0437)	(0.0503)	(0.0588)	(0.0262)	(0.0375)	(0.0406)	(0.0495)
Age	0.0408	0.0358	-0.0016	-0.0749	0.0124	0.0155	0.0161	-0.0440
	(0.0054)	(0.0065)	(0.0073)	(0.0086)	0.0046)	(0.0068)	(0.0077)	(0.0094)
Child6	0.0203	-0.0091	0.0109	-0.0221	-0.0044	-0.0148	-0.0101	0.0293
	(0.0079)	(0.0107)	(0.0110)	(0.0134)	(0.0082)	(0.0118)	(0.0130)	(0.0156)
Employrate	-0.1047	-0.0582	-0.0850	0.2479	-0.2775	-0.1788	-0.0317	0.4880
	(0.0589)	(0.0711)	(0.0805)	(0.0953)	(0.0518)	(0.0728)	(0.0815)	(0.1003)

Standard errors in parentheses

Table 11: MODEL 4: MARGINAL EFFECTS. YEAR AND STATE INVARIANT

	Labour state: 00	01	10	11
Area	-0.0129	-0.0009	-0.0019	0.0156
	(0.0020)	(0.0020)	(0.0022)	(0.0026)
Livestock	0.0414	0.0408	0.0453	-0.1275
	(0.0034)	(0.0045)	(0.0056)	(0.0093)
Investment	-0.0715	-0.0507	0.0019	0.1203
	(0.0220)	(0.0236)	(0.0257)	(0.0298)
Age	0.0310	0.0225	-0.0168	-0.0367
	(0.0027)	(0.0031)	(0.0034)	(0.0040)
Child6	0.0156	0.0050	-0.0059	-0.0148
	(0.0047)	(0.0053)	(0.0059)	(0.0069)
Employrate	-0.3755	-0.0750	-0.3103	0.7608
	(0.0317)	(0.0346)	(0.0395)	(0.0454)
Observations	17605	17605	17605	17605

Standard errors in parentheses

Table 12: MODEL 5: MARGINAL EFFECTS FOR ALTERNATIVE: REMAIN IN THE EXIT STATE

	Observations from 1989–1993				*Observations from 1994–1998*			
	00 → 00	01 → 01	10 → 10	11 → 11	00 → 00	01 → 01	10 → 10	11 → 11
Area	-0.6134	0.0340	-0.0949	-0.0950	-0.2695	-0.0993	0.0094	-0.0043
	(0.2292)	(0.2062)	(0.1730)	(0.1754)	(0.2339)	(0.1616)	(0.1950)	(0.1623)
Livestock	0.0549	0.0564	0.0683	-0.0516	0.0443	-0.1416	0.1092	-0.4959
	(0.0643)	(0.0597)	(0.0564)	(0.0436)	(0.1955)	(0.1423)	(0.1616)	(0.1126)
Investment	-0.0532	-0.0031	-0.0339	-0.0587	-0.0607	-0.0022	0.0187	-0.0523
	(0.0672)	(0.0780)	(0.0632)	(0.0572)	(0.0705)	(0.0602)	(0.0677)	(0.0546)
Age	1.9173	1.1149	-0.3575	-0.0341	2.2984	1.3201	0.3292	-0.2888
	(0.5010)	(0.5340)	(0.4309)	(0.5407)	(0.5773)	(0.5545)	(0.5342)	(0.5318)
Child6	0.0383	0.0249	0.0356	-0.0886	-0.0195	-0.0247	-0.0589	-0.1349
	(0.0521)	(0.0526)	(0.0437)	(0.0371)	(0.0404)	(0.0379)	(0.0425)	(0.0357)
Employrate	0.4159	0.8188	-1.6255	0.6197	-0.1391	1.3663	-0.9073	2.7037
	(1.3416)	(1.4144)	(1.1124)	(1.1948)	(1.4041)	(1.0682)	(1.2775)	(1.1149)
Observations	742	634	985	1186	632	797	1050	1976

	Observations from 1999–2003				*Observations from 2004–2008*			
	00 → 00	01 → 01	10 → 10	11 → 11	00 → 00	01 → 01	10 → 10	11 → 11
Area	-0.0180	-0.0690	0.1769	-0.0042	-0.2286	-0.3057	0.1897	-0.1805
	(0.2718)	(0.1949)	(0.1994)	(0.1293)	(0.3238)	(0.2061)	(0.2345)	(0.1409)
Livestock	0.2999	-0.0216	-0.0396	-0.3435	0.5213	0.2551	-0.1768	-0.1508
	(0.1902)	(0.1285)	(0.1306)	(0.0831)	(0.1877)	(0.1479)	(0.1425)	(0.0763)
Investment	-0.0563	-0.0001	-0.0696	0.0547	-0.1136	-0.0043	0.0014	0.1291
	(0.0722)	(0.0696)	(0.0610)	(0.0507)	(0.1123)	(0.0638)	(0.0852)	(0.0636)
Age	2.4006	1.2271	1.4290	-1.1419	2.0935	1.1145	0.5981	-0.1189
	(0.7292)	(0.6243)	(0.5787)	(0.4745)	(0.8281)	(0.6324)	(0.8009)	(0.5854)
Child6	-0.0186	-0.0397	-0.0388	-0.0310	-0.1268	-0.0176	-0.0978	0.0166
	(0.0542)	(0.0395)	(0.0456)	(0.0326)	(0.0694)	(0.0386)	(0.0514)	(0.0450)
Employrate	-0.2863	-2.0293	-0.4537	0.1121	-0.7828	-1.4776	-0.0290	0.5887
	(1.2920)	(1.0849)	(1.0951)	(0.7572)	(1.8198)	(1.1418)	(1.5670)	(0.9934)
Observations	387	643	874	2111	261	577	757	2202

Computed by marginal effects option of Stata command `xtlogit`. Standard errors in parentheses

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Appendix Tables

Table A.1:

Model 1: Coefficient estimates. State and year dependent

	1989-1993	1994-1998	1999-2003	2004-2008
00 → 01				
Area	0.2462	0.0069	-0.0635	0.0748
	(0.1389)	(0.1540)	(0.1998)	(0.1293)
Livestock	0.0363	-0.0664	-0.3797	-0.6620
	(0.1225)	(0.6994)	(0.6992)	(0.3741)
Investment	0.9320	0.1780	1.8108	1.6699
	(1.4534)	(1.5144)	(1.3090)	(1.2656)
Age	-0.0996	-0.4301	-0.1807	-0.4398
	(0.1366)	(0.1323)	(0.2080)	(0.1956)
Child6	0.0451	0.1107	0.2484	0.4523
	(0.2533)	(0.2650)	(0.3480)	(0.3185)
Employrate	-0.5706	2.1153	0.9537	-0.3235
	(2.4302)	(2.2936)	(2.5391)	(2.8655)
00 → 10				
Area	0.2615	0.0966	-0.0382	0.0600
	(0.0943)	(0.1021)	(0.1381)	(0.1173)
Livestock	-0.1072	0.1500	-0.5455	-0.7311
	(0.1194)	(0.4844)	(0.5185)	(0.3450)
Investment	0.2645	1.3704	-0.2565	0.3837
	(1.0454)	(1.0025)	(1.1763)	(1.3213)
Age	-0.2760	-0.3412	-0.5055	-0.2285
	(0.0880)	(0.1002)	(0.1430)	(0.1722)
Child6	-0.3171	0.0100	-0.3572	0.4952
	(0.1885)	(0.2125)	(0.3046)	(0.2998)
Employrate	1.2172	-1.9345	-1.4238	1.3655
	(1.5876)	(1.7062)	(1.8334)	(2.4912)
00 → 11				
Area	0.1285	0.2190	0.1322	0.0912
	(0.1896)	(0.2103)	(0.2159)	(0.1980)
Livestock	-0.5266	-0.4861	-1.5510	-1.3642
	(0.4735)	(1.1275)	(0.9459)	(0.7955)
Investment	0.5212	-0.7288	1.6568	1.4078
	(1.6083)	(2.7906)	(1.4600)	(1.7583)
Age	-0.7161	-0.6980	-0.5327	-0.6816
	(0.1670)	(0.2267)	(0.2465)	(0.2916)
Child6	-0.0471	0.5852	0.7050	0.7114
	(0.2538)	(0.3061)	(0.3168)	(0.3628)
Employrate	-4.3834	0.6448	3.6496	1.3226
	(2.8611)	(3.9221)	(3.0479)	(4.0079)
Observations	742	632	387	261
01 → 11				
Area	-0.0957	0.0319	0.0434	0.0967
	(0.1071)	(0.0677)	(0.0699)	(0.0655)
Livestock	-0.0339	-0.0601	0.0258	-0.4145
	(0.1171)	(0.4553)	(0.2806)	(0.2799)
Investment	-0.1665	0.1965	0.1781	-0.1912
	(1.4060)	(0.8158)	(0.7768)	(0.6422)
Age	-0.2951	-0.2833	-0.2578	-0.2012
	(0.1100)	(0.1041)	(0.1124)	(0.1163)
Child6	-0.2040	0.0199	0.1217	0.0253
	(0.1974)	(0.1673)	(0.1818)	(0.2227)
Employrate	-0.8688	-1.4750	1.6713	2.6230
	(1.7923)	(1.2670)	(1.2304)	(1.3038)
01 → 00				
Area	0.0861	0.0092	-0.1056	0.2186
	(0.1318)	(0.1452)	(0.1480)	(0.1264)
Livestock	0.0193	1.7297	0.5899	-1.4938
	(0.1573)	(0.7765)	(0.4355)	(0.8159)
Investment	1.2904	-0.0892	0.0824	0.9206
	(1.9197)	(1.5846)	(1.5305)	(1.1636)
Age	0.3278	0.0143	0.0241	-0.0205
	(0.1702)	(0.1972)	(0.2178)	(0.2486)
Child6	0.2964	0.5251	0.4240	-0.0757
	(0.2840)	(0.2526)	(0.3057)	(0.5500)
Employrate	-0.3866	-4.0072	1.8970	-3.8113
	(2.6905)	(2.4704)	(2.4129)	(2.6249)
01 → 10				
Area	0.1605	-0.0567	0.1185	-0.1724
	(0.2286)	(0.2312)	(0.1798)	(0.2003)
Livestock	-0.4733	2.5390	-1.4278	0.1095
	(0.6409)	(1.1666)	(1.1645)	(0.5700)
Investment	-2.1284	-0.9211	-1.6824	0.9171
	(3.8234)	(2.8157)	(2.7210)	(1.3711)
Age	-1.1158	-0.3555	-0.4445	-0.4218
	(0.3013)	(0.3068)	(0.3145)	(0.3161)
Child6	-0.1264	-0.2675	0.1604	0.5319
	(0.3545)	(0.5380)	(0.4749)	(0.4123)
Employrate	-2.0709	2.8899	6.6480	0.3047
	(4.0873)	(3.7593)	(3.3342)	(3.5459)
Observations	634	797	643	577

Standard errors in parentheses

Table A.1: (cont.)

Model 1: Coefficient estimates. State and year dependent

	1989-1993	1994-1998	1999-2003	2004-2008
10 → 11				
Area	0.1018	0.0305	-0.0511	-0.0625
	(0.0871)	(0.0703)	(0.0762)	(0.0615)
Livestock	-0.1150	-0.7052	-0.0589	0.0435
	(0.1362)	(0.4158)	(0.3469)	(0.2730)
Investment	0.0102	-0.5109	1.0310	-0.1644
	(1.0533)	(0.7839)	(0.6391)	(0.6906)
Age	-0.0887	-0.3534	-0.4453	-0.2988
	(0.1009)	(0.0959)	(0.1109)	(0.1118)
Child6	-0.1309	0.1425	0.0723	0.3239
	(0.1818)	(0.1474)	(0.1385)	(0.1789)
Employrate	2.2348	-1.5918	1.2919	0.3469
	(1.5789)	(1.3497)	(1.3138)	(1.3828)
10 → 00				
Area	0.0354	-0.1142	-0.0855	-0.0250
	(0.0910)	(0.1036)	(0.1039)	(0.0769)
Livestock	-0.0879	0.8048	0.4639	0.7772
	(0.1243)	(0.4772)	(0.3893)	(0.2705)
Investment	0.4584	0.3450	-0.4455	0.1132
	(0.9528)	(0.9286)	(0.9943)	(1.0050)
Age	0.1880	0.2432	-0.0123	0.1064
	(0.0977)	(0.1222)	(0.1380)	(0.1654)
Child6	-0.1657	0.2950	-0.0985	0.2898
	(0.2023)	(0.2096)	(0.2231)	(0.2773)
Employrate	0.4901	2.1501	-1.6058	-3.0665
	(1.4942)	(1.7159)	(1.7174)	(2.0026)
10 → 01				
Area	-0.2627	0.1720	-0.1976	-0.0942
	(0.2637)	(0.1515)	(0.2889)	(0.1475)
Livestock	0.1778	-0.7215	0.6113	0.2676
	(0.1652)	(1.0126)	(0.8586)	(0.5268)
Investment	0.7829	-2.6937	0.2484	0.3216
	(2.3133)	(2.6418)	(2.3646)	(1.5368)
Age	0.0332	0.2279	-0.1816	0.2283
	(0.2369)	(0.2428)	(0.3825)	(0.2673)
Child6	0.3340	0.2511	0.7992	0.4316
	(0.3459)	(0.4210)	(0.3088)	(0.4189)
Employrate	9.2835	2.0998	-0.8674	0.2383
	(3.7957)	(3.2791)	(4.4642)	(3.1885)
Observations	985	1050	874	757
11 → 01				
Area	-0.0211	-0.0027	0.0816	0.0383
	(0.0882)	(0.0709)	(0.0552)	(0.0522)
Livestock	0.2129	1.5248	1.3958	0.4725
	(0.1064)	(0.3578)	(0.2522)	(0.1729)
Investment	0.4140	1.2130	-0.4223	-1.8729
	(1.0195)	(0.6585)	(0.7537)	(0.8398)
Age	0.1816	0.2222	0.4741	0.0591
	(0.1159)	(0.1081)	(0.1148)	(0.1357)
Child6	0.3131	0.3946	-0.0466	-0.0754
	(0.1747)	(0.1368)	(0.1929)	(0.2061)
Employrate	-0.9613	-2.0788	-0.0546	0.1422
	(1.5218)	(1.3450)	(1.0903)	(1.3167)
11 → 10				
Area	0.0691	-0.0493	-0.0890	0.0744
	(0.0893)	(0.0833)	(0.0665)	(0.0488)
Livestock	0.0964	1.3028	0.4310	-0.1308
	(0.1445)	(0.4151)	(0.3043)	(0.2403)
Investment	1.7407	-0.6317	-0.7682	-0.5804
	(0.9565)	(0.9184)	(0.7375)	(0.6222)
Age	-0.1589	-0.2690	-0.0993	0.0688
	(0.1258)	(0.1181)	(0.1104)	(0.1280)
Child6	0.2183	0.4243	0.1499	0.0059
	(0.1837)	(0.1360)	(0.1463)	(0.1861)
Employrate	-0.8315	-4.4505	-0.7149	-1.4336
	(1.6796)	(1.4809)	(1.0514)	(1.2157)
11 → 00				
Area	0.1229	-0.5150	-0.0544	0.0216
	(0.2339)	(0.4877)	(0.1355)	(0.1338)
Livestock	0.2348	3.6758	0.4142	0.8349
	(0.2476)	(1.5190)	(0.6380)	(0.3042)
Investment	-3.9093	-2.8687	-0.4447	-1.0769
	(5.1181)	(5.3734)	(1.4896)	(1.9389)
Age	-0.4506	0.6455	0.1983	-1.0504
	(0.3531)	(0.5108)	(0.2292)	(0.3989)
Child6	0.6459	0.6212	0.4148	-0.3040
	(0.2991)	(0.5999)	(0.2761)	(0.4835)
Employrate	5.2904	6.4741	-1.5276	-0.7427
	(4.4663)	(6.6856)	(2.2113)	(3.7826)
Observations	1186	1976	2111	2202

Standard errors in parentheses

Table A.2:

Model 1: Marginal effects. State and year dependent

	Observations from 1989-1993				*Observations from 1994-1998*			
	00 → 00	00 → 01	00 → 10	00 → 11	00 → 00	00 → 01	00 → 10	00 → 11
Area	-0.0465	0.0114	0.0326	0.0025	-0.0163	-0.0019	0.0124	0.0058
	(0.0159)	(0.0082)	(0.0127)	(0.0083)	(0.0177)	(0.0120)	(0.0144)	(0.0062)
Livestock	0.0280	0.0051	-0.0105	-0.0226	-0.0050	-0.0060	0.0261	-0.0151
	(0.0226)	(0.0074)	(0.0169)	(0.0213)	(0.0824)	(0.0547)	(0.0687)	(0.0330)
Investment	-0.0905	0.0514	0.0214	0.0177	-0.1622	-0.0065	0.1999	-0.0313
	(0.1660)	(0.0865)	(0.1438)	(0.0706)	(0.1769)	(0.1180)	(0.1416)	(0.0815)
Age	0.0603	-0.0005	-0.0308	-0.0290	0.0799	-0.0258	-0.0373	-0.0167
	(0.0141)	(0.0079)	(0.0118)	(0.0081)	(0.0157)	(0.0102)	(0.0136)	(0.0071)
Child6	0.0373	0.0066	-0.0446	0.0007	-0.0189	0.0065	-0.0044	0.0167
	(0.0289)	(0.0150)	(0.0259)	(0.0111)	(0.0346)	(0.0203)	(0.0295)	(0.0091)
Employrate	0.0206	-0.0344	0.2187	-0.2050	0.0971	0.1987	-0.3200	0.0241
	(0.2611)	(0.1441)	(0.2182)	(0.1283)	(0.2836)	(0.1798)	(0.2415)	(0.1141)
Observations	742	742	742	742	632	632	632	632

	01 → 00	01 → 01	01 → 10	01 → 11	01 → 00	01 → 01	01 → 10	01 → 11
Area	0.0049	-0.0156	0.0062	0.0045	-0.0046	0.0058	0.0001	-0.0013
	(0.0168)	(0.0152)	(0.0082)	(0.0058)	(0.0131)	(0.0118)	(0.0071)	(0.0045)
Livestock	0.0120	-0.0024	0.0022	-0.0118	-0.0862	-0.0440	0.0826	0.0476
	(0.0216)	(0.0169)	(0.0098)	(0.0163)	(0.0844)	(0.0781)	(0.0384)	(0.0247)
Investment	-0.0048	-0.0260	0.0853	-0.0544	-0.0156	0.0400	-0.0057	-0.0187
	(0.2308)	(0.1993)	(0.1192)	(0.0965)	(0.1563)	(0.1418)	(0.0769)	(0.0547)
Age	0.0414	-0.0397	0.0252	-0.0269	0.0493	-0.0484	0.0046	-0.0056
	(0.0184)	(0.0151)	(0.0107)	(0.0092)	(0.0194)	(0.0179)	(0.0095)	(0.0060)
Child6	0.0133	-0.0318	0.0209	-0.0024	-0.0181	-0.0018	0.0258	-0.0059
	(0.0318)	(0.0279)	(0.0177)	(0.0088)	(0.0312)	(0.0287)	(0.0124)	(0.0104)
Employrate	0.1677	-0.1089	-0.0120	-0.0468	0.3371	-0.2234	-0.1815	0.0679
	(0.2955)	(0.2540)	(0.1668)	(0.1028)	(0.2394)	(0.2192)	(0.1215)	(0.0740)
Observations	634	634	634	634	797	797	797	797

	10 → 00	10 → 01	10 → 10	10 → 11	10 → 00	10 → 01	10 → 10	10 → 11
Area	-0.0086	0.0111	0.0030	-0.0055	0.0012	0.0050	-0.0098	0.0036
	(0.0134)	(0.0092)	(0.0100)	(0.0053)	(0.0116)	(0.0092)	(0.0082)	(0.0032)
Livestock	0.0159	-0.0115	-0.0085	0.0040	0.0411	-0.1019	0.0748	-0.0139
	(0.0181)	(0.0146)	(0.0139)	(0.0033)	(0.0638)	(0.0546)	(0.0379)	(0.0207)
Investment	-0.0554	-0.0082	0.0493	0.0142	0.0784	-0.0636	0.0393	-0.0540
	(0.1463)	(0.1121)	(0.1055)	(0.0454)	(0.1248)	(0.1032)	(0.0734)	(0.0549)
Age	-0.0102	-0.0126	0.0224	0.0004	0.0220	-0.0509	0.0236	0.0054
	(0.0145)	(0.0107)	(0.0108)	(0.0046)	(0.0152)	(0.0125)	(0.0097)	(0.0050)
Child6	0.0224	-0.0123	-0.0174	0.0073	-0.0396	0.0143	0.0212	0.0041
	(0.0274)	(0.0194)	(0.0225)	(0.0069)	(0.0251)	(0.0192)	(0.0165)	(0.0086)
Employrate	-0.3815	0.2097	-0.0040	0.1758	0.0142	-0.2467	0.1884	0.0441
	(0.2240)	(0.1674)	(0.1644)	(0.0822)	(0.2145)	(0.1772)	(0.1358)	(0.0670)
Observations	985	985	985	985	1050	1050	1050	1050

	11 → 00	11 → 01	11 → 10	11 → 11	11 → 00	11 → 01	11 → 10	11 → 11
Area	-0.0037	-0.0025	0.0051	0.0012	0.0040	0.0002	-0.0027	-0.0015
	(0.0098)	(0.0077)	(0.0064)	(0.0023)	(0.0066)	(0.0048)	(0.0047)	(0.0016)
Livestock	-0.0249	0.0178	0.0051	0.0020	-0.1712	0.0960	0.0648	0.0103
	(0.0141)	(0.0092)	(0.0103)	(0.0025)	(0.0329)	(0.0244)	(0.0233)	(0.0060)
Investment	-0.1129	0.0269	0.1263	-0.0404	-0.0366	0.0867	-0.0412	-0.0089
	(0.1162)	(0.0890)	(0.0691)	(0.0513)	(0.0667)	(0.0449)	(0.0515)	(0.0165)
Age	-0.0007	0.0177	-0.0125	-0.0045	-0.0018	0.0163	-0.0164	0.0019
	(0.0133)	(0.0102)	(0.0091)	(0.0037)	(0.0096)	(0.0074)	(0.0067)	(0.0017)
Child6	-0.0439	0.0252	0.0128	0.0058	-0.0479	0.0245	0.0217	0.0017
	(0.0197)	(0.0152)	(0.0131)	(0.0032)	(0.0118)	(0.0093)	(0.0077)	(0.0019)
Employrate	0.0875	-0.0838	-0.0574	0.0537	0.3410	-0.1208	-0.2412	0.0209
	(0.1747)	(0.1334)	(0.1208)	(0.0459)	(0.1195)	(0.0911)	(0.0844)	(0.0216)
Observations	1186	1186	1186	1186	1976	1976	1976	1976

Standard errors in parentheses

Table A.2: (cont.)

Model 1: Marginal effects. State and year dependent

	Observations from 1999-2003				*Observations from 2004-2008*			
	00 → 00	00 → 01	00 → 10	00 → 11	00 → 00	00 → 01	00 → 10	00 → 11
Area	0.0034	-0.0048	-0.0064	0.0079	-0.0153	0.0061	0.0057	0.0036
	(0.0239)	(0.0144)	(0.0207)	(0.0114)	(0.0207)	(0.0155)	(0.0180)	(0.0118)
Livestock	0.1433	-0.0103	-0.0590	-0.0740	0.1753	-0.0396	-0.0735	-0.0622
	(0.0888)	(0.0500)	(0.0774)	(0.0505)	(0.0575)	(0.0455)	(0.0539)	(0.0486)
Investment	-0.1208	0.1268	-0.0868	0.0808	-0.2165	0.1771	-0.0173	0.0567
	(0.1935)	(0.0930)	(0.1735)	(0.0751)	(0.2264)	(0.1439)	(0.1965)	(0.1005)
Age	0.0917	-0.0023	-0.0680	-0.0213	0.0808	-0.0381	-0.0109	-0.0318
	(0.0240)	(0.0144)	(0.0205)	(0.0129)	(0.0291)	(0.0229)	(0.0257)	(0.0177)
Child6	0.0068	0.0196	-0.0667	0.0404	-0.1124	0.0302	0.0531	0.0291
	(0.0487)	(0.0243)	(0.0446)	(0.0164)	(0.0550)	(0.0344)	(0.0418)	(0.0192)
Employrate	-0.0010	0.0706	-0.2754	0.2058	-0.1679	-0.1048	0.2098	0.0628
	(0.3180)	(0.1817)	(0.2730)	(0.1620)	(0.4520)	(0.3395)	(0.3803)	(0.2342)
Observations	387	387	387	387	261	261	261	261

	01 → 00	01 → 01	01 → 10	01 → 11	01 → 00	01 → 01	01 → 10	01 → 11
Area	-0.0051	0.0085	-0.0060	0.0025	-0.0196	0.0174	0.0080	-0.0059
	(0.0137)	(0.0125)	(0.0073)	(0.0040)	(0.0132)	(0.0122)	(0.0052)	(0.0057)
Livestock	-0.0035	0.0058	0.0306	-0.0329	0.1117	-0.0635	-0.0563	0.0080
	(0.0550)	(0.0499)	(0.0214)	(0.0271)	(0.0568)	(0.0526)	(0.0341)	(0.0159)
Investment	-0.0065	0.0417	0.0038	-0.0390	-0.0110	-0.0538	0.0385	0.0263
	(0.1533)	(0.1392)	(0.0751)	(0.0615)	(0.1260)	(0.1201)	(0.0470)	(0.0385)
Age	0.0477	-0.0444	0.0051	-0.0084	0.0432	-0.0348	0.0018	-0.0102
	(0.0215)	(0.0199)	(0.0106)	(0.0072)	(0.0232)	(0.0217)	(0.0099)	(0.0091)
Child6	-0.0371	0.0155	0.0192	0.0023	-0.0123	0.0014	-0.0039	0.0149
	(0.0353)	(0.0320)	(0.0150)	(0.0105)	(0.0453)	(0.0415)	(0.0221)	(0.0117)
Employrate	-0.4380	0.2373	0.0642	0.1366	-0.3472	0.5390	-0.1838	-0.0081
	(0.2364)	(0.2184)	(0.1179)	(0.0801)	(0.2596)	(0.2413)	(0.1086)	(0.0982)
Observations	643	643	643	643	577	577	577	577

	10 → 00	10 → 01	10 → 10	10 → 11	10 → 00	10 → 01	10 → 10	10 → 11
Area	0.0130	-0.0050	-0.0058	-0.0022	0.0106	-0.0078	-0.0007	-0.0021
	(0.0118)	(0.0096)	(0.0081)	(0.0035)	(0.0095)	(0.0083)	(0.0049)	(0.0038)
Livestock	-0.0288	-0.0147	0.0363	0.0071	-0.0504	-0.0042	0.0495	0.0051
	(0.0502)	(0.0434)	(0.0302)	(0.0105)	(0.0413)	(0.0362)	(0.0174)	(0.0133)
Investment	-0.0888	0.1356	-0.0480	0.0011	0.0078	-0.0251	0.0086	0.0087
	(0.1057)	(0.0799)	(0.0769)	(0.0286)	(0.1106)	(0.0931)	(0.0647)	(0.0393)
Age	0.0522	-0.0558	0.0048	-0.0012	0.0261	-0.0430	0.0099	0.0069
	(0.0165)	(0.0138)	(0.0105)	(0.0046)	(0.0180)	(0.0150)	(0.0106)	(0.0069)
Child6	-0.0088	0.0086	-0.0094	0.0096	-0.0623	0.0389	0.0142	0.0091
	(0.0230)	(0.0172)	(0.0172)	(0.0045)	(0.0301)	(0.0237)	(0.0177)	(0.0107)
Employrate	-0.0332	0.1857	-0.1407	-0.0118	0.1115	0.0818	-0.2040	0.0107
	(0.2016)	(0.1646)	(0.1332)	(0.0541)	(0.2208)	(0.1862)	(0.1305)	(0.0813)
Observations	874	874	874	874	757	757	757	757

	11 → 00	11 → 01	11 → 10	11 → 11	11 → 00	11 → 01	11 → 10	11 → 11
Area	0.0014	0.0056	-0.0062	-0.0008	-0.0053	0.0015	0.0037	0.0001
	(0.0056)	(0.0034)	(0.0044)	(0.0020)	(0.0035)	(0.0024)	(0.0025)	(0.0008)
Livestock	-0.1102	0.0846	0.0214	0.0042	-0.0184	0.0215	-0.0082	0.0050
	(0.0262)	(0.0160)	(0.0198)	(0.0094)	(0.0144)	(0.0079)	(0.0122)	(0.0022)
Investment	0.0759	-0.0222	-0.0483	-0.0053	0.1133	-0.0832	-0.0243	-0.0058
	(0.0671)	(0.0469)	(0.0488)	(0.0222)	(0.0491)	(0.0387)	(0.0317)	(0.0121)
Age	-0.0233	0.0298	-0.0091	0.0026	-0.0000	0.0029	0.0037	-0.0066
	(0.0103)	(0.0073)	(0.0072)	(0.0034)	(0.0091)	(0.0061)	(0.0065)	(0.0030)
Child6	-0.0117	-0.0041	0.0097	0.0061	0.0046	-0.0033	0.0006	-0.0019
	(0.0152)	(0.0120)	(0.0097)	(0.0042)	(0.0132)	(0.0094)	(0.0095)	(0.0030)
Employrate	0.0656	0.0016	-0.0454	-0.0219	0.0669	0.0105	-0.0732	-0.0042
	(0.0971)	(0.0678)	(0.0694)	(0.0331)	(0.0863)	(0.0597)	(0.0621)	(0.0235)
Observations	2111	2111	2111	2111	2202	2202	2202	2202

Standard errors in parentheses

Table A.3: Model 2: Coefficient estimates. Year invariant, state dependent

	Labour state last year = 00 Labour state current year (base=00): 01	 10	 11	Labour state last year = 01 Labour state current year (base=01): 11	 00	 10
Area	0.1493 (0.0673)	0.1457 (0.0501)	0.2174 (0.0910)	0.0557 (0.0341)	0.0352 (0.0619)	0.0443 (0.0968)
Livestock	-0.0758 (0.1288)	-0.1648 (0.1120)	-0.7923 (0.3663)	-0.0881 (0.0980)	0.0618 (0.1308)	-0.1628 (0.2963)
Investment	1.5371 (0.6490)	0.5160 (0.5442)	1.5246 (0.8242)	0.1749 (0.3995)	0.4065 (0.7210)	-0.0809 (1.1179)
Age	-0.2321 (0.0752)	-0.2932 (0.0543)	-0.6026 (0.1023)	-0.2224 (0.0530)	0.0997 (0.0980)	-0.5961 (0.1461)
Child6	0.1073 (0.1373)	-0.1188 (0.1137)	0.3735 (0.1417)	0.0060 (0.0923)	0.3949 (0.1512)	0.0393 (0.2071)
Employrate	2.2023 (1.0917)	0.5376 (0.8083)	1.9671 (1.4774)	1.4625 (0.6124)	-1.8537 (1.1449)	3.2804 (1.6698)
Observations		2022			2651	
	Labour state last year = 10 Labour state current year (base=10): 11	 00	 01	Labour state last year = 11 Labour state current year (base=11): 01	 10	 00
Area	0.0045 (0.0337)	-0.0512 (0.0433)	-0.0565 (0.0892)	0.0163 (0.0287)	0.0040 (0.0312)	-0.0073 (0.0807)
Livestock	-0.1822 (0.1171)	0.1152 (0.0865)	0.1906 (0.1543)	0.4830 (0.0830)	0.1866 (0.1113)	0.5357 (0.1518)
Investment	0.2390 (0.3693)	0.0533 (0.4663)	-0.4516 (1.0182)	-0.4440 (0.3680)	-0.4002 (0.3757)	-1.1939 (1.1431)
Age	-0.2597 (0.0496)	0.0830 (0.0596)	0.1113 (0.1279)	0.1730 (0.0567)	-0.1234 (0.0582)	-0.1036 (0.1561)
Child6	0.1136 (0.0772)	0.0348 (0.1094)	0.4389 (0.1721)	0.1492 (0.0848)	0.2001 (0.0785)	0.4017 (0.1847)
Employrate	1.2508 (0.6016)	-1.4396 (0.7319)	2.2363 (1.5063)	-2.1903 (0.5612)	-1.9654 (0.5774)	0.2291 (1.5036)
Observations		3666			7475	

Standard errors in parentheses.

Table A.4: Model 2: Coefficient estimates. With random effects (`gllamm`)

	Labour state last year = 00 Labour state current year (base=00): 01	 10	 11	Labour state last year = 01 Labour state current year (base=01): 11	 00	 10
Area	0.1092 (0.0710)	0.1319 (0.0512)	0.1802 (0.0944)	0.0491 (0.0348)	0.0510 (0.0623)	0.0413 (0.0981)
Livestock	-0.0566 (0.1326)	-0.1575 (0.1126)	-0.7783 (0.3711)	-0.0775 (0.1001)	0.0371 (0.1329)	-0.1678 (0.3025)
Investment	1.3758 (0.6590)	0.4698 (0.5467)	1.3698 (0.8327)	0.1362 (0.4009)	0.4858 (0.7280)	-0.0962 (1.1207)
Age	-0.2613 (0.0773)	-0.3024 (0.0550)	-0.6369 (0.1051)	-0.2332 (0.0539)	0.1201 (0.0984)	-0.6003 (0.1484)
Child6	0.0882 (0.1385)	-0.1250 (0.1138)	0.3570 (0.1428)	0.0042 (0.0925)	0.3992 (0.1516)	0.0353 (0.2075)
Employrate	1.2703 (1.1961)	0.9548 (1.6007)	0.2557 (0.8504)	1.3329 (0.6340)	-1.5929 (1.1818)	3.2003 (1.7277)
Observations		2022			2651	
	Labour state last year = 10 Labour state current year (base=10): 11	 00	 01	Labour state last year = 11 Labour state current year (base=11): 01	 10	 00
Area	-0.0024 (0.0343)	-0.0397 (0.0436)	-0.0486 (0.089)	0.0383 (0.0301)	0.0066 (0.032)	-0.0117 (0.0859)
Livestock	-0.1797 (0.1195)	0.1122 (0.0891	0.1867 (0.1552)	0.4924 (0.0874)	0.1969 (0.1131)	0.5857 (0.1644)
Investment	0.1935 (0.3709)	0.0908 (0.4679)	-0.0468 (1.019)	-0.317 (0.3735)	-0.3629 (0.3782)	-1.1153 (1.1595)
Age	-0.2794 (0.0509)	0.1056 (0.0609)	0.1328 (0.1295)	0.2071 (0.0586)	-0.1177 (0.0592)	-0.1128 (0.1603)
Child6	0.1091 (0.0773)	0.0424 (0.1096)	0.4449 (0.1725)	0.1635 (0.0848)	0.2032 (0.0787)	0.4042 (0.1863)
Employrate	0.7750 (0.6627)	-0.8556 (0.8033)	2.7812 (1.6025)	-1.4048 (0.6635)	-1.9410 (0.6277)	-0.4255 (1.7019)
Observations		3666			7475	

Standard errors in parentheses.

Table A.5: Model 3: Coefficient estimates, State invariant, year dependent

	Obs. from 1989–1993, 3757 obs. Labour state (base=00)			Obs. from 1994–1998, 4658 obs. Labour state (base=00)		
	01	10	11	01	10	11
Area	0.0339	0.0129	0.0022	0.1656	0.1466	0.1766
	(0.0484)	(0.0452)	(0.0431)	(0.0503)	(0.0485)	(0.0454)
Livestock	-0.0322	-0.0244	-0.3185	-1.3279	-0.7934	-2.3840
	(0.0539)	(0.0484)	(0.0682)	(0.2416)	(0.2240)	(0.2175)
Investment	-0.5969	0.4541	-0.5688	0.4754	1.0591	0.8556
	(0.5869)	(0.5016)	(0.5022)	(0.5285)	(0.4959)	(0.4616)
Age	-0.1352	-0.4123	-0.3805	-0.2748	-0.5617	-0.6299
	(0.0554)	(0.0513)	(0.0486)	(0.0624)	(0.0599)	(0.0550)
Child6	-0.0616	-0.2226	-0.3497	-0.0191	-0.1397	-0.1767
	(0.0958)	(0.0890)	(0.0874)	(0.1085)	(0.1037)	(0.0961)
Employrate	2.1560	-0.8809	1.2338	1.0617	-1.4331	1.2062
	(0.8331)	(0.7695)	(0.7296)	(0.8336)	(0.8043)	(0.7313)

	Obs. from 1999–2003, 4327 obs. Labour state (base=00)			Obs. from 2004–2008, 4010 obs. Labour state (base=00)		
	01	10	11	01	10	11
Area	0.1364	0.1351	0.1557	0.0243	0.0613	0.0475
	(0.0501)	(0.0485)	(0.0452)	(0.0418)	(0.0407)	(0.0374)
Livestock	-0.1628	-0.8533	-1.3896	-0.3112	-0.8152	-0.9246
	(0.1740)	(0.1798)	(0.1674)	(0.1177)	(0.1343)	(0.1140)
Investment	0.6262	0.4251	0.7523	0.0406	0.2391	0.6034
	(0.5264)	(0.5046)	(0.4628)	(0.5269)	(0.5034)	(0.4633)
Age	-0.1943	-0.4398	-0.5835	-0.0956	-0.1232	-0.2828
	(0.0742)	(0.0706)	(0.0648)	(0.0927)	(0.0897)	(0.0823)
Child6	-0.2659	-0.1615	-0.2552	-0.0295	0.0229	0.1257
	(0.1145)	(0.1030)	(0.0950)	(0.1640)	(0.1584)	(0.1447)
Employrate	0.7119	0.7233	1.6048	3.2803	4.4191	5.4370
	(0.8094)	(0.7673)	(0.7027)	(1.0100)	(0.9748)	(0.8993)

Table A.6: Model 3: Coefficient estimates. With random effects (`gllamm`)

	Obs. from 1989-1993, 3757 obs. Labour state (base=00):			Obs. from 1994-1998, 4658 obs. Labour state (base=00):		
	01	10	11	01	10	11
Area	0.0322	0.0127	-0.0004	0.1595	0.1406	0.1641
	(0.0484)	(0.0452)	(0.0432)	(0.0502)	(0.0485)	(0.0454)
Livestock	-0.0265	-0.0235	-0.3059	-1.3398	-0.8046	-2.4197
	(0.0549)	(0.0486)	(0.0708)	(0.2419)	(0.2243)	(0.2182)
Investment	-0.5722	0.4593	-0.5326	0.4671	1.0564	0.8189
	(0.5874)	(0.5018)	(0.5032)	(0.5300)	(0.4976)	(0.4640)
Age	-0.1356	-0.4116	-0.3817	-0.2826	-0.5696	-0.6516
	(0.0554)	(0.0512)	(0.0487)	(0.0625)	(0.0600)	(0.0552)
Child6	-0.0609	-0.2223	-0.3487	-0.0248	-0.1460	-0.1898
	(0.0958)	(0.0890)	(0.0875)	(0.1089)	(0.1040)	(0.0965)
Employrate	2.2033	-0.8720	1.3031	0.8376	-1.6600	0.6662
	(0.8348)	(0.7702)	(0.7320)	(0.8402)	(0.8101)	(0.7343)

	Obs. from 1999-2003, 4327 obs. Labour state (base=00):			Obs. from 2004-2008, 4010 obs. Labour state (base=00):		
	01	10	11	01	10	11
Area	0.1379	0.1362	0.1575	0.0241	0.0607	0.0381
	(0.0502)	(0.0486)	(0.0454)	(0.0418)	(0.0406)	(0.0374)
Livestock	-0.1608	-0.8520	-1.3880	-0.3109	-0.8163	-0.9412
	(0.1740)	(0.1799)	(0.1675)	(0.1178)	(0.1345)	(0.1142)
Investment	0.6232	0.4227	0.7492	0.0416	0.2411	0.6359
	(0.5269)	(0.5051)	(0.4635)	(0.5276)	(0.5041)	(0.4643)
Age	-0.1928	-0.4386	-0.5817	-0.0960	-0.1240	-0.3009
	(0.0743)	(0.0706)	(0.0649)	(0.0921)	(0.0891)	(0.0818)
Child6	-0.2650	-0.1606	-0.2542	-0.0312	0.0205	0.1280
	(0.1146)	(0.1030)	(0.0950)	(0.1636)	(0.1580)	(0.1444)
Employrate	0.8076	0.7887	1.7331	3.2802	4.4120	5.0137
	(0.8300)	(0.7811)	(0.7361)	(0.9954)	(0.9580)	(0.8853)

Standard errors in parentheses.

Table A.7:

Model 4: Coefficient estimates

	No unobserved heterogeneity			With random effects: `Gllamm`		
	01	10	11	01	10	11
Area	0.0996 (0.0215)	0.0973 (0.0205)	0.1402 (0.0190)	0.0520 (0.0216)	0.0429 (0.0207)	0.0429 (0.0193)
Livestock	-0.0957 (0.0338)	-0.1478 (0.0331)	-0.6249 (0.0448)	-0.0396 (0.0349)	-0.1028 (0.0351)	-0.5481 (0.0474)
Investment	0.2782 (0.2506)	0.5980 (0.2333)	0.8553 (0.2134)	0.1087 (0.2540)	0.4075 (0.2368)	0.4674 (0.2184)
Age	-0.1169 (0.0311)	-0.3283 (0.0292)	-0.3364 (0.0268)	-0.1662 (0.0314)	-0.3857 (0.0296)	-0.4612 (0.0274)
Child6	-0.0967 (0.0542)	-0.1537 (0.0503)	-0.1611 (0.0460)	-0.1206 (0.0541)	-0.1804 (0.0502)	-0.2102 (0.0463)
Employrate	2.6254 (0.3628)	1.7404 (0.3430)	4.7716 (0.3137)	1.5119 (0.3918)	0.3080 (0.3749)	1.9044 (0.3405)
Observations		17605			17605	

Table A.8:

Model 4. State specific random effects. Covariance matrix

Correlation coefficients in bold. Base state=00. `Gllamm` *results*

	01	10	11
01	0.5585 (0.0145) **1**		
10	0.0598 (0.0137) **0.9461**	0.0716 (0.0176) **1**	
11	0.1135 (0.0212) **0.9199**	0.1362 (0.0250) **0.9748**	0.2725 (0.0396) **1**

Table A.9: Model 5: Coefficient estimates. Binomial Year and state dependent

	00 → 00	01 → 01	10 → 10	11 → 11	00 → 00	01 → 01	10 → 10	11 → 11
	Observations from 1989–1993				*Observations from 1994–1998*			
Area	-0.3268	0.0183	-0.0510	-0.0518	-0.1382	-0.0485	0.0045	-0.0021
	(0.1221)	(0.1111)	(0.0930)	(0.0956)	(0.1200)	(0.0789)	(0.0927)	(0.0805)
Livestock	0.1038	0.1172	0.1324	-0.1404	0.1285	-0.5009	0.3443	-1.9597
	(0.1216)	(0.1241)	(0.1094)	(0.1187)	(0.5674)	(0.5033)	(0.5097)	(0.4448)
Investment	-0.8182	-0.0537	-0.4813	-0.9532	-0.9067	-0.0316	0.2239	-0.6687
	(1.0339)	(1.3647)	(0.8966)	(0.9288)	(1.0534)	(0.8516)	(0.8107)	(0.6980)
Age	0.4218	0.2509	-0.0844	-0.0079	0.4691	0.2783	0.0732	-0.0643
	(0.1102)	(0.1202)	(0.1018)	(0.1251)	(0.1178)	(0.1169)	(0.1188)	(0.1183)
Child6	0.1535	0.0974	0.1517	-0.4510	-0.1084	-0.1184	-0.2688	-0.5833
	(0.2089)	(0.2057)	(0.1864)	(0.1887)	(0.2241)	(0.1818)	(0.1938)	(0.1544)
Employrate	0.5950	1.1537	-2.3362	0.8789	-0.1924	1.8813	-1.2631	3.7120
	(1.9193)	(1.9931)	(1.5988)	(1.6946)	(1.9423)	(1.4708)	(1.7785)	(1.5307)
Observations	742	634	985	1186	632	797	1050	1976
log-likelihood	-421.9287	-364.7914	-567.4211	-556.7694	-364.8879	-478.4501	-592.6057	-753.0028
σ_u	1.2946	1.0454	1.2015	1.4398	1.0367	0.8518	1.4596	1.5116
ρ	0.3375	0.2494	0.3050	0.3866	0.2463	0.1807	0.3931	0.4099
$\chi^2(1)$	17.6261	6.1368	16.9424	21.5325	9.1648	8.5016	37.6898	35.3814
p-value	0.000	0.007	0.000	0.000	0.001	0.002	0.000	0.000
	Observations from 1999–2003				*Observations from 2004–2008*			
Area	-0.0084	-0.0285	0.0755	-0.0018	-0.0790	-0.1064	0.0678	-0.0639
	(0.1263)	(0.0806)	(0.0851)	(0.0553)	(0.1119)	(0.0717)	(0.0838)	(0.0499)
Livestock	0.7574	-0.0533	-0.1103	-1.1199	0.8709	0.5194	-0.4425	-0.3858
	(0.4803)	(0.3173)	(0.3638)	(0.2708)	(0.3136)	(0.3012)	(0.3565)	(0.1952)
Investment	-0.7245	-0.0009	-0.7616	0.6324	-1.1330	-0.0425	0.0132	1.1238
	(0.9291)	(0.8193)	(0.6675)	(0.5861)	(1.1199)	(0.6300)	(0.8012)	(0.5535)
Age	0.4739	0.2506	0.3041	-0.2445	0.4285	0.2241	0.1208	-0.0247
	(0.1439)	(0.1275)	(0.1232)	(0.1016)	(0.1695)	(0.1271)	(0.1618)	(0.1216)
Child6	-0.0827	-0.2077	-0.1408	-0.1376	-0.5170	-0.1081	-0.5002	0.0663
	(0.2409)	(0.2065)	(0.1653)	(0.1444)	(0.2830)	(0.2370)	(0.2630)	(0.1792)
Employrate	-0.3771	-2.6639	-0.5964	0.1466	-1.0070	-1.8554	-0.0361	0.7278
	(1.7019)	(1.4242)	(1.4396)	(0.9903)	(2.3410)	(1.4338)	(1.9528)	(1.2281)
Observations	387	643	874	2111	261	577	757	2202
log-likelihood	-237.8791	-392.4984	-479.5582	-891.7323	-163.8076	-361.8233	-414.3380	-740.8054
σ_u	0.6166	0.8968	1.1256	1.1158	0.6837	0.7342	1.7470	1.3446
ρ	0.1036	0.1964	0.2780	0.2746	0.1244	0.1408	0.4812	0.3546
$\chi^2(1)$	1.0473	6.7305	13.1024	16.7623	1.5268	3.2711	34.0554	16.3498
p-value	0.153	0.005	0.000	0.000	0.108	0.035	0.000	0.000

Standard errors in parentheses.
σ_u : standard deviation of farm-specific latent heterogeneity.
ρ : share of variance of gross disturbance accounted for by farm-specific latent heterogeneity.
$\chi^2(1)$, p : χ^2-statistic and p-value for testing for farm-specific latent heterogeneity.