Determinants and Dynamics of Farm Diversification

Christoph Weiss
e-mail: cweiss@food-econ.unikiel.de

Wolfgang Briglauer
e-mail: Wolfgang Briglauer@tkc.at

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Christoph Weiss and Wolfgang Briglauer[+),++)]

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Keywords: Diversification, Farm Sector, Dynamics, Panel Data

+) Christoph Weiss, Department of Food Economics and Consumption Studies, University of Kiel, Olshausenstr. 40, D-24118 Kiel, Germany. e-mail: cweiss@food-econ.uni-kiel.de; Wolfgang Briglauer, Telekom-Control GmbH, A-1060 Wien; Mariahilfer Str. 77-79. e-mail: Wolfgang Briglauer@tkc.at

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This paper examines the impact of various farm and household characteristics (such as farm size, the off-farm employment status, the farm operator's age and schooling and the number of family members) on the level as well as the dynamics of on-farm diversification. Using linked census data for Upper-Austria from 1980, 1985 and 1990 we provide evidence that smaller farms are more specialised and also tend to increase the degree of specialisation over time more quickly than large farms. A significantly lower degree of diversification (higher degree of specialisation) as well as a stronger reduction in diversification over time is also reported for businesses operated by older, less educated, part-time farm operators. The analysis of diversification dynamics also suggests that (a) farms adjust to changes in their environment by steadily approaching their long-run equilibrium level of diversification (β-convergence), and (b) the variance of the diversification distribution declines over time (σ-convergence).

1. Introduction

Typically, firms produce more than one product. In this sense their production is diversified. After a wave of intense diversification in the sixties and seventies, especially in the United States but also in Europe, the eighties and nineties have seen a mitigation or even a reversal of this trend. Nevertheless, the diversified (multi product) firm still is the rule rather than the exception in the modern industrial sector (Montgomery, 1994) and analysing the determinants of diversification remains a busy field of research in strategic management and industrial organisation (Briglauer, 2000).
In contrast to large corporate firms in the non-farm economy, where the wide dispersion of ownership helps to spread business risk over numerous stockholders, the smaller family farms in agriculture have little capacity for this kind of risk reduction given that a large share of the family's and the farm operator's wealth as well as their labour capacity is allocated to their own (farm) business. It is well known that on-farm product diversification (diversification of farm production activities) can be an efficient mechanism for dealing with risk by stabilising expected returns in an uncertain environment and the analysis of this issue already has a long tradition in agricultural economics.[1]

Despite the frequent observation that diversification plays an important role in agriculture, only few empirical studies on the determinants of farm diversification are available. The limited number of econometric studies on diversification using micro-data are confined to the U.S. situation and focus on the relationship between diversification and farm size. White and Irwin (1972), using aggregate U.S. Census Data, compare diversification across farm size classes and conclude that larger farms are more specialised. The opposite finding is reported in Pope and Prescott (1980). Investigating the relationship between farm size as well as other socio-economic variables and four different measures of diversification for more than 1,000

[1] Nearly half a century has passed since Heady noticed: “the topic of diversification as a means of handling uncertainty is an old one in agricultural economics” (1952, p. 483). Recently, this issue seems to have gained renewed interest (Quiroz, and Valdés, 1995; Martin, and McLeay, 1998) not least due to the liberalisation of agricultural policies and the globalisation of agricultural markets. In the past, government market interventions have caused domestic prices to vary substantially less than international ones (Hazell et al., 1990). As domestic prices start following international price signals more closely, farmers (as well as those working on policies concerned with their welfare) are forced to consider the implications of larger fluctuations in commodity prices. In a recent survey on farmers’ exposure to income risk under the 1996 farm bill Knutson et al. (1998) stress the high ranking of diversification as a risk-management tool.

Californian Crop farms, they find "a strong indication of a positive relationship between diversification and size" (p. 554). In analysing data on 2,192 farms across three U.S. regions, Sun, Jinkins and El-Osta (1995) finally distinguish between different "stages of diversification", which are found to influence the relationship between size and diversification.

Although these studies differ substantially in the empirical approach used as well as in the results reported, two common characteristics are to be mentioned. Firstly, they consider farm production diversification only and do not control for the impact of additional off-farm income. As pointed out in Pope and Prescott, the exclusion of the off-farm employment status may introduce a bias in the parameter estimates (in particular of the farm size variable). Given that additional off-farm income is one form of diversification to reduce risk and considering the well established empirical observation that smaller farms are more likely to have additional off-farm income, one would expect the parameter estimate of farm size (in a model not controlling for the off-farm employment status) to be biased upwards. And secondly, the existing empirical literature has not yet considered the dynamics of farmer's diversification behaviour. Using cross-sectional data implies interpreting the results as long-run equilibrium relationship and does not allow to investigate the actual adjustment of farmers to changes in economic conditions. Concerning the importance of analysing diversification in a dynamic context White and Irwin observe: “Most existing firms are thus a product of past conditions which mandated diversified production. Their present status determines where they should go” (p.210).

This paper examines the determinants and dynamics of farm production diversification in Upper Austria empirically. Using panel data for individual farm households, we (i) focus on the importance of additional off-farm employment as an explanatory variable in addition to a number of characteristics of the farm and the farm operator as well as (ii) explicitly consider changes in the degree of diversification of individual farms over time.

The following section 2 provides a summary of economic rationales for firm (farm) diversification. Section 3 describes the data and the definitions of the variables, section 4 reports the empirical results and the final section 5 summarises and concludes.

2. Motives for firm (farm) diversification

Theoretical models offer many different arguments about why firms diversify. These arguments can be divided into three groups: the market power-, the synergy-, and the agency view.[2] The *market power* approach considers possible anticompetitive strategies (such as cross subsidisation or reciprocal buying) employed by diversified firms in pursuit of increasing profits. The higher probability for multi product firms to interact simultaneously with a specific competitor in different markets facilitates reciprocal buying or to take advantage of their conglomerate interdependence by forming collusive outcomes. While this explanation may be important in many industries, it is of little relevance when applied to the agricultural sector being characterised by a large number of small family farms.
Synergy effects refers to cost advantages that emerge from the existence of joint production facilities. If it is cheaper to produce several goods jointly instead of producing each of them separately, the cost function exhibits "economies of scope". Although one finds unanimous approval concerning the definition of the synergy concept,[3] the sources of economies of scope are not so easy to identify. In addition to purely technical synergies referring to the complementarity or supplementarity for the products when they are produced in combination

2 The following section draws heavily on Briglauer (2000).
3 Baumol et al. (1982) formalised this concept in an extensive treatise.

(Heady, 1952) a lot of attention is devoted to operational synergies focusing on shared input facilities and excess capacity in the presence of demand constraint). If the firms' current production of one product is too low to fully employ its fixed inputs, this excess capacity can be utilised productively by entering into other markets.[4] Financial synergies shift attention away from the operational side of the firm but create economies of scope by lowering capital costs. Two arguments are frequently proposed in the literature: Firstly, the possibility to erect internal capital markets, which reallocate firm capital based on efficiency considerations. Secondly, by lowering the variability of firms profits, diversification might positively affect the firms' capital costs because investors tend to be risk-averse.

The third group of theoretical arguments focuses on the *principal-agent relationship* between corporate managers and shareholders. This agency relationship is fraught with opportunistic managerial behaviour that leads to serious conflicts, in the sense that managers follow strategies that do not come up to the interests of shareholders. Specifically, managerial economists[5] maintain that the separation of ownership and control enables management to enforce utility maximising behaviour (instead of profit maximisation). It is argued that managerial utility is determined by the growth of firm size, whereby the growth rate stands proxy for managerial perquisites, monetary rewards, prestige or other non-economic motives. Given that demand restrictions in existing product markets limit the rate of firm growth, firms have an incentive to diversify into new, faster growing markets.

A similar line of reasoning (Amihud and Lev (1981)) states that risk averse managers favour diversification programs, because manager's risk is closely related to the variation in firm performance through employment contracts that contain forms of profit sharing. Consequently managers benefit from diversification strategies that generate more stable streams of income. With reference to the agricultural sector this argument (together with synergy effects) seems to have the strongest appeal. As the role of the owner and the manager coincide within family farms (the "manager" receives all the rewards of his efforts), the farm operator has a strong incentive to spread personal risks by diversification of farm production.

3. Data and definition of variables

The empirical approach in the present paper is based on a panel of more than 50,000 Upper Austrian farm households for three years, 1980, 1985, and 1990. Upper Austria, which is the third largest state in Austria (14.3% of area and 17.2% of population) borders Germany and the Czech Republic. It is one of three major agricultural regions in Austria and is primarily devoted to dairy production. While 19% of all farms are located here, these farms own 29% of all livestock in Austria.

For each year, the farm census collects extensive information on the farm as well as some family characteristics such as age, sex, and schooling of various family members, and the off-farm employment status. Given the importance of dairy farming in Upper Austria, our measures of size and diversification will be based on the number of livestock (measured in "median large animal units"). A median large animal unit is an index defined according to the live weight of an animal. A live weight of 650 kg (1,433 pounds) corresponds to one median large animal unit. This aggregate measure of farm size can be broken down into nine sub-categories ("median large animal units" for: calfs, fattened cattle, cattle, piglets, sheeps and goats, chicken, cows, fattened pigs, and brood sow). Based on these nine product groups we

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[4] It is important to notice that these examples explain diversification only in cases, where contractual mechanisms fail to employ the free resources. In a world of zero transaction costs the above arguments have no merit since market contracts would be perfect substitutes for internal production arrangements. Teece (1980, 1982) identified input categories where it is reasonable to assume that market transaction costs outweigh transaction costs that arise within a multi product organisation.

[5] Most notably, Marris (1964), Baumol (1958) and Williamson (1967).

analyse diversification using the following three measures: (1) a modified concentration ratio $D_C = \frac{Q - q^{\max}}{Q}$, (2) the Berry-index (Berry, 1971) $D_B = [1 - \sum_{j=1}^{n} (\frac{q_j}{Q})^2]$, and (3) the entropy measure $D_E = \sum_{j=1}^{n} \frac{q_j}{Q} \log(\frac{Q}{q_j})$. Here, q_j denotes the quantity of product *j* with $Q = \sum_{j=1}^{n} q_j$, $q^{\max}$ is the quantity of the most important product in the group of all nine products ($q^{\max} = \max(q_1, q_2, \ldots, q_n)$) and *n* is the number of products ($n = 9$). Note that complete specialisation implies $D_C = D_B = D_E = 0$, whereas the maximum level of diversification is given by $D_C = D_B = 1$ and $D_E = \log(n)$. The properties of these measures of diversification are discussed in more detail in Hackbart and Anderson (1978) as well as Gollop and Monahan (1991).

To guarantee a homogenous data base, the analysis is restricted to households that did not exit from the agricultural sector and reported all relevant information for estimating the equations. The farm households satisfying these criteria number 40,626. The definition and summary statistics of all variables used is reported in the Appendix.

4. Empirical results

The results of the instrumental-variable regression using the transformed entropy index (TD_E) as a measure of farm diversification are reported in Table 1.[6] Four different models are reported. Column (1) has the results of a cross-section model for the 1990 farm census, which is similar to those estimated by Pope and Prescott (1980) and Sun, Jinkins and El-Osta (1995) but controls for the off-farm employment status. The parameter estimate of farm size ($\ln(S)$) is significantly different from zero and positive.[7] A one standard deviation increase in $\ln(S)$ raises the entropy index by 47.48%.[8] This positive relationship between size and diversification (even when controlling for the off-farm employment status) confirms the findings of Pope and Prescott, large farms tend to be more diversified than smaller ones.

As expected, the existence of additional off-farm income reduces the degree of diversification. If the married couple spends less than 50% of total working time on farm work and more than 50% on off-farm work ($PT = 1$), the entropy index is 6.12 percent below that of an otherwise identical full-time farm. Part-time farms will c.p. have less time to devote to the production of a broad agricultural product mix. Furthermore, and maybe more important, off-farm income has to be considered as one strategy to diversify employment risks and thus reduces the necessity to diversify on the farm.[9]

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6 Since the entropy index D_E is bounded by zero and 0.95 (=ln(*n*)), one may be suspicious of the assumption of normality. Further, one may wish an estimator which ensures that predicted values for D_E are in the interval (0, 0.95). A popular transformation to alleviate these problems is the logit transformation (Greene, 1997, p. 227f.) where the dependent variable becomes $TD_E = \ln[D_E/(1-D_E)]$. To prevent computational problems with the logit transformation where $D_E = 0$, we used the following modification of the logit transformation $TD_E = \ln[(D_E+k)/(1-D_E)]$, with $k = 0.1$. The econometric results when using TD_B and TD_C instead of TD_E do not differ substantially (see Table A2 in the appendix), we thus conclude that the coeficients are not sensitive with respect to the measure of diversification.

7 The size distribution of farms is skewed to the right with a skewness coefficient equal to 1.3 (Greene, 1997, p.66). Given this skewed distribution the natural logarithm of farm size is used in the empirical analysis.

8 Estimation experiments show a somewhat stronger positive impact of farm size when we did not control for the off-farm employment status.

9 Considering off-farm employment as a strategy to reduce risk calls into question the assumption of exogeneity of the variable *PT*. We thus used information from the 1980 farm census as well as all other exogenous variables to instrument *PT* in Table 1.

Table 1: Results of the instrumental-variable regression analysis on levels of and changes in the transformed entropy index.

Dependent Variable:	TD_E *all farms*	ΔTD_E *all farms*	ΔTD_E *full-time farms only*	ΔTD_E *part-time farms only*
Independent Variable (Symbol)	Parameter (t-value) (1)	Parameter (t-value) (2)	Parameter. (t-value) (3)	Parameter (t-value) (4)
Constant	-2.344	-1.082	-0.929	-1.419
	(-89.29)	(-39.21)	(-27.16)	(-40.46)
Farm size ($\ln(S)_t$)	0.415	0.114	0.094	0.144
	(121.07)	(36.17)	(21.61)	(38.23)
Part-time farm (PT_t)	-0.075	-0.143		
	(-5.80)	(-12.14)		
Schooling (EDU_t)/100	0.015	0.039	-0.092	-0.065
	(2.48)	(0.07)	(-0.14)	(-0.08)
Age (AGE_t)	-0.017	-0.044	-0.014	-0.069
	(-1.57)	(-4.62)	(-1.13)	(-4.89)
Number of family members ($\#FAM_t$)	0.020	0.017	0.013	0.021
	(10.26)	(10.90)	(6.79)	(9.04)
Gender ($GENDER_t$)	0.068	0.015	-0.019	0.025
	(7.95)	(1.75)	(-1.47)	(2.33)
Marrital status ($MARR_t$)	-0.019	0.078	0.038	0.077
	(-1.94)	(8.21)	(3.40)	(5.44)
Region 1 (R_1)	-0.265	-0.167	-0.153	-0.094
	(-12.90)	(-9.31)	(-7.54)	(-3.20)
Region 2 (R_2)	-0.090	-0.045	-0.031	-0.031
	(-8.28)	(-4.76)	(-2.60)	(-2.24)
Region 3 (R_3)	-0.118	-0.029	-0.015	-0.038
	(-9.84)	(-2.81)	(-1.09)	(-2.51)
Region 4 (R_4)	-0.146	-0.019	0.006	-0.042
	(-14.06)	(-2.16)	(0.51)	(-3.11)
Region 5 (R_5)	-0.028	-0.014	-0.002	-0.026
	(-3.01)	(-1.72)	(-0.19)	(-2.14)
Hardshipzone 1 (HZ_1)	-0.004	0.066	0.073	0.055
	(-0.49)	(8.75)	(7.62)	(4.88)
Hardshipzone 2 (HZ_2)	0.017	0.066	0.078	0.053
	(1.72)	(7.45)	(6.86)	(4.06)
Hardshipzone 3 (HZ_3)	0.045	0.075	0.066	0.077
	(4.24)	(8.07)	(5.61)	(5.71)
Hardshipzone 4 (HZ_4)	0.263	0.083	0.296	0.035
	(4.49)	(1.64)	(3.07)	(0.56)

Table 1 to be continued

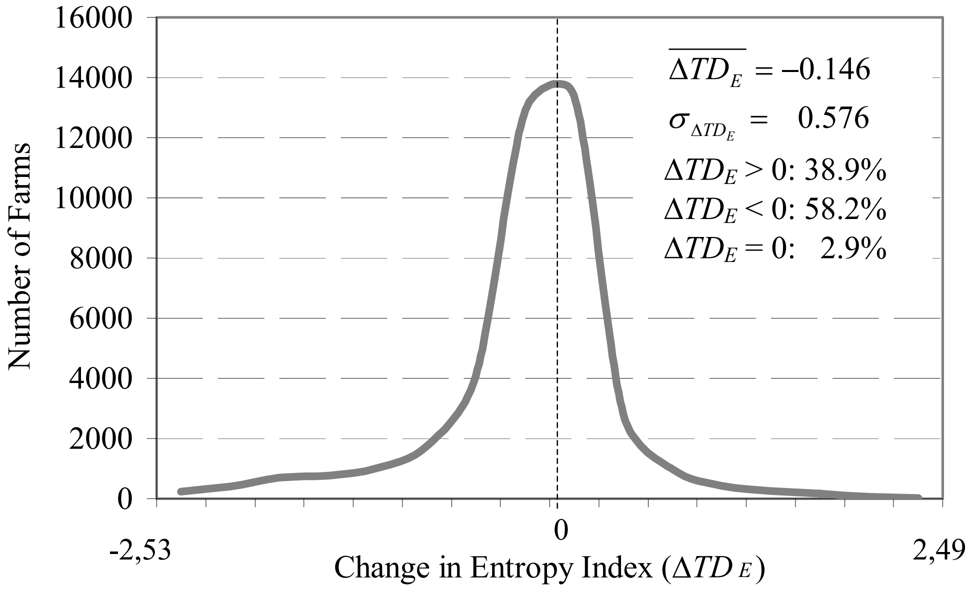
	(1)	(2)	(3)	(4)
Diversification (TDE_t)		-0.351 (-76.71)	-0.232 (-38.81)	-0.426 (-65.56)
$\overline{R}^2$	0.453	0.138	0.094	0,169
F-Test [16, a), b), c)]	2,108.6[a)]	385.07[a)]	117.73[b)]	288.70[c)]
Log-Likelihood	-38,079.9	-32,306.6	-10,798.0	-20,335.7
Restricted Log-Likelihood	-50,347.0	-35,351.6	-11,703.2	-22,446.9

Remarks: The degrees of freedom for the F-test are: a) 40,627; b) 18,055; and c) 22,555. The time index *t* of the explanatory variables refers to 1990 in column (1) and to 1985 in columns (2) to (4).

Table 1 also suggests personal characteristics of the farm operator as well as the farm family to influence on-farm diversification. According to column (1), diversification significantly increases with the farm operators farm-specific schooling (*EDU*) and the number of family members living on the farm (*#FAM*). Management and coordination becomes more demanding as diversification of the farm increases. By improving managerial skills, schooling enables the farm operator to run a farm which is more diversified. The impact of age (*AGE*) is not significantly different from zero at the 10% level. If the farm operator is female (*GENDER* = 1) and is unmarried (*MARR* = 0), diversification is higher, the impact of the latter variable not being significantly different at the 5% level in column (1), however. Table 1 also controls for the impact of regional characteristics (R_1 to R_5, and HZ_1 to HZ_4).

A significant shortcoming of the existing empirical literature (and the results presented so far) is that they do not consider any dynamics of adjustment over time. Comparing the average entropy indices for 1985 and 1990 indicates, that farms have become more specialised, the average entropy index declined from 0.370 to 0.339. However, this decline in the average level of diversification is the result of an extremely heterogenous development at the individual farm-household level (see Figure 1). From all farms, 58.2% report a decline in the transformed entropy measure and the percentage of farms where diversification increases is 38.9%.

Figure 1: Histogram for ΔTD_E.



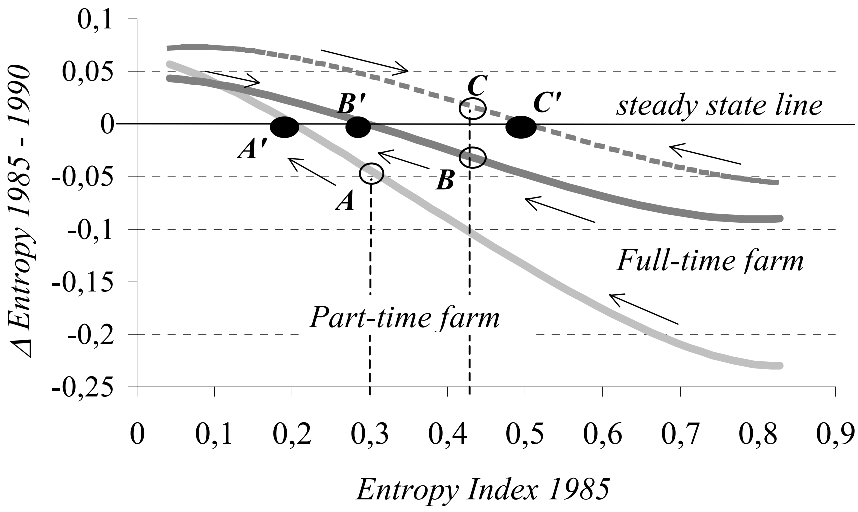
Remarks: $\overline{\Delta TD_E}$ and $\sigma_{\Delta TD_E}$ refers to the mean and the standard deviation of ΔTD_E respectively.

In order to investigate changes in diversification of individual farms, we compute first differences of the entropy measure for the period 1985 to 1990 to be used as a dependent variable in the regression models in columns (2), (3), and (4) of Table 1.

The regression equation in column (2) is estimated on all farms. Columns (3) and (4) report parameter estimates from models using data for full-time and part-time farms only to allow different adjustment paths to the steady state for the two groups. The results in column (2) compare well with those reported in column (1). Most of the explanatory variables are significant and have the same sign as in the model explaining levels of diversification. Compared to column (1), the schooling (*EDU*) and gender (*GENDER*) variables now are insignificant, the parameter estimate for the age variable (*AGE*) is negative and significant and the farm operator's marrital status (*MARR*) now has a positive and significant impact. The parameter estimates reported in column (2) imply that older farm operators, working on small part-time farms with a small number of family members living on the farm are reducing the degree of diversification most. The significant and negative parameter estimate of the initial diversification level implies convergence of the farms towards their own steady state diversification level.

A comparison of columns (3) and (4) indicates that the process of convergence differs between full-time and part-time farms. Based upon the parameter estimates of Table 1, Figure 2 shows the adjustment paths for a hypothetical full-time as well as part-time farm (which are defined by taking mean and mode values of exogenous and continuous dummy variables respectively).

Figure 2: A phase diagram for hypothetical farm's diversification decisions (O unstable, O

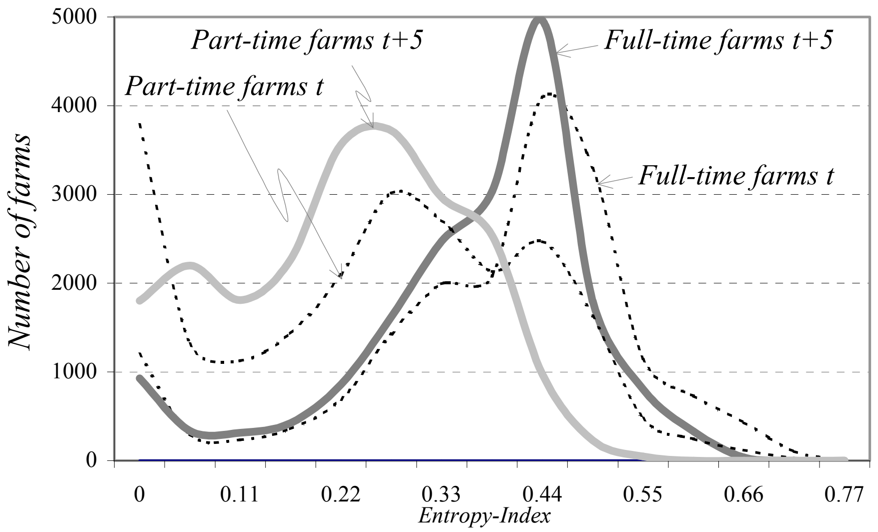


stable).

Figure 2 suggests that for high levels of specialisation the adjustment in the entropy index for the hypothetical full-time and part-time farm is nearly identical, differences in adjustment are more pronounced for higher levels of diversification. Also note that farms characterised by average levels of diversification ($\overline{D_E}$ = 0.437 for full-time farms and $\overline{D_E}$ = 0.317 for part-time farms) will realise points on the adjustment paths (*A* and *B*) which are below the horizontal steady state line, indicating that farms on average tend to specialise over time. Furthermore, the adjustment path for the part-time farm is typically below that of the full-time farm implying a faster process of specialisation for part-time farms, ceteris paribus. Figure 2 finally suggests a higher steady state level of diversification for the full-time compared to the part-time farm. Starting from the average level of diversification for both farm types (in points *A* and *B*), the hypothetical full-time farm would move along the darker path and finally end up at point *B*' (with an entropy index of 0.295), whereas the hypothetical part-time farm would reduce the level of diversification more quickly along the lower path and move towards point *A*' (with an entropy index of 0.201).

However, care is needed when inferring the behaviour of the total population of farms from the adjustment of two hypothetical farms. Figure 2 indicates that a farm with specific characteristics (hypothetical farm) converges towards its own steady state diversification level ("β-convergence"). Farms with different characteristics will also converge towards a specific steady state level, which will be different from that of the hypothetical farm, however. To illustrate this, we compute the adjustment path of a larger than average full-time farm. Since larger farms are found to have significantly larger changes in diversification (see Table 1, column (3)), an increase in farm size will shift the adjustment path upwards. If we now compare the diversification behaviour of two farms with different farm sizes (the large and the average sized full-time farm) starting from the same initial entropy index (points *C* and *B*), we find that the larger farm converges towards point *C* ' whereas the average sized full-time farm converges towards point *B*'. The two farms diverge and the distribution of farms widens in this case, although both of them converge towards their own steady state diversification level. In order to assess changes in the distribution of diversification over time ("σ-convergence" or "σ-divergence"), we thus simulate diversification adjustments for all farms in the census according to the estimated equations in Table 1. The resulting distributions of the entropy indices for full-time and part-time farms are shown in Figure 3.

Figure 3: Simulation results on the changing distribution of the entropy index.



For both types of farms we observe a shift to the left, indicating that diversification will decrease and farms tend to specialise. Furthermore, Figure 3 suggests that the number of farms at the tails of the distribution decreases and that the distribution is squeezed. The reduction of the number of farms at the tails is more pronounced for part-time farms. Correspondingly, the variance of the entropy index for full-time farms declines from 0.026 at time *t* (in 1990) to 0.019 at *t* + 5, for part-time farms, the figures are 0.031 at time *t* and 0.017 at *t* + 5.

5. Summary and Conclusion

The purpose of this paper is to examine the impact of various farm and household characteristics (such as farm size, the off-farm employment status, the farm operator's age and schooling and the number of family members) on the level as well as the dynamics of on-farm diversification. Using linked census data for Upper-Austria from 1980, 1985 and 1990 we provide evidence that smaller farms are more specialised and also tend to increase the degree of specialisation over time more quickly than large farms. A significantly lower degree of diversification (higher degree of specialisation) as well as a stronger reduction in diversification over time is also reported for farms operated by older, less educated, part-time farm operators. The analysis of diversification dynamics furthermore suggests that (a) farms adjust to changes in their environment by steadily approaching their long-run equilibrium level of diversification (β-convergence), and (b) the variance of the diversification distribution declines over time (σ-convergence). The path of adjustment towards the new equilibrium level, however, again depends on farm characteristics.

The observation that those farms, being considered as the fittest for surviving in the long run (large, full-time farms managed by a young farm operator) report the smallest increases in specialisation (the largest increases in diversification) suggests, that for this group of farms, the potential gains from realising economies of scale are not that important compared to the returns from risk reduction due to on-farm diversification. Given that the liberalisation of international agricultural markets will further increase the variability of domestic prices, one might expect the current trend towards specialisation of production to slow down or eventually be reversed, in particular, since those farms reporting to reduce diversification most quickly, have been found to face the highest probability of exiting from the agricultural sector (Weiss, 1999).

Investigating the probability of farm exits simultaneously with the dynamics of diversification would be an important extension of the present empirical analysis insofar, as the results reported from the sample of surviving farms only might be biased due to sample selectivity. Similarly, one might wish to consider the issue of off-farm employment more carefully by estimating a simultaneous off-farm employment / diversification model. Finally, it is important to keep in mind that the continuous measures of diversification used here captures only one dimension of diversification. In comparing categorical and continuous measures, Hall and St. John (1994) for example conclude that the choice of measurement technique is important and will influence research results. Additionally applying categorical typologies of diversification thus would allow us to more carefully study and understand the determinants and dynamics of farm diversification.

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Table A.1.Definition and Descriptive Statistics of Variables

Variable	Symbol	Part-time Farms Mean (Std. Dev.)	Full-time Farms Mean (Std. Dev.)	All Farms Mean (Std. Dev.)
Number of Observations	N	22,200	18,072	40,115
Farm size in 1985 is the Log of Livestock (measured in Median Large Animal Units):	$\ln(S)_i$	6.3049 (1.3177)	7.4726 (0.9558)	6.8309 (1.3006)
Farm operators age in years in 1985	$AGE_{i,85}$	1.805 (0.2983)	1.0963 (0.2924)	1.1434 (0.2979)
Schooling	$EDU_{i,85}$	0.3946 (0.4888)	0.3793 (0.4852)	0.3882 (0.4873)
Part-time farming: married couple spends more than 50% of total working time on off-farm employment.	$PT_{i,85}$	1.0000	0.0000	0.5534
Dummy for farm operators married state (1=married; 0=unmarried)	$MARR_{i,85}$	0.8972 (0.3037)	0.7589 (0.4278)	0.8360 (0.3703)
Number of family members	$\#FAM_{i,85}$	4.9369 (1.8684)	5.0822 (2.0980)	5.0058 (1.9744)
Farm operators sex: (0 = male, 1 = female)	$GENDER_{i,85}$	0.1817	0.1033	0.1464
Region 1	$R1$	0.0220 (0.1466)	0.0358 (0.1858)	0.0278 (0.1645)
Region 2	$R2$	0.1361 (0.3429)	0.1609 (0.3674)	0.1472 (0.3543)
Region 3	$R3$	0.1012 (0.3016)	0.0908 (0.2873)	0.0966 (0.2954)
Region 4	$R4$	0.1994 (0.3996)	0.2374 (0.4255)	0.2164 (0.4118)
Region 5	$R5$	0.2565 (0.4367)	0.2484 (0.4321)	0.2529 (0.4347)
Hardshipzone 1	$HZ1$	0.2553 (0.4360)	0.2335 (0.4230)	0.2460 (0.4307)
Hardshipzone 2	$HZ2$	0.1447 (0.3518)	0.1150 (0.3191)	0.1316 (0.3381)
Hardshipzone 3	$HZ3$	0.1276 (0.3337)	0.1023 (0.3031)	0.1164 (0.3207)
Hardshipzone 4	$HZ4$	0.0041 (0.0635)	0.0012 (0.0341)	0.0028 (0.0525)
Entropy Index of Diversification1990	DE_{90}	0.2844 (0.1755)	0.4113 (0.1604)	0.3416 (0.1801)
Entropy Index of Diversification 1985	DE_{85}	0.3190 (0.1676)	0.4375 (0.1496)	0.3725 (0.1700)
Transformed Entropy Index of Diversification 1990	TDE_{90}	-0.7363 (0.8366)	-0.1891 (0.7178)	-0.4893 (0.8301)
Transformed Entropy Index of Diversification 1985	TDE_{85}	-0.5649 (0.7599)	-0.0747 (0.6463)	-0.3431 (0.7499)

Table A.2: Results of the instrumental-variable regression analysis using the transformed diversification measures.

Dependent Variable:		TD_C	TD_B	TD_E
Independent Variable	Symbol	Parameter (t-value) (1)	Parameter. (t-value) (2)	Parameter (t-value) (3)
Constant		-2.419	-2.363	-2.344
		(-82.54)	(-75.47)	(-89.29)
Farm size	log(*GVE*)	0.409	0.469	0.415
		(107.18)	(114.90)	(121.07)
Part-time farm	*PT*	-0.104	-0.038	-0.075
		(-7.21)	(-2.47)	(-5.80)
Schooling	*EDU*	0.019	0.021	0.015
		(2.72)	(2.85)	(2.48)
Age	*AGE*	-0.031	-0.025	-0.017
		(-2.53)	(-1.91)	(-1.57)
Number of family members	*#FAM*	0.012	0.016	0.020
		(5.75)	(7.15)	(10.26)
Gender	*GENDER*	0.052	0.054	0.068
		(5.41)	(5.29)	(7.95)
Marrital status	*MARR*	-0.012	-0.031	-0.019
		(-1.07)	(-2.62)	(-1.94)
Region 1	R_1	-0.223	-0.249	-0.265
		(-9.71)	(-10.18)	(-12.90)
Region 2	R_2	-0.071	-0.086	-0.090
		(-5.87)	(-6.63)	(-8.28)
Region 3	R_3	-0.116	-0.122	-0.118
		(-8.58)	(-8.52)	(-9.84)
Region 4	R_4	-0.145	-0.161	-0.146
		(-12.53)	(-12.96)	(-14.06)
Region 5	R_5	-0.053	-0.053	-0.028
		(-5.04)	(-4.66)	(-3.01)
Hardshipzone 1	HZ_1	0.001	0.009	-0.004
		(0.03)	(0.87)	(-0.49)
Hardshipzone 2	HZ_2	0.013	0.028	0.017
		(1.13)	(2.29)	(1.72)
Hardshipzone 3	HZ_3	0.028	0.054	0.045
		(2.33)	(4.22)	(4.24)
Hardshipzone 4	HZ_4	0.247	0.281	0.263
		(3.77)	(4.02)	(4.49)
$\overline{R}^2$		0.396	0.416	0,453
F-Test [16, 40.627]		1,667.7	1,810.6	2,108.6
Log-Likelihood		-42,558.5	-45,240.8	-38,079.9
Restricted Log-Likelihood		-52,827.2	-56,188.4	-50,5374.0