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Thomas Glauben+), Hendrik Tietje+) and
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Department of Food Economics
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Address:
Department of Food Economics and Consumption Studies,
University of Kiel, Olshausenstr. 40, D-24118 Kiel, Germany.
Phone: +49/431 880 4425, Fax.: +49/431 880 7308,
e-mail: tglauben@food-econ.uni-kiel.de
http://www.food-econ.uni-kiel.de/

Agriculture on the Move:
Exploring Regional Differences in Farm Exit Rates

Thomas Glauben[+)], Hendrik Tietje[+)] and Christoph Weiss[++)]

Abstract:

This paper investigates the relationship between farm exits and various farm, family, and regional characteristics during the period of 1991 to 1999. Using county-level data for 326 regions in western Germany, econometric cross section estimations indicate that exits from farming are strongly influenced by farm and family characteristics. In particular, exit rates are higher in regions with smaller farms. Further, farm exits are closely related to retirement and succession considerations. Exit rates are lower in regions with a high share of part-time farms, which indicates that off-farm income has a stabilizing impact on structural change in agriculture.

Keywords:

Farm exit, county-level census data, cross-section estimation, Germany

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[+)] Department of Food Economics and Consumption Studies, University of Kiel, Olshausentstr. 40, D-24118 Kiel Germany. e-mails: tglauben@food-econ.uni-kiel.de and htietje@food-econ.uni-kiel.de

[++)] Department of Economics, Vienna University of Economics and Business Administration, Augasse 2-6, A-4040 Vienna, Austria. e-mail: cweiss@wu-wien.ac.at

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1. Introduction

Krugman's seminal book, "Geography and Trade," constitutes a starting point for a large volume of theoretical and empirical literature on studying processes of regional concentration of economic activities. This literature aims at understanding the driving forces of divergent regional developments and strongly focuses on the importance of economics of scale and imperfect competition. These models are most appropriately applied to those sectors of the economy which are not as strongly tied to specific regional characteristics (availability of land or natural resources) but can be considered "footloose." Much of the existing empirical work thus focuses on the manufacturing sector and analyzes changes in the number of manufacturing firms as well as dynamics of manufacturing industries' employment shares in various regions. Nevertheless, it is obvious that a process of regional concentration (or de-concentration) in one sector will have consequences for geographically less mobile sectors of the economy as well. It is one of these sectors, agriculture, that is the primary focus of this paper.

Closely related to the upswing in manufacturing and services, the farm sector in Organisation for Economic Co-Operation and Development (OECD) member countries has experienced a decline in the absolute level as well as in the relative importance of farm employment. In Germany, the relative decline of the number of farmers between 1991 and 1999 was around 30 percent. This strong decline is the result of a very heterogeneous development at a regional level (the rate of decline is between 4 percent and 55 percent across 326 counties). Despite the fact that agricultural goods are produced using a location-specific factor (land) and in contrast to the footloose industries that are closely tied down by natural resources, we nevertheless observe a process of regional concentration and de-concentration of farm numbers. This paper strives to study this process empirically. More specifically, we aim to examine the impact of location-specific, firm-specific and family-specific characteristics on the decline of farm numbers in 326 counties in West Germany between

1991 and 1999. Studying regional differences in structural adjustment in the farm sector is an important area of research in agricultural economics, and the following section will briefly summarize this literature. Section 3 describes the data used, section 4 reports empirical results, and section 5 summarizes the study.

2. Structural Change in Agriculture – Survey of the Literature

By reviewing the causes of structural change in the farm sector, Tweeten (1984) concludes that "the major determinants of farm size and numbers have been technology, national economic growth, and off-farm income." (p. 44) Technical change in agriculture has displayed a labor-saving bias. The resulting reduction in the demand for farm labor required farms to grow to cover a given level of management and labor costs. It is frequently argued (Lu 1985) that this process of technologically induced farm growth is stronger for larger farms. But even if technological advances are scale neutral (i.e., they are equally applicable to large and small farms) their adoption tends to favor larger farms since they typically have more access to information and financing and also have the necessary management skills. As noted in Tweeten (1984), small firms can nevertheless survive provided they use income from outside the farm sector to maintain their total income. The "invisible hand of non-farm opportunity" (Gardner 1992, p. 75) has increasingly been grasped by well educated operators of small farms, whose opportunity costs of farm labor increased with the rising non-farm incomes in a period of macroeconomic growth.

The macroeconomic environment before the first oil shock in 1973 has facilitated the out-migration of labor by readily providing employment for farm labor made redundant by technological change. After the first oil shock, however, high unemployment rates plagued many OECD countries, thereby reducing the force of the invisible hand of attractive non-farm opportunities. Much of the agricultural economics literature stresses socio-economic characteristics of the farm operator and his family (managerial ability as well as life-cycle

patterns) as major reasons why farm structure changes over time. Sumner and Leiby (1987), for example, argue that human capital increases the ability of farmers to adapt more rapidly to changing conditions, implying larger herd sizes and faster growth. However, as noted by Goddard et al. (1993), given that the opportunity of employment outside the farm sector also increases with the human capital of the farmer, the net effect of human capital on farm growth and survival is unclear. Gasson and Errington (1993) furthermore point out that understanding the nature of the farm business requires conscious recognition of the family that operates it, since farming, as it is practiced in most industrialized countries, is predominantly a family business. Thus, considering the characteristics of the farm family also is important for explaining the success (or failure) of the farm business.

The importance of technology, macroeconomic factors, and socio-economic characteristics in deciding whether to quit or keep farming have also been addressed in formal models. Recent studies include Goetz and Debertin (2001) and Pietola et al. (2002). The available empirical literature in this area typically applies one of two different approaches: empirical studies at the farm-household level and studies focusing on the adjustment of farm labor at the aggregate (sector and/or regional) level. The advantage of the first approach, which is typically based on a more or less comprehensive cross section of farm households in a particular region, is that information on the characteristics of the farm and the farm family is available and can be used to explain individual adjustment behavior[1]. Its main disadvantage, however, is that the impact of general economic conditions as well as agricultural policy (changes in output prices and direct income transfers) cannot be investigated in greater detail, because these factors concern all farmers in a specific region and the time dimension of these studies typically is very short (or non-existent in the case of cross-section studies).

[1] Due to the increasing availability of individual farm-household data, the number of empirical studies in this field is rapidly growing: Weiss (1999), Kimhi and Bollman (1999), Kimhi (2000), Stiglbauer and Weiss (2000), Pietola et al. (2002), Glauben, Tietje and Weiss (2002).

These disadvantages can be addressed in empirical studies focusing on farm labor adjustment at an aggregate level. Here, information over a longer time period and for different regions is available and the effect of policy changes on the agricultural labor market can (in principle) be analyzed. The most comprehensive study on farm labor adjustment at the sector level has been carried out by the OECD (1994). In this study, equations linking family and hired labor to various agricultural and macroeconomic variables have been estimated for eight countries: Australia, Canada, western Germany, Italy, Japan, New Zealand, the United Kingdom, and the United States. The results indicate that neither the macroeconomic variables nor the farm-sector variables consistently influence the rates of change of family and hired farm labor at statistically significant levels. The estimated coefficients are very often statistically insignificant and the overall explanatory power of most equations is poor. The authors conclude that farm family labor as well as hired labor is not particularly sensitive to business cycle conditions or to agricultural prices.

A substantially higher flexibility of labor to macroeconomic changes as well as agricultural prices is reported for Germany in Andermann and Schmitt (1995). Applying a similar estimation approach, the authors find changes in total farm labor to be explained by economic factors such as sector income and farm input and output prices as well as the industry wage rate and general labor market conditions. The authors also analyze changes in labor input by various groups such as family and hired labor as well as full-time and part-time labor.

In a careful econometric analysis of the determinants of aggregate migration of labor out of agriculture in the United States from 1940 to 1985, Barkley (1990) concludes: “Farm labor is found to be mobile. Mobility is measured by the relatively high elasticity of annual changes in the relative returns to farm labor.” (p. 573) Barkley’s study deserves some attention because the author also analyzes the impact of agricultural policy on off-farm migration. He finds that government payments did not directly influence changes in

agricultural employment. This might be due to two divergent effects of government policy offsetting each other. “Government payments have divergent effects on the size of the labor force. Income assistance in the form of price supports and target prices are expected to slow the rate of migration out of agriculture. However, acreage set-asides accompany enrollment in the price support programs. Land diversion reduces the need for inputs which are complementary to land, resulting in an increase in the migration of labor out of agriculture.[…] Perhaps the two effects offset each other and net to zero.” (Barkley, 1990, p. 571) Barkley finds an indirect impact of agricultural policy on migration, however: “Government intervention in the agricultural sector may have slowed the rate of migration from agriculture indirectly through higher land prices.” (p. 572). Higher land values are found to be associated with less migration out of agriculture. Similar results are also reported for Germany in Andermann and Schmitt (1995).

Most recently, Goetz and Debertin (2001) estimate a county-level model of net farm exits. Using data for 2,999 U.S. counties between 1987 and 1997, they find that farmers quit at faster rates with lower transaction costs of entering into the non-farm business if they reside in counties with high population density or if they are adjacent to a metropolitan area. Socio-economic characteristics, such as the average age of farm operators, are not found to influence exit rates significantly. The authors particularly focus on the relationship between off-farm employment and net farm exits and find two opposing effects. Higher levels of off-farm employment reduced the odds that a county lost farm proprietors between 1987 and 1997. The authors suggest that this finding is the result of an income-stabilizing effect of off-farm employment. On the other hand, off-farm employment accelerates exits from farming in the subset of counties where the number of farm proprietors declines. The more widespread experience of farmers who have worked off-farm might reduce transaction costs for those seeking to leave agriculture (“beaten path effect”). Similarly, government payments also exert opposing effects on structural change. The authors argue that government payments help

farmers keep their farms (they report evidence that payments reduce the odds that a county loses farms) but on the other hand makes it easier for farmers to buy out farms from those who are seeking to exit. (In their subset of counties losing farms, higher levels of payments accelerate the rate at which farmers exit.)

3. Data

To analyze the relationship between the number of farm exits and several farm, family, and regional characteristics, we combine data from two sources: (1) the census of agriculture which reports basic farm characteristics and the number of farms of 326 counties in West-Germany[2], and (2) the EUROSTAT New Cronos database for selected regional characteristics. The agricultural census only reports the total number of farms at county level in 1991 and 1999. Separate information about farmers entering or leaving the sector is not available. Therefore, we can only identify the net change in farm numbers. Calculating relative changes in farm numbers $\Delta NF = \ln(NF_{1999}) - \ln(NF_{1991})$ (where NF_{1999} and NF_{1991} are the number of farms in 1999 and 1991 respectively), we observe (a) that ΔNF is negative for all counties (i.e., more farmers are leaving than entering) and (b) that there are significant differences between counties. The relative decline in farm numbers on average is around 30 percent and varies between 4 percent (City of Herne, North Rhine Westphalia) up to around 55 percent (City of Bamberg, Bavaria). Excluding city-counties, the relative exits in rural counties range between 12 percent (Miesbach, Bavaria) and around 49 percent (Calw, Baden-Württemberg).

To account for regional differences in the decline in farm numbers, we collect a number of regional, farm, and family characteristics for the beginning of the period over which the change in farm numbers is calculated (1991). **Table 1** reports definitions and some

[2] Counties located in the former GDR are not included in the 1991 census of agriculture. Data for Hamburg and Berlin are missing in the 1991 and 1999 census of agriculture.

descriptive statistics of the variables used for the empirical analysis for all counties. The descriptive statistics for only rural counties can be found in Table A1 in the appendix.

Table 1: Definition and Description of Variables

Definition	*SYMBOL*	Mean	Std.Dev.	Min.	Max.
Net change in farm numbers, ln ($farms_{99}$) – ln ($farms_{91}$)	*ΔNF*	-0.352	0.106	-0.780	-0.044
Number of farms in 1991 (1,000 farms)	*NF*	1.933	1.628	0.024	8.092
Average farm size, hectare	*SIZE*	22.638	9.930	3.840	64.724
Share of farms with more than 50% of owned land	*OWN*	0.673	0.143	0.236	0.935
Cattle / dairy farms, share of total farms, 0-1	*CATTLE*	0.410	0.226	0.000	0.952
Pig production farms, share of total farms, 0-1	*PIG*	0.045	0.055	0.000	0.390
Permanent crops (fruit, wine, trees), share of total farms, 0-1	*PERM*	0.075	0.176	0.000	0.924
Farms with holiday accommodation, share of total farms, 0-1	*TOUR*	0.017	0.038	0.000	0.279
Part-time farms, share of total farms, 0-1	*PT*	0.509	0.162	0.129	0.866
Farms having a successor, share of total farms, 0-1	*SUCC*	0.338	0.102	0.144	0.753
Farms with farm operator aged 45 and older, share of total farms, 0-1	*AGE45*	0.636	0.061	0.488	0.856
Gross Domestic Product per Head in region (1,000 €)	*GDP*	18.822	7.177	7.711	59.164
Population density, 1,000 inhabitants per km²	*POPDENS*	0.557	0.702	0.041	3.957
Regional Dummy Variable for Schleswig-Holstein	*SH*	0.046			
Regional Dummy Variable for Lower Saxony and Bremen	*LSHB*	0.150			
Regional Dummy Variable for North Rhine Westphalia	*NW*	0.166			
Regional Dummy Variable for Hesse	*HE*	0.080			
Regional Dummy Variable for Saarland	*SL*	0.018			
Regional Dummy Variable for Rhineland-Palatinate	*RP*	0.110			
Regional Dummy Variable for Baden-Wurttemberg	*BW*	0.135			

3. Empirical Results

The results of two different econometric models are reported in **Table 2**. Column 1 estimates the empirical model on observations for all 326 counties; Column 2 reports parameter estimates of a model estimated when excluding city-counties. Both models are significant at the 1 percent level or better as measured by the F-test. In general, the results suggest that the

declining number of farms is significantly influenced by characteristics of the farm sector, whereas characteristics of the non-farm economy seem to be less important. A comparison between the two models indicates that these results mainly are not driven by the specific circumstances of city-counties. The following discussion is based on the results reported in Column 1.

Table 2: Econometric Results of the OLS Model on Farm Exit Rate

	All counties [1]		Without city-counties [2]	
Independent Variable (S*YMBOL*)	Parameter	(t-value)	Parameter	(t-value)
Constant	-0.350	(-3.308)	-0.370	(-2.778)
Farms in 1991 ($\ln(NF_{1991})$)	-0.014	(-2.420)	-0.016	(-1.558)
Farm size (*SIZE*)/100	0.570	(5.215)	0.527	(5.028)
Owned land (*OWN*)	-0.227	(-2.476)	-0.211	(-2.269)
Cattle / dairy farms (*CATTLE*)	0.241	(7.084)	0.265	(7.622)
Pig production farms (*PIG*)	0.201	(2.117)	0.215	(2.597)
Permanent culture farms (*PERM*)	0.452	(8.539)	0.477	(9.173)
Farms with tourism (*TOUR*)	0.252	(2.096)	0.183	(1.997)
Part-time farms (*PT**)[1]	0.364	(2.683)	0.240	(2.288)
Farms with successor (*SUCC*)	0.565	(6.134)	0.567	(5.633)
Farmer's age ≥ 45 (*AGE45*)	-0.633	(-5.845)	-0.526	(-4.280)
GDP per Head (*GDP*)/100	-0.001	(-1.609)	0.001	(0.634)
Population density (*PODENS*)	0.073	(4.827)	0.093	(2.433)
Schleswig-Holstein (*SH*)	-0.009	(-0.346)	-0.069	(-2.601)
Lower Saxony / Bremen (*LSHB*)	-0.099	(-4.330)	-0.110	(-5.066)
North Rhine Westphalia (*NW*)	0.039	(2.123)	0.013	(0.810)
Hesse (*HE*)	-0.043	(-2.021)	-0.058	(-3.351)
Saarland (*SL*)	-0.068	(-1.489)	-0.070	(-1.972)
Rhineland-Palatinate (*RP*)	-0.017	(-0.790)	-0.025	(-1.249)
Baden-Wurttemberg (*BW*)	-0.005	(-0.243)	-0.013	(-0.789)
R^2 / Adjusted R^2:	0.580 / 0.554		0.735 / 0.712	
F-Test (DF):	22.23 (19, 306)		31.60 (19, 216)	
LogL / Restr. LogL:	412.023 / 270.686		384.205 / 227.300	
LR-Test (20):	282.674 (20)		313.810 (20)	
Sample size:	326		216	

[1]: *PT** has been instrumented

According to **Table 2**, an increase in average farm size (*SIZE*) significantly reduces the tendency to close down farms (reduces the negative growth rate of the number of farms). This result is confirmed by Pietola et al. (2002), Goetz and Debertin (2001), and Kimhi and

Bollman (1999). Kimhi and Bollman argue that farm size or farm value would contribute positively to farm survival since larger farms are more likely to provide the farm operator and his family with a reasonable and sustainable income. However, a high value of farm assets may also increase the market value of the farm and thus the income after retirement increasing the probability of exits. Our analysis suggests that the first effect of farm size or value of land and buildings is the dominant force in driving exit behavior in Germany during the 1990s.

In regions where farmers have a larger share of owned land (*OWN*), farm exit rates are found to be significantly higher. A high percentage of owned land contributes positively to farm value. Farmers might receive additional income from selling or leasing out land, especially if there are no or only few opportunities for off-farm employment. Farm exits rates differ significantly between different farm types. Differences in agricultural production structures and the degree of specialization are reflected by the respective shares of dairy and cattle (*CATTLE*), as well as pig production farms (*PIG*) and farms with permanent cultures (*PERM*). These shares might reflect production conditions as well as commodity-specific factors, such as market conditions and government payments tied to different products. In addition, a high share of permanent crops might indicate relatively high sunk costs of closing down the farm. Relative to counties in which cash crop farms dominate, counties with farms specializing in any of the other commodities lost fewer farms. The additional income from on-farm diversification (i.e., holiday accommodations - *TOUR*) significantly lowers farm exit rates.

PT is the share of farms in a county which receive more than 50 percent of income from off-farm employment. Entering into the off-farm labor market as a part-time farm has frequently been considered "…a first step out of agriculture" for these farms (Kimhi 2000). One could thus expect the net exit rate to be higher in regions with a large share of part-time farms in 1991. On the other hand, off-farm income could stabilize total household income which would suggest that part-time farming reduces the number of farmer exits in a county.

Several studies examine the impact of part-time farming on exit considerations. The results reported are controversial. Pfeffer (1989) reports that part-time farms in Germany had lower expectations of continuing the farm in the future. Similarly, the existence of off-farm work has a positive impact on the exit probability of Austrian farmers (Weiss 1997 and 1999) and farmers in the United States (Roe 1985). In contrast, Kimhi and Bollman (1999) and Kimhi (2000) find that the exit probability decreases with the extent of off-farm work in Canada and Israel. They conclude that off-farm work is a "stable phenomenon" rather than the first step toward farm exit. Goetz and Debertin (2001) suggest that off-farm employment both stabilizes household income and lowers the transaction costs of closing down the farm. Estimation results for U.S. counties show that off-farm employment on the one hand lowers the probability that a county faces a net loss of farmers, but on the other hand leads to higher exit rates if a net loss occurs ("beaten path effect"). **Table 2** suggests that a higher number of part-time farmers is negatively related to farm exit rates in Germany. The parameter estimate of the instrumented share of part-time farms (*PT**) is significantly different from zero and positive.[3] Part-time farms in Germany therefore are less likely to be closed down, indicating that part-time farming stabilizes household income.

Undoubtedly, succession and retirement considerations are closely related to exit decisions. Farms will be closed down when the farm operator reaches retirement age and no successor is available. The results of the econometric analysis reported in **Table 2** confirm this argument. A large share of farm operators aged 45 and older (*AGE45*) accelerates exits from farming, while a large share of farms reporting to have a successor (*SUCC*) contributes negatively to exit rates. Similarly, Weiss (1999) reports "…that a farm which has been taken over by a younger farm operator […] reports a […] higher probability of survival in the subsequent period, ceteris paribus." (p. 110) In addition, Pietola et al. (2002) find that the

[3] To capture the potential endogeneity of part-time farming (Kimhi 2000), this variable is instrumented in the econometric model.

probability of a voluntary exit and closure is decreasing with farmer's age, but the probability to exit and transfer is decreasing even faster.

Regarding the impact of non-farm characteristics, we find that a greater population density (*POPDENS*) significantly reduces exit rates. This result may indicate that urban areas have undergone greater structural changes in the past than rural areas. Goetz and Debertin (2001) report the opposite effect of population density on the odds that a county lost farm proprietors. Furthermore, counties with a high GDP per head (*GDP*) tend to experience greater losses of farm operators, which might be caused by good job opportunities outside the agricultural sector. The parameter estimates for some of the regional dummy variables (*LSHB, NRW,* and *HE*) show significant differences between the farm exit rates in the federal states of Germany. The exit rates in Lower Saxony/Bremen (*LSHB*) and Hesse (*HE*) are significantly higher while exit rates in North Rhine Westphalia (*NRW*) are significantly lower than in Bavaria, which is the excluded category.

Finally, the number of farms in the initial time period (1991) is included to control for county size differences as well as to explore the persistence of the adjustment behavior in more detail. As **Table 2** indicates, this variable contributes significantly to the explanatory power of the model. The higher the number of farms was in 1991, the higher the number of farmers exiting.

4. Summary

During the last decade the number of farms in western Germany declined rapidly. The speed of structural change significantly differs between regions, which has important consequences for rural areas. First, farm exits accelerate the growth of remaining farms by redistributing land and other inputs. The changing structure of the farm sector has important consequences for equity within agriculture as well as productivity and efficiency of farming, and therefore for the international competitiveness of the agricultural sector in Germany. Secondly, the

decreasing number of farms has not only consequences for the agricultural sector but also for rural areas on the whole. Empirical studies found that one farm exit leads to the loss of another non-farming family from the rural population (Tweeten 1984). A depopulation of the countryside influences the demand for government services and infrastructure and the well-being of local communities, and thus has been the subject of considerable interest among policy makers.

Using county-level data derived from the German agricultural census and EUROSTAT's New Cronos database, which have been linked, this study investigates the relationship between farm exits from 1991 to 1999 and farm and family characteristics, as well as regional economic conditions. The results indicate that exit rates are strongly influenced by farm and family characteristics. Farmers quit at faster rates in countries with small farms, where the average age of the operator is high and no successor is available.

In addition, we find that exit rates are lower in regions with a high share of part-time farming and on-farm diversification. This indicates that income from off-farm work and on-farm diversification has a stabilizing impact on structural change in agriculture. Some characteristics of the non-farm economy also influence farm operators' decisions to close down the farm. In particular, a high regional GDP per head, which could indicate more employment opportunities for farmers and their heirs in the non-farm sector, enforce the decision to exit.

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Appendix

Table A1: Definition and Description of Variables, Without City Counties

Definition	*SYMBOL*	Mean	Std.Dev.	Min.	Max.
Net change in farm numbers, ln ($farms_{99}$) – ln ($farms_{91}$)	*ΔNF*	-0.352	0.106	-0.780	-0.044
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Regional Dummy Variable for Lower Saxony and Bremen	*LSHB*	0.150			
Regional Dummy Variable for North Rhine Westphalia	*NW*	0.166			
Regional Dummy Variable for Hesse	*HE*	0.080			
Regional Dummy Variable for Saarland	*SL*	0.018			
Regional Dummy Variable for Rhineland-Palatinate	*RP*	0.110			
Regional Dummy Variable for Baden-Wurttemberg	*BW*	0.135			