European Association
of Agricultural Economists

100th Seminar of the EAAE

DEVELOPMENT OF AGRICULTURE AND RURAL AREAS IN CENTRAL AND EASTERN EUROPE

Edited by
Danilo Tomić
Miladin M. Ševarlić

Regional Chamber of Commerce Novi Sad

21st – 23rd June 2007
Novi Sad, Serbia

Serbian Association
of Agricultural Economists

EXPLORING THE FLEXIBILITY OF POLISH FAMILY FARMS DURING TRANSITION

Agata Pieniadz[1], Swetlana Renner[1], Martin Petrick[1]

1. INTRODUCTION

Agricultural holdings in transition countries face dynamic changes in economic, legal and political conditions. Still, one characteristic of those countries is the existence of multiple market failures, especially on the capital, labour and product markets, which amplify uncertainty at the farm level. The complexity of the agribusiness environment increases with the ongoing liberalization, globalization and standardization processes, all of which change trade patterns for agricultural commodities and influence production costs and commodity prices. In the same way, the continuing expansion and deepening integration of the European Union, as well as the current reforms of the Common Agricultural Policy (CAP) are redefining the challenges for European farmers. Thus, the issue for those farmers who decide to stay in the agricultural sector is whether to adapt their current business strategy to the changing operating environment. The success of the enterprise depends on its ability to reconfigure the farming system (technology) and inputs (resource allocation) so as to produce efficiently the demanded level or composition of output. In this context, flexibility can be considered as a crucial farm-specific attribute for coping with all forms of turbulence in the farm's environment.

Polish agriculture is dominated by individual family farms. During transition it was not clear whether those farms were holding-up or stimulating the performance of the agricultural sector. One fact is that, despite their apparently low productivity (Latruffe et al., 2005), family farms neither disappeared during the transition period nor after EU-accession. One explanation could be the gains made from utilizing flexible farming systems, which can even overcompensate for static inefficiencies. Small farms are especially likely to react flexibly to the changing conditions, i.e., to plant crop mixtures and even combine or rotate crops and livestock, which can stabilize the total farm output and income under uncertainty. Additionally, family members living on the farm and involved in various non-agricultural activities can support the capital flow to the farm and at least improve its access to current assets.

[1] Agata Pieniadz, Swetlana Renner, Martin Petrick, Leibniz-Institute of Agricultural Development in Central and Eastern Europe, Theodor-Lieser-Str. 2, 06120 Halle (Saale), Germany

At the same time, family labour is likely to widely satisfy the flexible manpower needs of agriculture. Access to additional resources may facilitate the adjustment of both the production scale (aggregate output) and scope (product mix) to a changing operational environment. However, despite its flexibility, the farm family business also has weaknesses regarding the capability to adjust in comparison with the competing firms in the EU market. Perhaps the most important drawbacks are limited financial and qualified human resources for significantly improving production technology and increasing specialization and production levels (e.g., Petrick 2004). These adjustments are crucial for gaining access to value added chains.

These considerations suggest that even in the group of family farms there is a variation in flexibility with respect to their farm-specific features and constraints. Moreover, since the farm business and the farm household are hardly 'separable', many factors can interact in a complex manner not necessarily fully explained by the theoretical literature. To our knowledge, there are no studies that have addressed the flexibility issue in post-communist economies. Thus, a comprehensive understanding of the subject remains elusive.

The goal of our paper is to identify the determinants of flexibility in Polish family farming during transition. We restrict the analysis to flexibility within agricultural production, and hence search for factors that drive the re-orientation of the farm production program with regard to the scope and scale of production. Thus, we focus on two dimensions of flexibility: output flexibility (adjustment in scale) and product switching, or so-called product-mix flexibility (adjustment in scope) (Carlson, 1989; Parker/Wirth, 1999).

In the first step of the study we parameterize the notion of flexibility. Appropriate indices measuring the farm's flexibility in scale and scope, as well as the determinants of flexibility, will be identified. In the second part of the study we elaborate on farm-level flexibility using panel data on 562 Polish family farms from 1994 to 2001. The farm family attributes and the farming system are given specific attention in our empirical model.

2. DATA SET

The data set was provided by the Polish Institute of Agricultural and Food Economics - National Research Institute (IERiGZ-PIB) and contains both farm-specific accountancy information (i.e., land, capital, labour, operating recourses) and socio-demographic variables (i.e., age and gender of the head of the household, farm succession, participation on labour market). Since our intention was to obtain the largest possible number of panel observations, we used a balanced data set consisting of eight years of observations (1994-2001) on 562 Polish agricultural

farms; this resulted in 4,496 observations. The analyzed period was characterized by a relatively constant survey methodology, and hence possessed a stable variables composition before it was adjusted to the methodology used by the European Farm Accountancy Data Network (FADN).

The descriptive statistics of the data show increasing income disparities among the family farms: 5% of investigated farms in 1994 (27) and 17% (96) in 2001 achieved a negative agricultural income. Moreover, 38% of the remaining farms in 2001 (212) obtained more than the half of their disposable income from agricultural production, whereas the corresponding figure for 1994 was just 6% (36). These developments suggest that among farms capable of generating a positive agricultural income, there is a decline in the diversification of economic activities, thereby indicating a trend towards full-time farming, even if the production scale has not changed significantly over that time.

The applied distribution indicators, such as the Berry-Index and entropy mass (Jacquemin-Berry Index) both calculated based on 14 typical agricultural products, reveal further interesting developments in the data set: First, there is a general decline in farms' diversification. Second, we observed the persistence of highly diversified farms on the one hand, and a disproportionately growing role (share) of specialized enterprises on the other. The increasing variation and polarization in the data set suggest that the farms possess varying ability, and willingness, to adjust to the changing environmental conditions. Additionally, we found the degree of the farm commodity diversification to be negatively correlated with farm income, thereby indicating that Polish family farms should seek a higher degree of specialization, since this business strategy is likely to be more profitable. These figures point to the need for further investigations of flexibility with regard to scale and scope of agricultural production.

3. FLEXIBILITY MEASURES

We focus on two dimensions of flexibility in our empirical application: output-flexibility (adjustment in scale) and product-switching or so-called product-mix flexibility (adjustment in scope). The respective indices are defined as follows (Weiss, 2001):

$$F\_scale_{it} = \left[Ln\ (Q_{it} / \overline{Q_i}) \right]^2$$

$$F\_scope_{it} = \sum_{j=1}^{J} \left| s_{jit} - s_{ji(t-1)} \right|,$$

with i (i = 1, …, n) representing the number of farms and t (t =1, …, T) the respective year. Q_{it} indicates the total agricultural output of farm i in period t, and is

calculated as a sum of gross crop and animal production values. The variable $\overline{Q_i}$ refers to the average farm-specific output over the investigated period. We argue that this indicator is a more comprehensive measure of farm scale than merely land size or livestock unit numbers (Weiss, 2001); this is due to the high diversification of agricultural production of the majority of farms. Thus, F_scale addresses the depth of the underlying activity. The output figures were provided in current values, thus we deflated the variables by the corresponding producer price indices provided by the Central Statistical Office in Poland (GUS var. issues, a, b).

The variable s_{jit} represents the share of the j-th product in the total gross production value of the i-th farm in the t-th year: $s_{jit} = q_{jit}/Q_{it}$. We have calculated the F_scope index based on 14 agricultural products, which we identified in the provided data set. The descriptive statistics of both flexibility measurers are provided in Table 1.

4. DETERMINANTS OF FLEXIBILITY

Generally we distinguish among five groups of factors that influence a farm's ability to cope with changes. We will first discuss our assumptions and test them in the subsequent section.

(1) Farm size: We assume that within the investigated market, flexibility varies inversely with farm size. Following Mills/Schumann (1985), we argue that small firms use production technologies that are more flexible than those chosen by large firms. Thus, small firms have an offsetting advantage in their deeper and quicker responsiveness to environmental changes. On the contrary, large firms - despite being relatively inflexible - have a competitive advantage due to lower average costs, and hence higher technical scale economies. This indicates that there is a trade off between flexibility and productivity (Carlson, 1989; Grubbstrom/Olhager, 1997). Additionally, large farms might be better integrated in the whole supply chain. First, this implies higher capital intensity due to specific investments needed to meet the requirements regarding the quantity and quality of the purchasers. Second, large farms are more likely to use long-lasting contracts as governance instruments on the factor and product markets. Therefore, large farms tend to have more stable output regarding both the aggregate production as well as the product mix.

(2) Socio-demographic factors: Pollak (1985) argues that some roots of farm heterogeneity may lie in differences in the internal organization and structure of families and households, as well as the attitudes of farm holders towards taking risks. For example, the behaviour of family-owned and family-managed farms might differ systematically. Family-owned farms, typically jointly-operated by a

married couple and their children, and additional relatives (as required) dominate the utilized data set. Gasson/ Errington (1993) argue that such a structure is likely to widely satisfy the flexible manpower needs in agriculture, and hence facilitate the adjustment of both production scale and scope to the changing operational environment. Thus, we expect the 'family size', defined as the total number of family members living in the farm household, to positively influence flexibility.

Furthermore, we assume that flexibility decreases with the age of the farm holder. Younger farmers are, in general, better educated than older ones. Additionally, older farmers are more risk-averse decision-makers than their younger counterparts, and hence prefer organization forms with lower flexibility (Weiss, 2001, Zeller/ Robinson, 1992). Our assumption neglects the impact of experience on upgrading qualifications (Bartels, 1999). However, given the drastic changes in the economic and institutional environment during transition, it can still be expected that formal education has become more relevant for the ability to adjust than long practical experience. A particularly interesting group of farmers are those aged over 65 and still engaged in farm management. A high proportion of farmers remaining in agriculture beyond the normal retirement age has been a source of concern to policy makers, since these farmers are supposedly less progressive than younger ones (Gasson/Errington, 1993). Thus, older farmers especially are believed to impede the farm's flexibility. In order to test this hypothesis, we introduced the variable 'age>65' in our model. On contrary, we assume that 'succession' has a positive effect on farm flexibility (Gasson/ Errington (1993) and Weiss (2001). We understand family farm succession as the transfer of business ownership and managerial control to one of the younger inheritors.

Additionally, we introduced the variable 'gender' in the model. Even if we did not find any plausible theoretical grounds for gender's influence on flexibility, there is empirical evidence that this variable might be a significant one.

Attitude to risk might indeed be a relevant factor in the decision-making process, irrespective of the farm holder's age, since the very nature of decision-making in farm families makes it difficult to identify the principals. Long-term strategic business decisions are especially discussed and made jointly (Gasson/Errington, 1993). Thus, we argue that risk-averse families prefer stability in production and will have higher relative expenditures for agricultural insurance to avoid output variations. Thus, we expect the variable 'risk aversion' to negatively influence flexibility.

(3) Access to additional financial resources: Changes in the agribusiness environment offer farms new opportunities, while encroachment by external sources of production factors might help meet the changing demand (Gasson/Errington (1993). Our descriptive statistics reveal that many farms generate negative agricultural income. This suggests a need for additional working

capital to successfully adjust to the changes. Following this argument, we expect additional capital flows to have a positive influence on the farms' flexibility. We could identify three sources of additional capital inflows: off-farm-incomes, credits and governmental aids. However, while the sources of the capital inflows are diversifying, their influences are uneven through time (transition) and among farms, and are related to production structure and size. In particular, specialized and large farms might have better access to credits and governmental aids, and hence benefit from additional capital flows (Petrick 2004). On the contrary, large families that own small farms might have better access to off-farm incomes.

(4) Cost structure: Following the arguments of Mills/Schumann (1985) and Carlson (1989), we assume that a farm's cost structure influences its flexibility. First, we argue that greater flexibility is achieved by a farm's increased reliance on variable factors of production. Therefore, we introduce the variable 'input ratio', calculated as total variable costs, divided by gross agricultural production, to test this hypothesis. In addition, we assume fixed costs-per unit of output to be inversely related to flexibility among firms with a heterogeneous cost structure. We argue that a farm's greater reliance on production factors provided by the market increases fixed costs per unit of output. Indeed, expenses for other production factors not owned by the family firm, such as land or labour, influence the fixed costs in the middle term, since the factors must be remunerated irrespective of the annual supply/demand fluctuations. Following Pollak (1985), we argue that hired labour costs particularly might influence the cost position of a farm, since hired labour requires more monitoring, supervision and control efforts than family labour. Thus, we expect both variables, 'leasing costs' and 'labour costs', to have a negative influence on farm flexibility.

Table 1 Variable definition and descriptive statistics

	Variable	Description	Mean (SD)	Min. Max.
(1)	Farm Size	Gross agricultural production, deflated by PPIs for plant and animal products, in 100 thousand Polish Zloty	0.319 (0.321)	0.013 4.319
(2)	Family size	Total number of family members living in the farm household, divided by 4	1.128 (0.411)	0.250 3.500
	Age	Age of the farm manager, divided by 40	1.141 (0.270)	0.450 1.975
	Age>65	Dummy variable for elderly farmer; The variable is set equal to 1 if the holder is older than 65, and 0 otherwise	0.042 (0.201)	0 1

	Gender	Dummy variable for gender; The variable is set equal to 1 if the farmer is female, and 0 otherwise	0.127 (0.333)	0 1
	Succession	Dummy variable for farm succession. The variable is set to 1 if the difference between the farm holder's age in current and previous year is > 2, and 0 otherwise	0.139 (0.346)	0 1
	Risk aversion	Share of insurance costs in gross agricultural production, in percent	1.455 (2.000)	0.000 43.724
(3)	Off-farm incomes	Share of total hours of work allocated to non-agricultural activities by family members in total family labor	0.427 (0.155)	0.000 0.965
	Access to credit markets	Share of financing costs (interest, charges) in the gross agricultural production, in percent	0.811 (1.862)	0.000 34.802
	Governmental aids	Share of governmental aid (compensations, subventions) in gross agricultural production, in percent	0.384 (2.324)	0.000 61.631
(4)	VK: Input ratio	Total variable costs, divided by gross agricultural production	0.712 (0.172)	0.163 2.629
	FK: Leasing costs	Share of leasing and rental costs in gross agricultural production, in percent	0.379 (0.898)	0.000 24.882
	FK: Labour costs	Share of hired (permanent+ seasonal) labour hours in total agricultural labour input (hired + family)	0.042 (0.093)	0.000 0.813
(5)	Specialization on milk production	Share of gross milk production in gross agricultural production	0.190 (0.156)	0.000 0.905
	Specialization on crop production	Share of crop production in gross agricultural production	0.461 (0.180)	0.003 1.000
	Berry-Index	Berry-Index, $BI = 1 - \Sigma (s_{j\,i\,t})^2$, calculated on base of 14 typical agricultural products; $s_{j\,i\,t}$ is defined in text	0.730 (0.124)	0.008 0.885
	Land quality	Index for favorable production conditions, based on soil type & fertility, climate, water & geographic conditions of the area	0.847 (0.291)	0.166 1.750
	F_scale	Scale flexibility, as defined in text	0.044 (0.116)	0.000 3.121
	F_scope	Scope flexibility, as defined in text	0.243 (0.171)	0.000 1.970

(5) Structure of the utilized farming systems: We assume that depending on seasonality, natural conditions and capital/labour intensity, (partial) flexibility differs among the various agricultural products. Specialization on capital-intensive production technologies might influence the farms flexibility negatively

(Mills/Schumann, 1985). Since milk production requires high specific investments and ongoing monitoring, we assume the high share of this product in total agricultural production to be negatively correlated with the farms flexibility. Additionally, milk supplies are expected to have less output variability. On the one hand, 75% of the procured milk in Poland is delivered to producer-based milk cooperatives. The relationships among the co-ops and their milk suppliers are mainly based on long-lasting implicit or explicit contracts (Hanf/Pieniadz, 2007). On the other hand, the investigated period refers to the time before the intensive adjustment to EU-quality standards, and hence structural change via market exit from milk production is set off. On the contrary, focusing on fluctuation-prone productions, such as plant production, is likely to have a positive influence on both flexibility measures.

The diversification of agricultural production was measured by the Berry index. We assume that the more production lines a farm has, the higher is its scope flexibility. One argument provided by Weiss (2001) is that multi-product firms are able to reduce adjustment costs. Another argument derived from the work of Carlson (1989) is that highly diversified farms have more possibilities to combine or rotate crops and livestock, which can stabilize the total farm output and income under uncertainty. The influence on scale flexibility is, however, ambiguous.

Furthermore, we assume that a better quality of production factors can influence flexibility positively. Thus, we include the variable 'land quality' to control for this hypothesis.

The definition of the exogenous variables, including some descriptive statistics, are provided in Table 1.

5. EMPIRICAL RESULTS

In order to take into account the data's panel structure, we analyzed several model specifications. Since the pooled regression provided very low explanatory power, as indicated by the R^2 values, we extended the model to take account of individual effects. The respective statistical tests (Hausmann) reveal that the fixed effect model with farm-specific and time-invariant effects is the appropriate specification (GREEN, 2003). The estimation results are reported in Table 2.

The high significance of the F-test indicates joint significance and confirms the relevance of the variable used in both models. In principle, our hypotheses regarding the impact of farm size (1), as well as the variable representing cost structure (4), and structure of the utilized farming systems (5) for both flexibility measures cannot be rejected. All of the estimated coefficients yielded the expected sign and are highly significant in most cases. Nevertheless, some variables

representing socio-demographic factors (2) and access to additional financial resources (3) require additional comments.

(2) Our findings reveal a significant influence of farm holders' age on their ability to adjust both the aggregate and product-mix output. In both equations, flexibility decreases with the farmers' age. However, particularly in the case of scale flexibility, the relationship seems not to be a linear one, since the estimation provides a significant positive coefficient of variable 'age>65'. One possible interpretation of this result is that, especially with regard to the aggregate output, 'learning by doing' effects by elderly farmers outperform the formal education and youth-connected effects such as being more flexible, progressive and risk-friendly. Another interpretation is that the respective variable (age>65) indicates farmers, though statistically designated as a farm holder, that are actually semi-retired, thus implying that the farm may be in fact run by a younger successor. This would justify the two (or three) generation character of the investigated family type farms. Moreover, we found that succession significantly changes the farms' flexibility. However, our estimates contradict the theoretical considerations. We can, however, deduce some possible reasons for these findings. First, it is likely that due to the gloomy prospects of agricultural business during transition, the most skilled of the potential successors decided upon a career in other sectors. This suggests that those who stayed (or were compelled to stay) on the farm were not the best educated ones to manage and operate a farm. In this context, it would be useful to test for the education effect in future work. Another interpretation would be that due to the traditional family hierarchy, the extent to which the successor might exercise his freedom while managing the farm is somehow restricted; the additional transaction costs of the decision-making process might have impeded flexibility. However, perhaps the most plausible reason is that the successor managed to stabilize the production output, which would result in lower flexibility. Thus, further analyses are needed.

Table 2 Fixed-effect estimates for the scale and scope flexibility models

	Exogenous variables	Dependent variable	
		F_scale	F_scope
(1)	Farm Size	- 0.100*** (0.014)	- 0.098*** (0.023)
(2)	Family size	- 0.018** (0.009)	0.033** (0.014)
	Age	- 0.027** (0.013)	- 0.064*** (0.021)
	Age>65	0.029** (0.013)	0.019 (0.021)

	Gender	0.006 (0.009)	0.002 (0.014)
	Succession	- 0.029*** (0.008)	- 0.048*** (0.013)
	Risk aversion	0.016*** (0.001)	- 0.015*** (0.002)
(3)	Off-farm incomes	0.182*** (0.023)	- 0.120*** (0.037)
	Access to credit markets	- 0.003** (0.001)	0.006*** (0.002)
	Governmental aids	0.002*** (0.001)	- 0.001 (0.001)
(4)	VK: Input ratio	0.121*** (0.019)	0.043 (0.030)
	FK: Leasing costs	- 0.009*** (0.002)	- 0.009** (0.004)
	FK: Labour costs	- 0.047* (0.028)	- 0.073* (0.044)
(5)	Specialization on milk production	- 0.109*** (0.026)	- 0.203*** (0.041)
	Specialization on crop production	0.155*** (0.022)	0.110*** (0.035)
	Berry-Index	- 0.206*** (0.026)	0.486*** (0.41)
	Land quality	0.062** (0.031)	0.059 (0.050)
	F_scale	—	- 0.081*** (0.025)
	F_scope	- 0.018* (0.010)	—
	R^2	0.46	0.36
	F-statistic	5.64*** [579, 3915]	3.86*** [579, 3915]

Note: ***, **, * indicate significance at the 1, 5 or 10 percent level, respectively. Standard errors are given in parentheses. Degrees of freedom for the F-tests are in brackets. N=4496.

(3) Empirical evidence reveals that farms use different sources of additional working capital to adjust their scale and scope of production. This suggests that financial stress might be the major source of stress for family farms in Poland. Scale flexibility is higher if family members provide capital to the business and if the farm has access to governmental aids. Access to capital has the opposite influence on the two flexibility measures. Whereas scope flexibility is positively

influenced by those variables, access to capital markets impedes scale flexibility. One explanation could be different structure and terms of borrowing. For example, long-term borrowed funds (buildings investment) are expected to raise the unit's fixed costs, and hence to decrease the farm's flexibility. On the contrary, short-term credits (i.e., one-year loans for operating resources) are likely to satisfy the flexible capital needs of the farm. The negative sign of the estimates for the Berry Index in the F-scale equation indicates that farms with high scale flexibility are rather specialized ones. This would imply that those farms have to carry higher production-specific investments, and hence are more likely to use long-term borrowing.

CONCLUSIONS

We argue that family farms are a unique style of commerce. And since these farms dominate Polish agriculture, the adjustment ability of this group is a critical part of the success or failure of the whole agricultural sector. Based on farm panel data, we empirically investigated the determinants of Polish farm household flexibility from 1994 to 2001. We focused on output flexibility (adjustment in scale) and product-mix flexibility (adjustment in scope). Our findings reveal that smaller farms are more flexible, both with regard to scale and product mix. This confirms our expectations, that farms enjoy their own advantages irrespective of their size. Whereas small farms seem to benefit from their flexibility (dynamic efficiency), relatively large farms are likely to owe their advantages to economies of scale in purchasing, producing and marketing operations. Farms with a higher share of variable costs but a lower share of leasing costs, and costs of hired labor, tend to be more flexible as well. Producers who specialized in capital-intensive technologies (e.g., milk production) turned out to be less flexible both with regard to scale and scope. Contrary to expectations, farms where a succession took place displayed less flexibility over time. Furthermore, the role of a farmer's age warrants further investigation. Both access to off-farm income and finance have opposite effects on scale and scope flexibility, where the signs for both factors are interchanged. An explanation for these outcomes may be the varying term structure of liquidity sources.

Generally, the investigated farms have undergone a process of uneven change over many years, a process driven by different sets of internal and external factors. We conclude that the observed stability of family farms arises from the fact that they combine production factors (land, labour, capital and management) in a single unit, which seems to reduce the transaction costs of adjustment. However, the findings provide evidence that there exist different factors that enable and limit the farm families' ability to cope with change. This suggests that there are relevant differences in the strategies Polish farmers used to adjust to changing environmental conditions during transition. Forthcoming support policies should take this heterogeneity into account and avoid blueprint thinking when undertaking instrumental design.

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