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# EXPLORING THE FLEXIBILITY OF POLISH FAMILY FARMS DURING TRANSITION

## Abstract

*Based on farm panel data we empirically investigate the determinants of Polish farm households' flexibility from 1994 to 2001. We focus on scale flexibility (adjustment in production volume) and scope flexibility (adjustment in product mix). The findings of our fixed-effects regression provide evidence that smaller farms are more flexible, both with regard to scale and scope of production. Farms with a higher share of variable costs tended to be more flexible, while producers who specialized in capital-intensive technologies turned out to be less flexible. Some results differ significantly from the prevailing expectations, in particular we found that farms where a generational succession took place displayed less flexibility over time. Moreover, access to off-farm income and finances have opposite effects on scale and scope flexibility. An explanation for these outcomes may be the varying term structure of liquidity sources. There are relevant differences in the strategies Polish farmers used to adjust to changing environmental conditions during transition, which should be taken into account in the design of supporting policies.*

## 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, labor 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, and leading to structural change in the whole agricultural sector.

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. At the same time, family labor is likely to widely satisfy the flexible manpower needs of agriculture. Access to additional resources of land, capital and labor 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 farms 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 [21]. 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 economic and socio-demographic 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.

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, are 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.

## 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, labor, operating recourses) and socio-demographic variables (i.e. age and gender of the head of the household, farm succession, participation on labor 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 for 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.

## Flexibility measures

Researchers have been interested in firm's flexibility, since its notion has been first introduced by Stigler [25]. From that time on the breadth and diversity in the understanding of the subject increased leading to evaluation of different flexibility concepts in the current literature, some of which address flexibility of production factors, outputs, organizational structures etc. [2, 3, 23]. Moreover, flexibility may be evaluated by different kinds of measures [10, 20]. However, even if there is no exhaustive or particularly comprehensive framework to facilitate the analysis of farm's flexibility, a common issue for all of those concepts is that they refer to the ability to respond to change, and they point to the use of flexibility to accommodate uncertainty, such as the altering conditions on both the factor and product markets. In our analysis, we assume that the organizational flexibility of a farm (resource and coordination flexibility) manifests itself in the variation in farm's output. Thus, in following we focus on output measures and differentiate between (1) scale and (2) scope flexibility.

**(1)** We define the *scale flexibility* as the ability of the farm to adjust the *production volume* to changes in its environment [28]. In order to account for farm's adjustments over time we applied a variance based index, as proposed by [28]. Thus,

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

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 [28]; 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 [11, 12].

**(2)** *Scope flexibility* is the ability of farms to adjust their *product-mix* by changing market conditions, to switch easily to production of other commodities [20, 27]. Several measures can be applied to quantify the extend of changes in production scope over time. In our analysis we applied two measures based on commonly used indices of structural change: the Michaely-Stoikov index and the Lilien index [4, 17].

The first index, proposed by Michaely [18] and Stoikov [26], measures a sum of absolute structural changes within a farm and between two time periods and is defined as follows:

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

where $s_{jit}$ is 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_MS

index based on 14 agricultural products, which we identified in the provided data set. The advantage of this measure is its simplicity of calculation [24]. Additionally, the index takes values between 0 and 2, and hence is easy to interpret. However, since the index is based on absolute and not relative changes, it disregards the unequal distribution of products within the total farm production and hence the growth/decline rates. For example, strong absolute changes of a small number of products are given the same weights as small absolute changes of a large number of products [17]. Thus, as far as deep changes in the structure of agricultural production of a farm are considered, the index may provide biased results concerning the scale of its restructuring.

Thus, we applied an additional index for the scope flexibility as proposed by Lilien [16]. With current-period shares of products $s_{jit}$ as weights, the Lilien-index is defined as follows:

$$F\_scope\_L_{it} = \sqrt{\sum_{j=1}^{J} s_{jit}\left[\ln\left(q_{jit}/q_{ji(t-1)}\right) - \ln\left(Q_{it}/Q_{i(t-1)}\right)\right]^2} \quad .$$

This index measures output dispersion by taking a weighted standard deviation of product share changes (shifts) relative to aggregate output changes. One property of the index is, that farms, which specialised in a production line (high value of $s_{jit}$) are treated differently in the calculation of F_scope_$L_{it}$ (provide higher index values) than farms with highly diversified agricultural production, provided that there are changes over time ($\Delta s_{ij} > 0$). The disadvantage of this measure is that $q_{jit}$ have to take a positive value.[1] The Lilien index satisfies the most important criteria of structural change indices defined by Stamer [24].

The descriptive statistics of scale flexibility measure and both indices of scope flexibility are provided in Table 1. Additionally, we were interested, how the characteristics of those measures change over time. Thus, we applied kernel density plots to illustrate the distribution of the respective measures in two years: at the beginning and at the end of the investigated period. Figures 1-3 show the respective plots and their shifts (changes) over time. The mean of the scale flexibility increased from 0.043 in 1995 to 0.085 in 2001 indicating slightly increasing ability of an average farm in the data set to adjust its production scale to the operational environment. However, considering the other years it turns out, that this trend has been visible only since 1999. On the contrary, both distributions of the scope flexibility shifted to the left over the time (Figure 2-3): The average scope flexibility, measured by Michaely-Stoikov index, has reduced slightly (from 0.30 in 1995 to 0.28 in 2001); in the case of Lilien index the changes were stronger, since the mean decreased from 0.53 to 0.35 over the investigated period. Moreover, the dispersion of the farm specific flexibilities grew in the investigated period. This was indicated by both, the increasing variance and coefficient of variation for all flexibility measures during this period. The findings confirm our previous statements regarding increasing heterogeneity and polarization in the investigated sample.

[1] Thus, in order to avoid calculation problems we added a constant a = 0.00001 to $g_{ij}$.

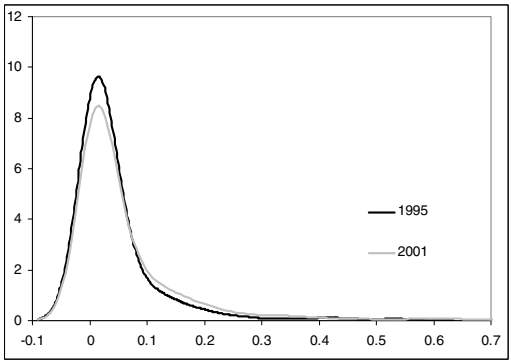


**Fig. 1**. Kernel of the scale flexibility in 1995 and 2001
Source: Own calculations based on IERiGŻ-PIB data set.

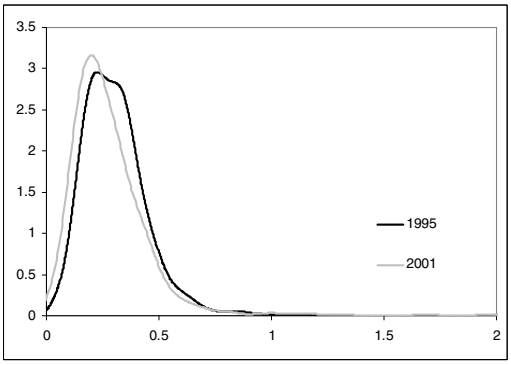


**Fig. 2**. Kernel of the Michaely-Stoikov index in 1995 and 2001
Source: Own calculations based on IERiGŻ-PIB data set.

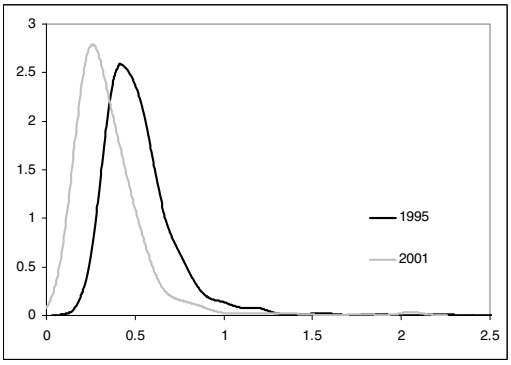


**Fig. 3**. Kernel of the Lilien index in 1995 and 2001
Source: Own calculations based on IERiGŻ-PIB data set.

## 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 [19], we argue that small farms use production technologies that are more flexible than those chosen by large farms. Thus, small farms have an offsetting advantage in their deeper and quicker responsiveness to environmental changes. On the contrary, large farms – 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 [3, 9]. Additionally, large farms might be better integrated in the whole supply chain. First, this implies a higher capital intensity due to specific investments needed to meet the requirements regarding the quantity and quality of the purchases. 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 [22] 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 risk. For example, the behavior 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 [6] 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 [28, 29]. Our assumptions neglect the impact of experience on upgrading qualifications [1]. However, given the drastic changes in the economic and institutional environment during transition, it can still be expected that formal education will 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 [6]. 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. We assume that 'succession' has a positive effect on farm flexibility [6] and Weiss [28]. 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' to 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 [6]. 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 the access to external sources of production factors might help them meet the changing demand [6]. 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 aid. However, while the sources of the capital inflows are different, their influence is 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 funds, and hence benefit from additional capital flows [21]. 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 [19] and Carlson [3], 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 costs 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 farms 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, the costs of other production factors not owned by the family farm, such as lease rent or remuneration of hired work, influence the fixed costs in the middle term, since the factors must be remunerated irrespective of the annual supply/demand fluctuations. Following Pollak [22], we argue that hired labor costs particularly might influence the cost position of a farm, since hired labor requires more monitoring, supervision and control efforts than family labor. Thus, we expect

both variables, 'leasing costs' and 'labor costs', to have a negative influence on farm flexibility.

**(5) Structure of the utilized farming systems**: We assume that depending on seasonality, natural conditions and capital/labor intensity, (partial) flexibility differs among the various agricultural products. Specialization on capital-intensive production technologies might adversely affect the farms flexibility [19]. 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 [13]. 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 [28] is that multi-product farms are able to reduce adjustment costs. Another argument derived from the work of Carlson [3] 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 definitions of the exogenous variables, including some descriptive statistics, are provided in Table 1.

Additionally, we conduced multicolinearity diagnostics to identify possible multicollinearity problems. Multicollinearity refers to the existence of one or more approximate linear relationships among the independent variables and can impact negatively the reliability of the regression estimates [14]. On account of this, we proved the multicollinearity by studying the simple correlations among regressors. The results provided, that there is no evidence of any strong bilateral interrelation among the candidate predictors; the highest correlation coefficient of 0.48 provided the variables 'Age' and 'Age>65'. Since bilateral correlations are not sufficient measures for identifying more complex interrelationships among many variables, we used additionally the variance inflation factor (VIF) as proposed by Judge et al. [14].[2] Indeed, also this statistics indicated no strong linear relationships among the independent variables.

[2] Variance inflated factor is a diagnostic statistic, defined for each variable as $VIF_k = 1/(1-R^2_k)$, where $R^2_k$ is the squared multiple correlation of the variable with the other independent variables. If any VIF exceeded 10 there is a multicollinearity problem.

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-agric. 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 aid | 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, in percent | 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: Labor costs | Share of hired (permanent+ seasonal) labor hours in total agricultural labor 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, $BI = 1 - \Sigma(s_{jit})^2$, calculated on basis of 14 typical agricultural products; $s_{jit}$ 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_MS | Scope flexibility, measured by Michaely-Stoikov--Index | 0.243 (0.171) | 0.000 1.970 |
| | F_scope_L | Scope flexibility, measured by Lilien Index | 0.342 (0.233) | 0.000 3.158 |

Source: Own calculations based on IERiGŻ-PIB data set.

## Estimation and 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-test) reveal that the fixed effect model with farm-specific and time-invariant effects is the appropriate specification [8]. 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 the three 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 all three 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) As regards socio-demographic factors, our findings reveal a significant influence of farm holders' age on their ability to adjust both the aggregate and product-mix output. In all three equations flexibility decreases with the farmers' age. However, particularly in the case of scale flexibility, the relationship does not seem 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 farm holders, that are actually semi-retired, thus implying that a 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 assumed that succession significantly increases 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 in this respect.

Table 2

**Fixed-effect estimates for the scale and scope flexibility models**

| | Exogenous variables | Dependent variable | | |
|---|---|---|---|---|
| | | F_scale | F_scope_ML | F_scope_L |
| (1) | Farm Size | - 0.081***<br>(0.014) | - 0.097***<br>(0.023) | - 0.251***<br>(0.032) |
| (2) | Family size | - 0.013<br>(0.009) | 0.034**<br>(0.014) | 0.059***<br>(0.020) |
| | Age | - 0.030**<br>(0.013) | - 0.064***<br>(0.021) | - 0.206***<br>(0.030) |
| | Age>65 | 0.028**<br>(0.013) | 0.019<br>(0.021) | 0.044<br>(0.030) |
| | Gender | 0.004<br>(0.009) | 0.002<br>(0.014) | 0.010<br>(0.020) |
| | Succession | - 0.035***<br>(0.008) | - 0.049***<br>(0.013) | - 0.143***<br>(0.018) |
| | Risk aversion | 0.012***<br>(0.001) | - 0.015***<br>(0.002) | - 0.023***<br>(0.003) |
| (3) | Off-farm incomes | 0.147***<br>(0.023) | - 0.123***<br>(0.037) | - 0.290***<br>(0.053) |
| | Access to credit markets | - 0.003***<br>(0.001) | 0.006***<br>(0.002) | 0.003<br>(0.003) |
| | Governmental aids | 0.001**<br>(0.001) | - 0.001<br>(0.001) | - 0.004**<br>(0.002) |
| (4) | VK: Input ratio | 0.183***<br>(0.015) | 0.039<br>(0.023) | 0.083**<br>(0.034) |
| | FK: Leasing costs | - 0.009***<br>(0.002) | - 0.009**<br>(0.004) | - 0.014***<br>(0.005) |
| | FK: Labor costs | - 0.047*<br>(0.027) | - 0.073**<br>(0.044) | - 0.217***<br>(0.062) |
| (5) | Specialization on milk production | - 0.109***<br>(0.026) | - 0.205***<br>(0.041) | - 0.349***<br>(0.059) |
| | Specialization on crop production | 0.159***<br>(0.022) | 0.107***<br>(0.034) | -0.103**<br>(0.049) |
| | Berry-Index | - 0.203***<br>(0.025) | 0.486***<br>(0.041) | 0.393***<br>(0.059) |
| | Land quality | 0.050<br>(0.031) | 0.058<br>(0.050) | 0.063<br>(0.071) |
| | F_scale | — | - 0.085***<br>(0.026) | 0.015<br>(0.037) |
| | F_scope_MS | - 0.021**<br>(0.010) | — | — |
| | $R^2$ | 0.47 | 0.36 | 0.31 |
| | F-statistic | 6.00***<br>[579, 3916] | 3.87***<br>[579, 3916] | 3.09***<br>[579, 3916] |

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 square brackets. N=4496.

Source: Own calculations based on IERiGŻ-PIB data set.

(3) As regards the access to additional financial resources, the empirical evidence reveals that farms use different sources of additional working capital to adjust their scale and scope of production. This suggests that financial problems 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 aid. Access to capital has the opposite influence on the scale and scope flexibility measured by the Michaely-Stoikov index and non-significant influence on the scope flexibility measured by the Lilien index. 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 unitary 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 out higher production-specific investments, and hence are more likely to use long-term bank credits.

## Conclusions

We argue that family farms are a unique style of activity. And since these farms dominate in Polish agriculture, the adjustment ability of this group is a critical part of the success or failure of the whole agricultural sector. On the basis of 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. A less clear-cut picture emerges for the role of socio-demographic factors. Contrary to expectations, farms where a succession took place displayed less flexibility over time. Furthermore, the impact of a farmer's age and education requires 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 profound 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, labor, 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 either enable or limit the farm families' ability to cope with change. This suggests that there are relevant differences in the strategies adopted by the Polish farmers 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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