

Competitive advantages and disadvantages of agriholdings and independent farms – a case study from Ukrainian arable production

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ABSTRACT

This article analyses the competitive advantages and disadvantages of agriholdings and independent farms in Ukrainian arable production using expert-based focus-group discussions and comparing typical farms with a cost-of-production approach. Agriholdings were found to have strong competitive advantages in access to and cost of capital, as well as more favourable input and output prices. On the other hand, they are less efficient, with lower yields and higher overhead costs than top-performing independent farms. At the bottom line, typical well-performing independent farms were found to generate a higher return to land than typical agriholding member farms of the same size. If agriholdings can overcome their efficiency challenge, the economic gap may close in the future. A likely way to accomplish this was found to be decentralization and strengthening of farm-level management.

KEYWORDS: agriholdings; corporate farming; competitiveness; transition agriculture; typical farms

1. Introduction

After the collapse of the socialist economic system, agriculture in the three large countries of the former Soviet Union – Kazakhstan, Russia and Ukraine – entered a severe crisis, with production declining throughout most of the ensuing decade. However, starting in the late 1990s, the trend in arable production has reversed and the region has transitioned from a net importer to a net exporter (Liefert and Liefert, 2012). Much of the revitalization of arable farming in the three countries can be attributed to the investment activities of agriholdings. Agriholdings are farming companies made up of multiple operations under a more or less centralised management. In Ukraine, the development of agriholdings has been very pronounced (Byerlee *et al.*, 2012).

During the farm crisis in the 1990s, a considerable part of Ukraine's farmland fell out of production (UKR-STAT, various) because a large number of insufficiently restructured former cooperative and state farms (*kolkhozy* and *sovkhosy*) lacked the liquidity to work the land (Liefert and Liefert, 2012). Hence, the demand for farmland was not particularly high in the past and competition for it was weak. Today, land rents in Ukraine are still very low in comparison with other regions with comparable productive potential (Byerlee *et al.*, 2012).

In addition, until January 1, 2017, a moratorium banned sales of agricultural land. Since its implementation in 2001, national and international investors found ways to circumvent the moratorium – e.g. by buying shares of agricultural companies (The Oakland Institute, 2015). With the ongoing tensions through the Ukraine conflict, it is difficult to forecast to what extent foreign investments into large-scale Ukrainian agriculture will continue. In 2014, the land consolidation of large agriholdings had slowed due to the global and geopolitical environment (UCAB, 2014).

In order to assess which of the two organizational forms will be more competitive in the future, two questions arise: Which factors drive the competitiveness of both organizational forms, and how great are their respective effects?

This article is structured as follows: First, a short overview of agricultural development since 1990, including crop and animal production, and statistical background information about farm structure in Ukraine is given. A literature review of competitive advantages and disadvantages of corporate farming follows. Next, the methodology and data sources are presented. Finally, competitive disadvantages and advantages of agriholdings based on focus group discussions and typical-farm data are discussed. Conclusions drawn from the analysis are presented in the last part of the article.

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2. Development of agricultural production and farm structure in Ukraine

Development of agricultural production

Figure 1 shows the development of Ukrainian agricultural production for selected crops from 1990 to 2014. One can observe a sharp decline in grain and leguminous crop production in the first years of the 1990s, recovering in the late 1990s and developing a substantial upward trend since 2003, surpassing the level of 1990 in 2011 with production of 56.47 million metric tons. Sugar beets have played a substantial role in Ukrainian crop production but did not recover to the same extent as grain or

leguminous crops. The production of potatoes and vegetables was more or less stable compared with grains, leguminous crops and sugar beets. Apparently, the cultivation of these products has not been affected to the same extent by the restructuring of Ukrainian agriculture.

Similar to plant production, the first post-soviet years in Ukraine were marked by a decline in animal production (Figure 2). Cattle, swine, sheep and goats and poultry stocks showed a significant drop until the late 1990s. As the bars in the graph (right axis) show, poultry production recovered beginning in 2001. Numbers of swine and sheep and goats (left axis) stabilized 10-15 years ago.

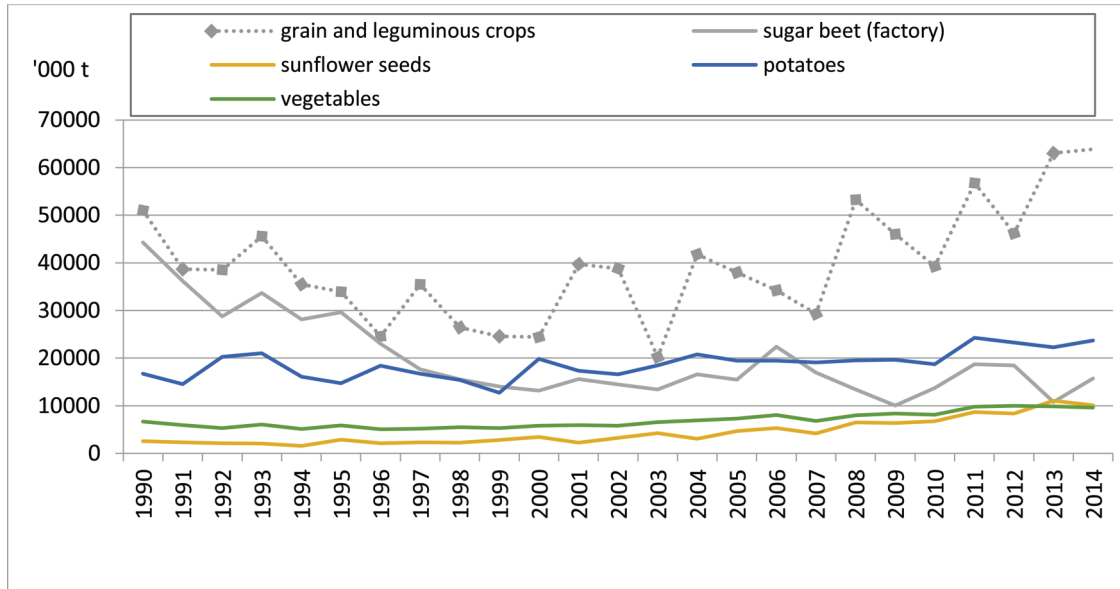


Figure 1: Development of arable production in Ukraine (1990-2014)
 Source: UKRSTAT, 2014.

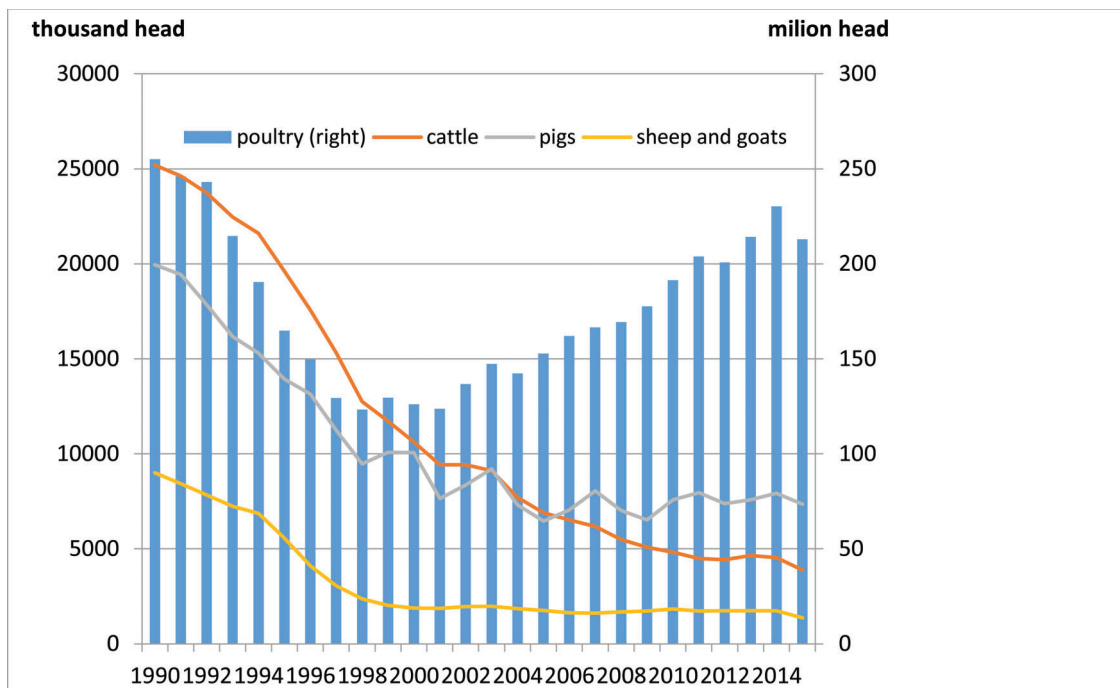


Figure 2: Development of animal production in Ukraine (1990-2014)
 Source: UKRSTAT, 2014.

The continued decrease in cattle numbers was observed in many Central and Eastern European (CEE) countries and is mainly based on a drastic reduction of the dairy herd. The dairy sector in Ukraine still has not consolidated and restructured.

Farm structure in Ukraine

The official Ukrainian statistics distinguish between household and agricultural enterprises, of which private farms account for three quarters of the total (Table 1). State farms, agriholdings and independent agricultural enterprises represent the balance (UKRSTAT, various).

Private household production (“households”) played a considerable role during Soviet times, when households accounted for a major share of the production of meat, milk, eggs, fruits, vegetables and potatoes. Since 1991, their importance for these products has hardly decreased (Lapa *et al.*, 2010, Moroz 2013), and households have also gained importance in the production of arable crops such as grains and oilseeds. In 2014, households held a 44.7% share of gross agricultural production and farmed roughly 15.1% of Ukrainian agricultural land. Almost 99% of private households farm less than 10 ha (Lapa *et al.*, 2010). While household use plays an important role, they often also sell a portion of their production.

Linkages between households and commercial farms are manifold. Village dwellers often are part of the commercial farms’ labour force, buy livestock feed from their employers or receive some of the feed for the households’ animals as in-kind land rent (Koester and Striewe, 1999). In addition, empirical findings from Mamonova (2015) indicate large farming enterprises assist private households with fieldwork operations and social services.

Private agricultural enterprises and agriholdings are included in the category of non-state farms. Independent agricultural enterprises are commercial farm businesses with employed labour and, typically, employed management. This farm segment is very heterogeneous. It contains the successors of the former collective and state farms, which often are in dire economic straits. On the other hand, it also contains economically successful, restructured operations. Agricultural enterprises produced 55.3% of production in 2014, had an almost 60% share of

crop production and a share of 49.5% of total agricultural land. According to Balmann *et al.* (2013), agriholdings account for a high share of the production of sunflowers, wheat, rapeseed, soybeans, corn, sugar beets, pork and poultry.

3. Competitive advantages and disadvantages of corporate farms in Ukraine

The development of agriholdings and large-scale farming operations that has been observed in many Eastern European countries was not expected by many Western European agricultural economists. Rather, the development of smaller family farms was anticipated (World Bank, 1992). Most studies explain the phenomenon with factors specific to transition economies.

A number of authors use economies of scale as part of their explanations for the development of agriholdings in Kasakstan, Russia and Ukraine (e.g., Zimmermann, 2004; Wandel, 2007; Demyanenko, 2008). However, the size of many agriholdings far exceeds the sizes at which relevant economies of scale are expected based on the experience in other countries.

Visser *et al.* (2012) suggests land speculation as a possible reason for the massive accumulation of agricultural land (“land grabbing”) by agriholdings in Russia. According to this explanation, investors buy agricultural land in the expectation of future appreciation in value.

The next group of explanations for the development of agriholdings refers to political economic factors. Gataulina *et al.* (2005) point out that the development of agriholdings in Russia was strongly supported by the authorities through the provision of credit, property or certain privileges. Another example is tax privileges (Hockmann *et al.*, 2005). In some Russian regions, the state even invested directly in agriholdings (Gataulina *et al.*, 2005). There also is evidence that in Russia, large agribusiness companies were actually pressured to invest in primary agriculture (Rylko and Jolly, 2005). Balmann *et al.* (2013) state that agriholdings can better adapt to existing deficits in the economic environment of Ukrainian agriculture.

Table 1: Farm structure in Ukraine

	Total	Agricultural enterprises				Households
		All	Portion that are state farms	Share that are non-state farms		
				All	Portion that are private farms	
Number of agricultural enterprises		52,543	228	12,887	39,428	4,136,800
Gross agricultural production in 2014 (in 2010 prices, %)	100.0	55.3	0.9	54.4	7.6	44.7
Gross crop production in 2014 (in 2010 prices, %)	100.0	59.4	1.0	58.4	10.0	40.6
Gross animal production in 2014 (in 2010 prices, %)	100.0	45.5	0.6	44.9	1.8	54.5
Agricultural land (thousand ha)*	41,511,7*	20,548,9	943,6	19,605,3	4,707,7	6,296,5
Arable land (thousand ha)*	32,531,1	19,293,4	780,7	18,512,7	4,543,2	5,424,7

*Difference between ‘total’ and ‘ag. enterprises’ + ‘households’ is ‘other users’, such as local communities, etc.

All statistical data providing information on the results of the year 2014 and later reflect the part of Ukraine’s territory that is not occupied and annexed; i.e., data do not include Crimea and occupied parts of Donetsk and Lugansk regions.

Source: UKRSTAT, 2014.

Another reason to explain the prevalence of agriholdings is market failure. Strubenhoff (2011) found the market for capital to be particularly underdeveloped in Ukraine. Agriholdings were found to have considerably better development options than traditional farms because they have the means to establish international accounting and auditing systems that reduce lenders' risk. Further, they can access international capital markets (Strubenhoff, 2011).

A serious problem in Ukraine in the past has been the lack of contract enforceability and practically no security of private property rights (Thiel, 2002). Another important set of market-supporting institutions is the standardization of goods and services, as well as quality assurance and control systems. In this field, Ukraine has a particular disadvantage (Lapa *et al.*, 2010). The authors consider the system of quality and safety as one of the weakest points in Ukrainian agribusiness. Agriholdings therein are seen as a way to save transaction costs (Koester, 2003; Hockmann *et al.*, 2005). Vertical integration between supply and processing is the most important way to decrease such transaction costs.

Another explanation offered for agriholding development assumes that they aim at gaining and increasing market power (Khanna and Yafeh, 2007, FAO, 2009). Some authors explain the persistence of large farms via the long history of large-scale farming in Russia and Ukraine and a positive attitude toward this farm type (Mamonova, 2015, Koester and Petrick, 2010, Hockmann *et al.*, 2005).

Concerning the competitive advantages and disadvantages of agriholdings compared with independent commercial farms, only a few scientific studies exist. An early study from Gorton and Davidova (2004) measuring the productivity and efficiency of corporate farms versus family farms in selected CEE countries, found no significant difference between those farm types.

One study about the profitability of six crops grown in agriholdings (>10,000 ha) and independent farms (<10,000 ha) is provided by Byerlee *et al.* (2012) using accounting data and estimates from the Ukrainian Agribusiness Club. For all crops except one, their figures indicate lower profitability of agriholdings – in three cases, almost by 50%. Using farm-level accounting data for the period 2008–2012, Balmann *et al.* (2013) found that agriholdings did not exhibit a significantly higher or lower efficiency than independent enterprises. The authors also found that efficiency of agriholdings increased over the years through more intensive practices.

Regarding future adaptations of the organizational forms, one group of authors reflected on the future of agriholdings. Rylko and Jolly (2005) as well as Rylko *et al.* (2008) point out the managerial dilemmas faced by agriholdings in Russia: The management typically has a strong top-down approach, as is customary in the industries from which the decision makers come. This approach conflicts with the requirements of arable farming, where short-term expert decisions are needed at individual operations. However, delegating management responsibility to the local level can quickly lead to losses from local mismanagement and abuse of freedoms.

The results related to the competitiveness of agriholdings in comparison with independent farms are quite limited and inconclusive. More research is needed that compares these organizational forms. So far, no empirical

approaches that involved farm business decision makers have been used.

4. Methodology and data

Several determinants influencing the competitiveness of agricultural enterprises have been analysed in the past (Schaper and Theuvsen, 2011). No single definition or technique defines competitiveness in agriculture. A number of studies in agricultural economics explain the competitiveness of farms taking into account cost of production and framework conditions using survey or accounting data (Schaper and Theuvsen, 2011).

For the competitiveness of Canadian agribusiness, Martin *et al.* (1991) defined competitiveness as the sustained ability to profitably gain and maintain market share. In this article, competitiveness shall be defined as a farming enterprise's sustained ability to profitably expand and maintain its share in cultivated farmland area. Therefore, a suitable quantitative indicator of competitiveness is the return to land that a business generates. This indicator reflects the maximum land cost a business could afford in the longer run – either in the form of land rents or the opportunity costs of owned land – without resulting in economic losses.

Due to a lack of detailed and reliable farm-level data in Ukraine, exploring competitive advantages and disadvantages of agriholdings is a challenge. Therefore, 'typical farms' have been established following the typical farm approach described by Zimmer and Deblitz (2005), and similar to the concept of representative farms (Sharples, 1969; Nuthall, 2011). These have been adapted to Ukrainian framework conditions. The typical farm approach utilizes the expert knowledge of farm decision makers and farm advisors to establish, validate, and explain typical farms – farm-level datasets that have a case-study character. A typical farm represents a stringently defined sub-group of a total farm population (Nuthall, 2011). It is defined by attributes such as size, combination of enterprises, production systems, management performance, yield level, input intensity, etc. (Zimmer and Deblitz, 2005).

Three steps were undertaken to establish the typical farms and determine their economic advantages and disadvantages:

- (1) In the first round, a series of face-to-face interviews were held, in which farm data and qualitative assessments were collected. These interviews were conducted with agriholding and independent farm managers. Additionally, agribusiness representatives and external scientists/analysts were included in this round to contribute information where the other participants lack knowledge.
- (2) In the second round, two separate focus-group discussions were held – one with agriholding managers and one with independent farm managers. In this round, the typical farms and the participants' qualitative assessments about competitive advantages and disadvantages of both organizational forms were validated and completed.
- (3) In the third round, a single focus group with both the independent farms and agriholding managers was held. The qualitative and quantitative results were further validated and future adaptations were considered. The scope of the analysis is arable farming only.

Research region and case-study design

The research region selected to conduct face-to-face interviews and focus-group discussion was selected according to the following criteria: All typical farms are in the same region; the region is homogeneous regarding the importance of arable production, the prevailing production systems and the existence of both organizational forms. Thus, results are not representative for the whole country, but have more of a case-study character. Nevertheless, the approach allows exploration of major competitive differences between the two organizational forms.

The region selected comprises the entire Oblast Vinnitsa and adjacent parts of Cherkasy and Kiev. The oblast is the term for the 24 administrative units in Ukraine, similar to a region. This region is one of the core regions of arable production in Ukraine. In 2010, agriholdings accounted for 37.5% of arable land use in Vinnitsa, 17.5% in Kiev, and 28.5% in Cherkasy (Lapa *et al.* 2010). While there are no statistics on the share of restructured independent farms in the area, the panel participants reported that the region is one where structural change has been going on longer than in other parts of Ukraine and therefore the share of progressive farms is relatively high. A likely reason is that the yield potential in the area is high compared with other regions, leading investors to arrive early in the region. It has fertile and productive Chernozem soils. Chernozem soils, or black earth soils, are typically found in the long-grass steppe regions of the world.

Managers of four independent farms and just one agriholding participated in the panel process. Four typical farms were established: One agriholding with 2,000 ha and one with 10,000 ha; one independent farm with 2,000 ha and one with 10,000 ha. The unit of reference in the analysis is the single farm.

The agriholding operations have overhead costs from the central organisation allocated to them. The smaller typical farms reflect the farm size that accounts for most of the arable land in Ukraine. The larger ones, on the other hand, reflect a farm size at which the panel participants considered most economies of scale at the farm level to be fully utilized.

The typical independent farms represent restructured independent farms (as opposed to small family farms or non-restructured collective farms). The panel process revealed the managers of the independent farms represented top performers among their peers. This is important to keep in mind when interpreting the results.

5. Results

Differences in key economic cost and return elements

During the three rounds of face-to-face interviews and focus groups, all participants (including the agribusiness representatives and external experts) were asked what they consider to be the most important competitive advantages and disadvantages of agriholdings and independent farms. For agriholdings, competitive advantages were stated to include better and cheaper access to capital. Both organizational forms have access to bank loans in Ukraine's national currency, supplier financing for variable inputs and machinery financing. Agriholdings also have access to considerably cheaper bank loans in foreign currency and loans by the European Bank for Reconstruction and Development (EBRD). Further, they can access equity capital via international private equity and/or stock market capital. While smaller independent farms cannot access these cheaper sources of



Map 1: Oblasts in Ukraine
Source: Author illustration.

capital, large independent farms, in some cases, can establish the conditions to access foreign currency loans or even EBRD loans. However, even they usually cannot access international private equity or stock market capital. Agriholdings also receive more favorable terms in input purchases and output sales. This primarily stems from negotiating power thanks to the large volumes they turn over.

Competitive disadvantages of agriholdings were said to include lower efficiency than independent farms. Their yields are lower than those of the independent farms, by more than would be warranted by their less intensive system. The following reasons for this were given by the focus group participants: (a) The typical agriholding farms currently have less capable farm managers than the participating top-performing independent farm managers. (b) Agriholdings have longer decision chains and more standardized processes, which makes them less flexible. (c) The participating agriholding has grown extremely rapidly over the past year (which is typical in this organisational form). Finally, (d) it is more challenging to control theft, fraud and corruption at agriholdings than at independent farms. Another competitive disadvantage of agriholdings is the costs incurred by their central organization, which appear as overhead costs.

In addition to these competitive advantages and disadvantages, a number of factors were indicated but not conclusively confirmed:

- Although both organizational forms need to be locally politically connected, agriholdings derive competitive advantages from political clout, especially at the regional and national levels.
- Agriholdings can suppress competition in the land market and thereby have better and cheaper access to land than independent farms.
- Highly capable farm managers have a preference to work at independent farms, because they have more decision-making authority and fewer bureaucratic constraints.

The competitive advantages and disadvantages of agriholdings were quantified during the process. Table 2 illustrates key differences in cost and return components between the two organizational forms.

Economic performance of the typical farms

The typical-farm models established in the three-round focus-group process allowed calculation of returns, cost of production and the return to land of the typical farms as indicators for economic competitiveness.

As can be seen in Figure 3, the total costs of both typical independent farms are higher than those of both typical agriholding farms. Within the organizational forms, the larger operations have lower costs per hectare than the smaller ones. The total revenues of the typical independent farms are higher than those of the typical agriholding farms, thanks to their higher yields, with the large typical independent farm having slightly higher revenue than its smaller peer thanks to its output price advantage of 5 USD/t. The output price advantage of the typical agriholding farms is not sufficient to compensate for their lower yields.

The graph differentiates among cash cost, depreciation and opportunity cost. This provides information on the endurance of the farms, especially in times of crises. A high share of opportunity costs indicates stability, as an owner can temporarily (or even permanently) decide to forego (part of) the remuneration for his own factors of production without liquidity problems. The small independent farm has the highest opportunity costs because it has the highest equity ratio. In some cases, such smaller independent farms also have owner-managers. If this is the case, the remuneration of the farm manager (45 USD/ha), which currently is included in cash costs, becomes part of opportunity cost instead. This also may be the case at larger independent farms. In our example large independent farm, this cost factor amounts to 25 USD/ha.

Generally, opportunity cost is the calculated cost for all owned factors of production – namely, capital, labour/management, and land. However, the typical farms all rent their land and therefore have no corresponding opportunity cost. Further, the calculations with the typical farms were based on employed labour and management only, and therefore also have no opportunity cost for those factors of production. Hence, opportunity costs only for equity capital appear in the calculations.

Table 2: Key components for cost and return differences between agriholdings and independent farms

	Typical farms	Difference in cost or return component
Price advantage, machinery	10F vs. 2F	-5%
	AH vs. 2F	-15%
Price advantage, pesticides	10F vs. 2F	-3%
	AH vs. 2F	-10%
Price advantage, fertilizer	10F vs. 2F	0%
	AH vs. 2F	-5%
Price advantage, seeds	10F vs. 2F	-2%
	AH vs. 2F	-7%
Price advantage, outputs	10F vs. 2F	+5 USD/t
	AH vs. 2F	+10 USD/t
Yield disadvantage	AH vs. FA	-24%
Agriholding overhead costs	2H	+35 USD/ha
	10H	+25 USD/ha
Land cost	FA	62-65 USD/ha
	AH	62-65 USD/ha

Note: “2F” = 2,000 ha typical independent farm, “10F” = 10,000 ha typical independent farm, “2H” = 2,000 ha agriholding farms, “10H” = 10,000 ha agriholding farms, “AH” = typical agriholding farms, “FA” = typical independent farms. Yield disadvantage is average over all crops. Where ranges are shown, the figures differ between the small and large farms within the respective organizational form.

Source: Author's data.

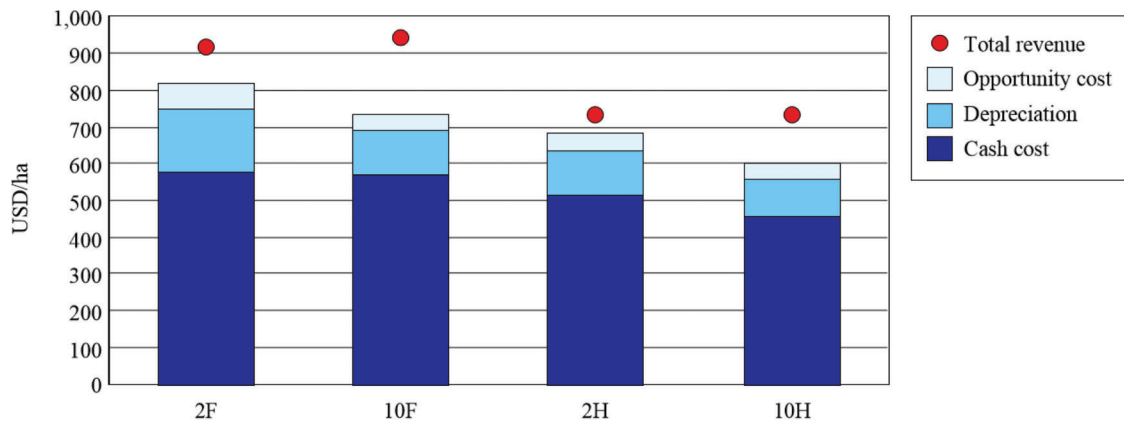


Figure 3: Total costs and revenue of the typical farms (average over all crops, USD/ha)
 Note: “2F” = 2,000 ha typical independent farm, “10F” = 10,000 ha typical independent farm, “2H” = 2,000 ha typical agriholding farm, “10H” = 10,000 ha typical agriholding farm.
 Source: Own illustration.

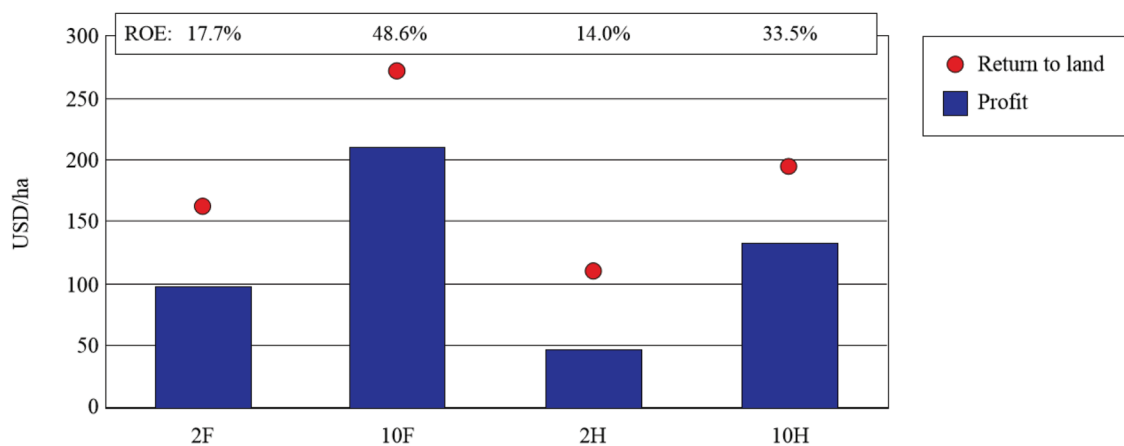


Figure 4: Return to land (USD/ha), profit (USD/ha) of the typical farms
 Note: “2F” = 2,000 ha typical independent farm, “10F” = 10,000 ha typical independent farm, “2H” = 2,000 ha typical agriholding farm “10H” = 10,000 ha typical agriholding farm.
 Source: Own illustration.

Figure 4 shows the economic performance of the typical farms. The key quantitative indicator of competitiveness in arable farming is return to land. As can be seen, this indicator is highest at the large independent farm; the second highest is achieved by the large agriholding farm. The 2,000 hectare farms achieve lower returns to land than the larger typical farms. The typical independent farm has again a higher return to land than the typical agriholding farm. Hence, the size of the operations has a greater impact on their return to land than the organizational form. The profits per hectare of the typical farms also are shown. They demonstrate the same ranking, at a lower level, as profit is return to land less land cost.

Further, the returns on equity of the typical farms are provided in text at the top of the graph. Their ranking is the same as the profit ranking, although factors other than profit play a role in this measurement – namely, the different capital structures and debt interest rates of the typical farms. The large independent farm not only has the highest profitability, it also has the highest debt ratio in its long-term capital. This provides leverage that increases the return on equity.

Overall, it can be stated that arable farming in Ukraine has been a very profitable investment for the analysed farm populations in the 2008-10 period, especially for larger farms within both organizational forms.

Future adaptations of agriholdings and independent farms

In the third round of focus group discussions, likely future adaptations of both organizational forms to maintain and increase their competitiveness were studied qualitatively. The following strategies of agriholdings were obtained by the participants. Consolidating the business by increasing the size of individual operations; taking unprofitable land or whole operations out of production; focus the umbrella organisation on its core functions and de-centralize management. This includes increasing the payment and incentivization of farm managers and taking measures to train or, if unsuccessful, replace them. As a result, a reduction in overhead costs and higher efficiency, especially at the farm level, is expected. Finally, it was also pointed out that agriholdings might take complexity out of their businesses, thereby reducing the management requirement. This could be done by simplifying crop rotations, as well as using larger machines and fewer workers.

In the case of independent farms, the following strategies were pointed out: Independent farms might found cooperatives in the future to fulfill certain tasks – especially purchases and sales – which the central organization fulfills at an agriholding. They also might consider diversification into specialty crops (such as vegetables) or

livestock production as a growth alternative of choice if expanding their arable land becomes more difficult because of high land prices or difficulty in competing for land.

6. Conclusions

This article explores competitive advantages and disadvantages of agriholdings compared with independent farms. The analysis is based on information and typical farm data collected in expert interviews and focus groups with agriholdings and independent farm managers.

Given the fact that in countries such as Ukraine there is basically no official and reliable data on farm economics available, the typical farm approach is the only viable option unless there is a huge budget available to do a broader sampling.

The typical independent farms in this analysis generate higher return to land than their agriholding counterparts of the same size. This indicates that agriholdings will face economic pressure when increasing competition for land raises land costs in the future. On the other hand, the typical agriholding farms have more potential to improve their efficiency than the already highly optimized typical independent farms. Further, they can achieve the same return to land without entirely reaching the independent farms' efficiency thanks to their other competitive advantages (purchases, sales, etc.). Therefore, it seems possible the economic gap between the organizational forms may close in the future. Smaller independent farms, in particular, are in a difficult situation when the competition in the land market increases, as the return to land of large agriholding and independent farms is higher. While agriholdings have the liquidity to increase the size of their small operations, small independent farms are limited in their ability to grow, especially due to restrictions to access capital.

The statements regarding likely future adaptations permit the conclusion that there may be a convergence of the two organizational forms in the future, with agriholdings strengthening their farm-level management and focusing their central organisation on their key functions, with independent farms co-operating in purchases and sales. This might even go so far that franchise-like setups develop – in this scenario, an agriholding center cooperates with largely independent entrepreneurs who manage their farming operations.

The results of the analysis, in principle, are valid only for Ukraine. However, the more similar the conditions in a country, the more likely it is that results can be transferred. A high degree of transferability tentatively can be concluded for Russia and Kazakhstan, as the economic and political conditions are largely comparable to those in Ukraine. In the interpretation of all results, it is important to keep in mind that the derived typical farms have a case-study character, which limits their degree of representativeness for the farm population as a whole. Further, as the results are based on the knowledge and data of the participants, certain factors may have been overlooked and others overemphasized.

About the authors

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