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Identifying differences in capital growth trajectories of agricultural enterprises in Russia

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Abstract

The great diversity of farms with regard to production, ownership and/or corporate structure and significant initial undercapitalization characteristic for post-socialist countries can be assumed to form conditions that allowed for diverse farm development strategies. The aim of this paper is to identify significantly different farm capital growth trajectories that characterize structural development of Russian agriculture. Special attention is paid to financial performance and strategies of agriholding farms. We apply a semi-parametric group-based trajectory modelling approach on the financial statement data of agricultural enterprises from northwest Russia from 2001 to 2012. We identified five groups of farms with significantly different growth trajectories. Most representative for the analyzed region are farms with continuous close to zero capital growth, while other (smaller) groups of farms display high fixed capital growth of various levels. Most farms incorporated into holding structures, predominantly very large farms, are found to display high financial performance and secure gradual growth.

Keywords: Financial performance, capital growth, group-based trajectory modelling, Russia, agrohholdings.

1. Introduction

Russia is one of the most important players in the world's agricultural commodity markets. Despite this established importance for food production, Russia still possesses great productivity growth potential (Schierhorn *et al.*, 2014). Developing productive agricultural organizations is considered an important means for the sector's productivity gains, and motivated state interventions that supported large-scale agriculture (Spoor and Visser, 2004) and favored the development of large horizontally- and vertically-integrated agroholding structures (Hockmann *et al.*, 2009) in the earlier stages of transition. Although these interventions initially affected equal farm growth conditions, in recent years, farm structures in Russia have been predominantly developing under strong market pressures. The more recent dynamics of Russia's farm structures incited by market forces may have received some attention in scholarly literature (e.g., Gataulina *et al.*, 2014), but subjecting them to new approaches and analytical methods can provide new insights .

This study aims to contribute to the discussion of farm structural change by approaching farm development from the perspective of farm capital growth. Starting from a point of great undercapitalization, investments in capital that have led to modernization and technological progress have accelerated farm economic development. Despite evidence of considerable average investments in fixed assets at the beginning of the 2000s (Bokusheva *et al.*, 2007), persisting high technical inefficiencies and relatively low total factor productivity change (Gataulina *et al.*, 2014) suggest that productivity gains have been hard to achieve. Slow organizational learning and high adjustment costs may be sources of the slow average productivity increases. High technical inefficiencies indicate significant performance differences among farms related to great diversity in farm organizational forms and managerial qualities that provide conditions for significantly divergent development paths. We hence assume that farms in conditions of transition

economies do not have the necessary capacities or conditions to follow principles of investment optimality, nor to follow uniform development strategies. Farms can adjust and grow within their given framework conditions (ownership form, initial production structure/sunk-cost), and differently respond to changing macroeconomic conditions given their financial and performance position at a given point in time. The core interest of our study is to identify development trajectories of Russian farm enterprises in terms of capital growth, and to analyze their determinants and economic outcomes with regard to various financial performance indicators and structure.

To identify the developmental differences between farms on real data, that is, to determine significantly different behavioral trajectories and their sources, we apply the Group-Based Trajectory Modelling (GBTM), developed by Nagin (1999, 2005). In the second step of the analysis, we compare the identified groups of agricultural enterprises with regard to various financial performance and structural indicators with the aim of profiling the characteristics of farms within the clusters. The data used in the study is derived from financial statements of agricultural enterprises from northwest Russia for the period 2001–2012. Further, the data consists of an unbalanced panel of enterprises varying between 750-1,350 observations over the years of the analyzed period. The data also includes information about the legal form of the agricultural enterprises, as well as agroholding membership. Before we describe the data and methodology in more detail (Chapter 3), we shortly discuss the Russian farm structure in Chapter 2. Chapter 4 presents and interprets the results of the GBTM application and identifies farm characteristics significantly distinguishing the identified capital growth trajectories. The paper is concluded in Chapter 5.

2. Structure of Russian farms

The Russian farm structure is represented by the following three farm types: agricultural organizations (enterprises) of various legal forms, individual farms, and (subsistence and semi-subsistence) household farms. There are ca. 20 thousand agricultural organizations ("the heirs" of the former collective farms and state farms), about 250 thousand farms and 20 million household farms. Currently, agricultural organizations produce almost 50% of gross agricultural output (in 2000, 45%), household farms about 40% (in 2000, 52%), and individual farms about 10% (in 2000, 3%) of gross agricultural output. Agricultural enterprises and farms produce the bulk of commercial products, while household farms' share in marketable products is small. The development of the farm types' representation in cultivated agricultural land over time shows significant dynamics. Agricultural area utilized by the agricultural organizations has decreased from 74 million hectares in 2000 to 55 million hectares in 2014, while the area cultivated by individual farms has increased from 6.5 to 20 million ha over the same period. Crop area of (subsistence and semi-subsistence) household farms decreased between 2000 and 2014 from 4 to 3.5 million hectares (Federal State Statistics Agency, 2015).

There are several studies reporting on and analyzing the phenomena of agroholding development and growth (e.g. Epstein, 2015), a structural phenomenon that have been gaining on importance for production and export of commercial agricultural products. The national statistics, however, do not contain information about the development of agricultural holdings. An agroholding is a group of companies, many of which produce agricultural products. They are united by a single hierarchically-organized management and, in part, "interlacing" ownership. In other words, an agroholding can be described as

an aggregate of the parent (controlling) company and subsidiary companies. The role of agroholding membership for farm development is of particular interest to our study. In this context we aim to explore whether agroholding farm subsidiaries follow a specific developmental path and command over unique investment/growth opportunities provided by companies' integration, agroholding's size or specialized staff financial competencies.

3. Data and methodology

3.1. Data

The study is based on data from financial (tax) records of agricultural enterprises from northwest Russia for the years 2001, 2004, 2007, 2009-2012 purchased from the First Rating Agency (FIRA). The main financial statements the data is derived from are: balance sheets, profits and losses statements, movement of capital and cash flow records. Since the balance sheets contain data for the beginning (preceding year) and the end of the year, we filled in the data panel for years 2002, 2003, 2006, and 2008. Data for the missing years of the panel, 2002 and 2005, were replaced by arithmetic average values from the preceding and subsequent years. As a result, we obtained data on most financial indicators for 2001-2012 with varying number of observation (between 750 and 1350) in individual years. The data was extended by information about the legal form of the agricultural enterprises as well as membership in agroholding structures obtained from SPARK-Interfax company¹.

To illustrate the representativeness of the sample, we present annual sample averages of main financial indicators over the analyzed period in comparison with data for agricultural enterprises located in the northwest of the Russian Federation from Roskomstat² (Table 1). The number of enterprises in the sample lies in the years 2004-2012 in the range between 84.5%-91.7% of the number of enterprises forming the official statistics³; only for the year 2001, the share of observation in our sample is with 71.7% lower. It overall shows high representativeness of the sample by the number of enterprises.

In terms of the size of revenues, enterprises in the sample generate 95.5% to 99.9% of the revenues of all agricultural organizations of the northwest region. This suggests high representativeness of our sample, however, in context of the number of observations also suggests that our sample is slightly skewed towards larger enterprises (it does not include small household farms). Gross profit values for 2007-2012 of the sample are in the range of 92.2% to 100%. The indices of total gross profit of the sample for 2001 and 2004 are higher than the statistics due to the low quality of profit accounting records of many companies in the 90s and beginning of 2000s. Some debt values of the sample for 2004-2012 exceed the official statistics because the balance sheets of enterprises take into account all types of debt, while the reported statistics provide only debt owed to banks and suppliers (upstream agents) only. Finally, there are significant deviations between the sample data in the size of fixed capita and the Roskomstat statistics due to the fact that the official statistics on fixed assets for agricultural organizations are not in the public

¹ www.spark-interfax.ru

² Roskomstat is the official statistical office of Russian Federation.

³ Main economic indicators of financial and economic activities of agricultural organizations. Collections for 2002 - 2012. Ministry of agriculture of the Russian Federation/ Department of economic programs, analysis, and management of state property.

domain. While till 2005, the statistics on fixed assets values were available for agriculture separately, since 2005, these statistics are provided in aggregate form for all types of producers⁴ in three sectors agriculture, hunting and forestry only⁵.

Table 1 A comparison of the annual total values of main financial indicators for the study sample and official (Roskomstat) statistics for the northwest region of Russia (values in mln RUB)

Indicators / Year	2001	2004	2007	2009	2010	2011	2012
Number of farm - sample	1344	1382	1239	1095	1079	1033	1056
Number of farm - statistics	1875	1507	1354	1296	1214	1190	1160
<i>Sample-to-statistics ratio (%)</i>	<i>71.7</i>	<i>91.7</i>	<i>91.5</i>	<i>84.5</i>	<i>88.9</i>	<i>86.8</i>	<i>91.0</i>
Revenue, sample	21017	31809	46060	63396	73500	85407	96007
Revenue, statistics	21662	30287	46123	66529	74776	88398	97102
<i>Sample-to-statistics ratio (%)</i>	<i>97.0</i>	<i>105.0</i>	<i>99.9</i>	<i>95.3</i>	<i>98.3</i>	<i>96.6</i>	<i>98.9</i>
Gross profit, sample	2067	1182	4226	5461	6959	8691	9487
Gross profit, statistics	1476	1048	4228	5530	6989	8700	10290
<i>Sample-to-statistics ratio (%)</i>	<i>140.0</i>	<i>112.8</i>	<i>100.0</i>	<i>98.7</i>	<i>99.6</i>	<i>99.9</i>	<i>92.2</i>
Total debt, sample	10414	18693	49382	83351	106805	129455	163510
Accounts payable, statistics	12013	15131	44442	86549	95401	119125	146630
<i>Sample-to-statistics ratio (%)</i>	<i>86.7</i>	<i>123.5</i>	<i>111.1</i>	<i>96.3</i>	<i>112.0</i>	<i>108.7</i>	<i>111.5</i>
Fixed capital, sample	28129	35419	45334	66057	80043	114472	147516
Fixed capital, statistics ¹⁾	36581	42358	81139	108442	138664	143536	155881
<i>Sample-to-statistics ratio (%)</i>	<i>76.9</i>	<i>83.6</i>	<i>55.9</i>	<i>60.9</i>	<i>57.7</i>	<i>79.8</i>	<i>94.6</i>

Note: The data is in nominal values (i.e., not adjusted for inflation); ¹⁾ statistics for agriculture, forest and fishery since 2007.

Although the data available to the study can be assessed as highly representative, we cannot rule out possible reporting and measurement errors to be present in the accounting records of the individual companies in our sample. Therefore, we pay attention to identifying and discounting potential outliers. We focus the identification of potential outliers on the indicator of fixed assets value growth rate that is the main outcome variable of our analysis. We considered observations with growth rate below 3 and higher than 0.3. We thus eliminated 506 observations from the sample, i.e. by 4% of all observations.

3.2. Group-based trajectory modelling

To identify the developmental differences between farms using the empirical data, i.e. to determine significantly different behavioral trajectories and their sources, we apply Group-Based Trajectory Modelling (GBTM) developed by Nagin (1999, 2005). In this econometric method, groups of objects, in our case agricultural enterprises, showing statistically significant differences of the course of an outcome over time are identified. The GBTM is a form of a finite mixture model, parameters of which are estimated using maximum likelihood method. The maximization is performed using a quasi-Newton procedure (Dennis *et al.*, 1981; Dennis and Mei, 1979). Compared to other similar

⁴ Not only for agricultural enterprises.

⁵ Statistical collections "Regions of Russia" of the Russian statistical Committee for the years 2002-2013; the category of "National wealth".

methods such as growth mixture modeling, GBTM offers the flexibility to describe these trajectories using polynomials. The polynomials in this method are a function of time. The polynomial order is chosen a priori depending on the expected number of maxima and minima values of the main indicator, which characterizes the behavior of the object. This flexibility regarding the functional form of individual trajectories is important for our analysis as economic crisis of 2007-2009 may have markedly affected the development opportunities and strategies of Russian farms. In the second step of the analysis, we compare the identified groups of agricultural enterprises with regard to various financial performance indicators. To authors' knowledge, such econometric methods allowing to group a set of objects (companies) by similarity of their development trajectories has not been applied to the analysis of empirical data on investment behavior. Known methods of clustering objects are connected with the rather arbitrary choice of metrics (that is, set criteria for the proximity of objects) and their weights. The order of the polynomial is chosen depending on the expected number of maxima and minima of the main parameters which characterize the behavior of the object.

The fundamental concept of interest is the distribution of outcomes conditional on time. In our analysis, the analyzed outcome indicator is the change in fixed assets measured by the ratio of the current value of fixed capital at the end of the year to its value at the beginning of the year (alternatively termed capital growth). Consequently, a value greater than 1 indicates an increase of fixed capital, a value less than 1 a decrease of fixed capital and a value equal to 1 implies no capital value change. Due to the large dispersion in this outcome variable possibly indicating some data irregularities and outliers, we reduce the trajectory analysis to fixed capital growth values of 3 and below but no less than 0.3. The GBTM analysis is thus carried out on total 12,274 observations over the entire period 2001-2012.

The model of the distribution of outcome trajectories conditional on the number of groups J can be written as follows:

$$P(Y_i|Time_i) = \sum_{j=1}^J \pi^j \cdot P(Y_i|Time_i, j; \beta^j) \quad (1)$$

where the random vector Y_i represents farm i 's longitudinal sequence of behavioral outcomes and the vector $Time_i$ denotes farm i 's time from treatment.⁶ π^j is the probability of membership in group j , and β^j is a vector of unknown parameters which among other things determines the shape of the group-specific trajectory (see Nagin, 1999, 2005, for more detailed description of the method). We implement GBTM by using *traj* command in statistical software Stata developed by Jones and Nagin (2012).

4. Results

Data show large differences in capital growth of agricultural enterprises in Russia. Some farms increase their fixed assets annually, others are investing unevenly, nevertheless, their overall tendency is to increase fixed assets value. There is, however, also a significant group of farms that have reduced the volume of fixed assets, and an imprescriptible group of farms that went bankrupt mostly due to their aggressive loan policy. There are other possible trajectories of fixed capital changes as a result of

⁶ Treatment in our study is considered to be the economic transition and accompanied reforms.

differences in performance, investment, financial and overall growth (including firm integration) behavior. In this section we classify and explore these different paths on real data described in previous section.

4.1. Group-based trajectory modelling of farm fixed-assets growth

As described in the theoretical section, the GBTM method is implemented to identify clusters of observations (farms) following similar progressions of outcome, in our case changes in fixed asset value, over time. Since GBTM is mainly an exploratory methodological approach aiming at identifying time-dependent structure in analyzed data, several alternative model specifications had to be tested for parameter significance and better overall fit of the model. The model specification that delivered best parameter estimates was a specification with five groups that were function of time in a form of a second order polynomial type.

Figure 1 illustrates graphically the identified farm-group trajectories in the changes in fixed assets value. These development trajectories can be described as follows:

- Group 1 – contains farms with growth rate of fixed capital close to one; they can be characterized as low-growing to almost stagnating farms (70% of farms);
- Group 2 – groups farms with increasing capital growth rate until the period of economic crisis of 2008-2009, when the growth started continuously remitting. (growth described by a downward-convex parabola, not exceeding the growth value of 1.4) (17% of farms);
- Group 3 – includes agricultural enterprises with low (stagnating) investment activity until 2003, then exponentially increasing capital value from 2004 onwards (5.8% of farms);
- Group 4 – identifies farms that display very high but significantly decreasing capital growth rates at the beginning of the analyzed period; from 2008 onwards, these farms do not achieve simple capital reproduction rate (2.9% of farms);
- Group 5 – pulls together farms with very high capital growth rates with rapidly decreasing tendencies in the final years of the analyzed period (from 2008 onwards) (4.5% of farms).

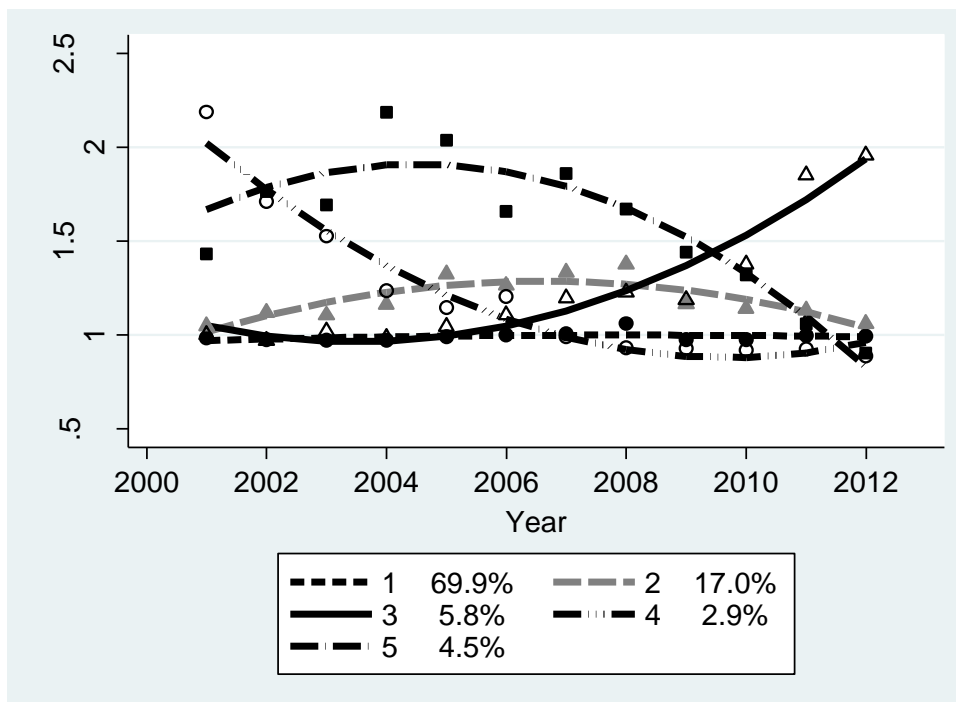


Figure 1 Group-based trajectories in farm fixed asset-value development, northwest Russia, 2001-2012

4.2. Explaining capital development trajectories

The identified statistically significantly different outcome (fixed capital) progressions motivate the question, what are other (e.g. performance) characteristics profiling the identified groups of farms and what could explain the different capital growth strategies captured in the development trajectories? Factors that could determine the economic/financial performance of agricultural enterprises could be grouped into internal such as management quality and external (framework) factors that could be affected by the activities of management of the enterprise during a reporting period to only a small degree. In this study we consider the framework factors only and will try to analyze the relationship between ownership form, legal form, and the farm's belonging to an agroholding and farm clustering in the five GBTM groups. We interpret each group individually while referring to several Tables in the text below showing group mean values in various financial performance indicators (Table 2 and Table 3), representation of ownership and legal forms (Table 4), and integration in holding structures (Table 5).

Farms of *Group 1* that is the most representative group of farms for Russian agriculture (nearly 70% of analyzed observations) are characterized by continuously weakest investment activity and consequently lowest growth rate not only in fixed assets, but also in revenues and equity. Their profitability rate decreased over the analyzed period, but stabilized in the second half of the analyzed period at a level around 5%. This development can be closely akin to the fact that over 30% of the enterprises in this group were dissolved, possibly went bankrupt. With regard to organization-related characteristics, almost 9% of the enterprises were state or municipality-owned (higher than in other groups) in 2001, but their share decreased to 4.6% in 2012. Furthermore, Group 1 is a group of farms with the lowest share of limited liability companies and highest share of producer cooperatives; the legal form representation, however,

significantly changed over the analyzed period – share of producer cooperatives decreased from 44.5% to 32.5%, while share of limited liability companies increased from 21% to 37%. This implies that it was predominantly producer cooperatives in this group that were dissolved, transformed or went bankrupt over the analyzed period. Lastly, characteristic of this group is also the lowest share of farms belonging to agrohholdings⁷.

Group 2, with 17% of farms the second largest group, clusters enterprises that are the far largest with regard to total revenues among farms of northwest Russia. The number of enterprises in this group increased by 30% between 2001 and 2012. As discussed above they display gradual positive growth rate in fixed capital value that reaches annual average of 20% (1.2). These farms deliver the most stable financial performance with profitability continuously between 10-15% over the whole time progression. They also display lowest level of indebtedness when measured by the share of total debt to revenues and at the same time the highest profit to debt ratio indicating comparatively higher ability of debt repayment. They could thus be considered the most financially stable and well-performing companies. From the organizational point of view, this group has with 31% the second highest representation of producer cooperatives and second lowest share of Limited Liability Companies among the groups (after *Group 1*). Importantly, *Group 2* had at the beginning of the analyzed period with 24% the far highest share of farms integrated in holding structures; this share increased till 2012 up to 28%, *Group 3*, however, grew significantly more in the number of farms belonging to agrohholdings and reached in 2012 share of 49% of agrohholding farms.

In *Group 3*, the second time period is characterized by significant and accelerating growth of fixed capital. The group clusters (small number of) large and relatively highly profitable farms that changed a strategy of low investment to fast growth strategy facilitated by external financing (debt). Their indebtedness measured by the share of total debt to revenues is far highest among the five groups, however, relatively low when measured with respect to total assets, which likely secures their access to credit. This group of farms may thus be specific in their asset structure and production specialization that requires further exploration. The development in these enterprises accompanied with significant increase of limited liability companies' share (to 73% in 2012) and membership in agrohholdings call for further investigation of ownership and management transformation during the analyzed period.

Group 4 is a small group of enterprises that are specific with regard to their high investment activity and rapid growth in the earlier years of the analyzed period. In that period they were marked by small size of fixed assets but relatively high revenues. Shown by the capital development trajectory, their growth rate was unsustainable, which may relate to their high indebtedness (77% share of debt in total assets in 2001) accompanied by low profitability. It resulted in fixed capital value reduction after 2007. This group lost the most enterprises (66%) over the period 2001-2012 suggesting that many of these enterprises overinvested in the earlier years and ended in bankruptcy or

⁷⁷ To identify enterprises belonging to agrohholdings, we adopted methodology proposed by Uzun *et al.* (2009). They define agricultural holdings on the basis of the presence of a mother (owner) company (some modification are permitted). We believe the company belonging to an agricultural holding, if it is an agricultural enterprise and its control (most of shares) packet belongs to a legal person who is not a municipal entity or company owned by one of the state academies of sciences.

being acquired by other companies. The enterprises in this group were mostly limited liability companies, but specific to this group is the higher share of Joint Stock Companies (36% in 2007) among which Open Joint Stock Companies were all 'dissolved' till 2012.

Group 5, also a small group considering the number of member farms, shows far highest fixed capital growth among all five groups, although the rate of growth has slightly weakened in the last years of the analyzed period. The enterprises in this group started on average from small scale nevertheless till 2012 they achieved total assets value and revenues of a size comparable to groups of larger enterprises (*Group 3* and *Group 2*). The higher values of indebtedness indicators in 2012 suggest that significant share of the capital growth was backed by external (debt) financing. The simultaneously higher equity growth among all groups may indicate higher share of venture financing when compared to the other groups of farms (possibly flow of money generated in other sectors of the economy).⁸ The private investment may be attracted by high profitability reported in the earlier years of the analyzed period; the profitability level has, however, significantly dropped in the later years which may imply either use of internally generated funds for reinvestment or higher marginal cost than marginal returns on the realized investments (overinvestment). To determine which of the answers is relevant for this empirical case, we appeal to other methods of investment behavior analysis in follow-up research.

⁸ This goes in line with the highest share of Limited Liability Companies among all five groups.

Table 2 Main indicators of financial performance and structure for farm groups identified by GBTM for northwest Russia (nominal values in thsd RUB)

	Group 1	Group 2	Group 3	Group 4	Group 5	Total
Number of farms, 2001	1,080	141	19	38	17	1,295
Number of farms, 2012	736	180	59	13	45	1,033
<i>Change in number of farms 2012/2001</i>	<i>0.68</i>	<i>1.28</i>	<i>3.11</i>	<i>0.34</i>	<i>2.65</i>	<i>0.80</i>
Fixed capital value, 2001	21,438	29,826	25,512	61,73	2,657	21,771
Fixed capital value, 2012	83,013	253,332	388,778	157,275	342,078	142,835
<i>Change in fixed capital 2012/2001</i>	<i>3.87</i>	<i>8.49</i>	<i>15.24</i>	<i>25.48</i>	<i>128.76</i>	<i>6.56</i>
Total assets, 2001	32,254	58,265	47,367	36,152	15,776	35,180
Total assets, 2012	147,784	498,374	522,476	264,064	513,529	249,005
<i>Change in total assets 2012/2001</i>	<i>4.6</i>	<i>8.6</i>	<i>11.0</i>	<i>7.3</i>	<i>32.6</i>	<i>7.1</i>
Revenue, 2001	11,970	45,140	17,947	25,497	8,347	16018
Revenue, 2012	43,074	267,718	130,837	105,160	128,287	91724
<i>Change in revenue 2012/2001</i>	<i>3.60</i>	<i>5.93</i>	<i>7.29</i>	<i>4.12</i>	<i>15.37</i>	<i>5.73</i>
Gross profit, 2001	871	6,799	2,833	1,930	2,360	1,596
Gross profit, 2012	1,971	36,788	22,962	1,325	1,213	9,196
<i>Change in gross profit 2012/2001</i>	<i>2.26</i>	<i>5.41</i>	<i>8.10</i>	<i>0.69</i>	<i>0.51</i>	<i>5.76</i>
Gross profit to revenue, 2001	0.07	0.15	0.16	0.08	0.28	0.10
Gross profit to revenue, 2012	0.05	0.14	0.18	0.01	0.01	0.10
<i>Change in profit to revenue 2012/2001</i>	<i>0.63</i>	<i>0.91</i>	<i>1.11</i>	<i>0.16</i>	<i>0.03</i>	<i>100.6</i>
Total debt, 2001	6,850	11,957	4,665	22,631	7,242	7,843
Total debt, 2012	77,455	277,031	464,495	155,134	309,830	145,438
<i>Change in total debt 2012/2001</i>	<i>11.31</i>	<i>23.17</i>	<i>99.57</i>	<i>6.85</i>	<i>42.78</i>	<i>18.54</i>
Gross profit to debt, 2001	0.127	0.569	0.607	0.085	0.326	0.203
Gross profit to debt, 2012	0.025	0.133	0.049	0.009	0.004	0.063
<i>Change in gross profit to debt ratio 2012/2001</i>	<i>0.200</i>	<i>0.234</i>	<i>0.081</i>	<i>0.100</i>	<i>0.012</i>	<i>0.311</i>
Total debt to assets, 2001	0.26	0.23	0.15	0.77	0.38	0.27
Total debt to assets, 2012	0.42	0.28	0.31	0.41	0.45	0.39
<i>Change in total debt to assets ratio 2012/2001</i>	<i>1.62</i>	<i>1.22</i>	<i>2.07</i>	<i>0.53</i>	<i>1.18</i>	<i>1.44</i>
Total debt to revenue, 2001	0.57	0.26	0.26	0.89	0.87	0.49
Total debt to revenue, 2012	1.80	1.03	3.55	1.48	2.42	1.59
<i>Change in debt to revenues ratio 2012/2001</i>	<i>3.14</i>	<i>3.91</i>	<i>13.66</i>	<i>1.66</i>	<i>2.78</i>	<i>3.24</i>
Equity, 2001	24,523	43,122	31,970	3,200	3,467	25,755
Equity, 2012	63,978	203,673	85,367	90,127	176,766	94,783
<i>Change in equity 2012/2001</i>	<i>2.61</i>	<i>4.72</i>	<i>2.67</i>	<i>28.17</i>	<i>50.99</i>	<i>3.68</i>

Note: Group 1 – farms with continuously lowest growth, Group 2 – farms with temperate growth, Group 3 – farms with rapid growth from 2006 onward, Group 4 – farms with initially high but significantly falling growth rates, Group 5 – farms with high but gradually declining growth rates.

Table 3 Average growth rate of fixed capital and revenues for GBTM groups between 2001 and 2012, inflation-adjusted (real) values (base year 2001)

	Group 1	Group 2	Group 3	Group 4	Group 5	Total
Fixed capital growth rate	1.49	3.26	5.84	9.77	49.37	2.51
Revenues growth rate	1.01	1.66	2.04	1.16	4.31	1.61

Table 4 Farm ownership and legal form representation in GBTM groups in 2001-2007 and 2009-12 (%)

	2001-2007						2009-2012					
	Group 1	Group 2	Group 3	Group 4	Group 5	Total	Group 1	Group 2	Group 3	Group 4	Group 5	Total
<i>Ownership form</i>												
State and municipal	8.5	6	8.1	0	3.8	7.8	4.6	3.7	1.4	0	0	4.1
Combined ¹⁾	0.8	2.6	0.0	2.4	1.3	1.0	0.5	2.4	0.0	4.8	1.9	0.9
Foreign	1.0	2.1	8.1	2.4	0.0	1.3	1.8	1.9	7.0	4.8	1.9	2.2
Private	89.5	89.3	83.8	95.2	93.8	89.7	92.7	92.0	91.5	90.4	94.3	92.6
<i>Legal form</i>												
Producer cooperative	44.5	31.2	24.3	9.5	11.3	40.2	32.5	28.3	9.9	9.5	9.4	29.2
Consumer cooperative	0.3	0.4	0.0	0.0	0.0	0.3	1.0	0.5	0.0	0.0	3.8	0.8
Closed JSC ²⁾	16.8	18.4	21.6	26.2	11.3	17.1	13.7	17.5	11.3	23.8	9.4	14.2
Limited Liability Comp.	21.0	30.8	43.2	52.4	66.3	25.4	37.4	37.3	73.2	57.1	71.7	41.1
Open JSC ²⁾	7.2	12.4	8.1	9.5	2.5	7.7	9.9	12.7	2.8	0.0	0.0	9.7
Single owner	7.0	4.3	2.7	2.4	3.8	6.3	2.7	1.9	1.4	9.5	3.8	2.3
Peasant farm	2.3	2.1	0.0	0.0	3.8	2.2	2.1	1.9	1.4	0.0	0.0	2.1
Non-commercial partnership	0.9	0.4	0.0	0.0	1.3	0.8	0.8	0.0	0.0	0.0	1.9	0.6
Total for legal forms	100	100	100	100	100	100	100	100	100	100	100	100

Note: The list of ownership forms does not include public associations that own in total a marginal share of agricultural enterprises (0.3% in 2012); ¹⁾Combined property means the common property of entities of different ownership forms (state, legal persons, citizens and foreign entities); ²⁾ JSC stands for Joint Stock Company.

Table 5 Share of farms integrated in agroholdings in GBTM groups in 2001-2007 and 2009-12 (%)

	2006						2012					
	Group 1	Group 2	Group 3	Group 4	Group 5	Total	Group 1	Group 2	Group 3	Group 4	Group 5	Total
All farms	1572	195	68	37	78	1950	1455	182	41	36	77	1791
Number of farms belonging to AH	87	46	4	5	7	149	179	51	20	5	9	264
Share of farms belonging to AH (%)	5.5	23.6	5.9	13.5	9.0	7.6	12.3	28.0	48.8	13.9	11.7	14.7

Note: AH stands for agroholding.

4.3. Agroholdings in development trajectories

One of our hypotheses motivating the analysis of influence of agroholdings of farm growth was that farms belonging to agroholdings will show higher investment activity compared to independent farms. Agroholdings (agricultural holding companies) as large business structures have, as a rule, specialized units of financiers and lawyers, who are systematically and effectively engaged in acquisition of credits from large banks and banks of regional significance. This is expected to allow them to access actively external financing and increase fixed assets. This in combination of complex corporate governance structure and managerial discretion in case of ownership dispersion, however, could be associated with higher risk of overinvestment. On the other hand, general statistics indicate that independent agricultural companies tend to be considerably smaller in terms of fixed assets, area of farmland and sales than farms belonging for some years to agroholdings. The size difference is another characterization that reduces the comparative credit accessibility of independent farm.

The discussion of GBTM results in section 4.2 points to an observation that agroholdings cannot be characterized by a uniform investment behavior. Nevertheless, there is a higher share of agroholding farms in groups of largest (in terms of revenues), financially well-performing (in terms of profitability) and growing farms (in terms of fixed capital growth). It was *Group 2* in both year 2006 and 2012 and *Group 3* in year 2012 showing significantly higher share of agroholding farms (see Table 5). Especially *Group 3* shows a significant increase in fixed capital growth rate with the increase of agroholdings in the group. Contrary to expectations, *Group 5* that clusters farms reporting largest growth of fixed capital between 2001 and 2012 was not leading in the share of enterprises belonging to agroholdings, and in 2012 even shows the lowest share of agroholding farms among all GBTM groups. To explore closer the influence of agroholdings on the group results, we investigate the average values of fixed capital of the enterprises of agroholdings for each group and the proportion of agroholding farms in the amount of the fixed capital of the group (Table 6).

Table 6 Comparison of average fixed capital of agricultural enterprises belonging to agroholdings and of independent enterprises in GBTM groups (values in thsd RUB)

	Group 1	Group 2	Group 3	Group 4	Group 5	Total
Fixed capital – independent farms, 2001	19,356	1,002	250	154	45	15,718
Fixed capital – independent farms, 2012	39,784	20,102	15,133	1,627	4,572	34,939
Fixed capital growth – independent farms, 2012/2001	2.1	20.1	60.5	10.6	101.6	2.2
Fixed capital – agroholding farms, 2001	43,647	69,630	58,798	16,099	0	49,818
Fixed capital – agroholding farms, 2012	119,069	499,960	390,222	83,438	1,202,444	261,254
Fixed capital growth – agroholding farms, 2012/2001	2.7	7.2	6.6	5.2	-	5.2
Share of fixed capital of agroholding farms in fixed capital of the group, 2001 (%) ¹⁾	16.4 [5.5]	76.2 [23.6]	48.5 [5.9]	34.3 [13.5]	0.0 [9.0]	26.3 [7.6]
Share of fixed capital of agroholding farms in fixed capital of the group, 2012 (%) ¹⁾	34.9 [12.3]	55.9 [28.0]	34.0 [48.8]	20.4 [13.9]	70.3 [11.7]	37.7 [14.7]

Note: ¹⁾Numbers in brackets indicate share of agroholding farms in the number of enterprises in the group.

Table 6 illustrates that enterprises belonging to agroholdings are on average significantly larger in terms of fixed capital value in all five capital trajectory groups than independent farms. This is especially the case for *Group 5* in 2012, where agroholding farms are on average 260 time larger than independent farms. This is also reflected in the share of fixed capital of agroholding farms in the average fixed capital value of the group reaching 70% (while these companies represent 12% in the total number of farms in the group). The presence of these mega-enterprises in *Group 5* may have influenced the growth indicators' results presented in Table 2. Nevertheless, independent enterprises of *Group 5* were also showing higher fixed capital growth rate among the independent farms of other groups, which is the reason for these companies forming one capital growth trajectory group with the fast growing agroholding farms as determined by the GBTM method.

5. Conclusions

This paper identified and analyzed various trajectories of fixed capital growth (investment) of farms in northwest Russia using data from 2001 to 2012. The GBTM method is found to be an effective tool for identifying clusters of farms differing significantly in their investment behavior over time. We found farms grouped in five statistically significantly different trajectories with regard to fixed capital growth. Farms in the largest group, that is, the majority of agricultural enterprises representative of the region, display no fixed capital growth (pure capital reproduction). This group of farms is also characterized by weak financial performance and high bankruptcy rates. The remaining groups of farms show significant fixed capital growths of various intensities and progressions. These farms significantly vary in their levels of indebtedness and financial performance, the combination of which determines the success of the investment strategy. Farms that invested with great intensity at the cost of optimal capital structure (over 70% indebtedness) in the early years of the analyzed period showed high rates of bankruptcy and rapid capital growth declines, resulting in disinvestment. The

optimal strategy for the studied period was the strategy of higher but steady capital value growth in the pre-crisis period (2008-2009), followed by gradual growth reduction. We also observe high dynamics in farm ownership and legal forms in the identified farm groups. Groups of successfully faster-growing farms show an increase in the representation of limited liability companies (a decrease of joint stock companies and producer cooperatives) and an increasing number of farms integrated into agriholding structures.

The second step of the analysis helped us determine the financial performance and structural factors, as well as outcomes profiling the identified farm group trajectories. The analysis thus not only offers a new perspective on farm structural development by allowing for different group-based investment progressions over time, it hints at possible development challenges and high-risk strategies. Quantifying the marginal effects of the individual factors would, however, require other modelling approaches. Although the analysis is mainly of an explorative and informative nature, it has the potential to improve specifications of follow-up theory-based investment or capital structure empirical models. Such model implementations are beyond the scope of this paper, but will be the subject of our future research.

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