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PRODUCTIVITY DEVELOPMENT AND REGIONAL SPECIFICITIES OF ECONOMIES OF SCALE OF SPECIALISED FARMS IN CENTRAL AND EASTERN EUROPEAN (EU 10) AGRICULTURE (2005-2016)

Csaba Forgacs[1], CSc.

[1]Corvinus University of Budapest

Abstract. The paper explores which farm types by specialisation direction[2] (ten different types) and at what farm sizes by physical size[3] (five categories) of specialised farms backed more production growth and productivity development in Central and Eastern European Countries (CEECs, EU10[4]) over the period of 2005-2016. We compare EU10 average figures to EU27/15 averages and outline the changes by specialisation in total resource use of (i) labour (AWU), (ii) land (UAA) as well as in (iii) average farm size (UAA/specialised farms), (iv) total farm productivity (SO/farm), (v) labour productivity (SO/AWU) and (vi) area productivity (SO/UAA). We conclude that production and productivity growth of specialised farms in EU 10 differs by country, and by type and size of farming and, each CEEC has followed her own path of farm structure development in line with the country's tradition and economic possibilities. We give regional characteristics of development in main specialisation types broken down to 5 farm size categories. We concluded the number of cereal farms increased in 6 out of 10 countries in all farm size categories and that of cattle farms went up in 5 out of EU 10 from 2005 to 2016. Farms with these two specializations have significantly extended agriculture land use and more than tripled production, but used more labor compared to basis year. SO/Farm/UAA/AWU productivity indicators of cereal farms increased quite a bit in most farm size categories in all EU 10 countries to a less extent in cattle, poultry pig and dairy farms. Growth in area productivity was led by pig, poultry, and cereal farms at E 10 level. Growth of the three productivity indicators in EU 10 are scattered quite a bit by farm types, and by countries but generally was headed by three farm size categories as 5-19.9 ha, 20-49.9 ha and 50-99.9 ha. However, the distance between EU10 and EU15 related to the level of production, land, and labour productivity still shows wide gap which needs to further narrow in the coming years.

Keywords: agriculture, specialization, farm size, productivity, CEECs.

JEL code: Q1

Introduction

EU 27 had 14.5 million farms in 2005 which went down to 10.3 million in 2016 the majority of which belonged to EU 10, 59.2% and 56.4% respectively. Over 41 % of total farms of EU 27 were already specialized in 2005 that increased to 48% in 2016. Share of number of specialized farms with UAA in total farms was lower in EU 10 than in EU 15 30.2% in 2005 and an 37.5% in 2016. Growth of production of EU 10 between 2005 and 2016 exceeded that of EU 15 by 12.1% in total but more in case of specialized farms 56.7%. Before joining the EU, it was generally accepted by experts that large farms in EU 10 have advantages of economies of scale against EU 15 farms, however, the higher level of farm total, area, and labour productivity of E U15 can counterbalance the advantages of economies of scale of EU 10.

Previous research did not focus on economies of scale of specialized farms by farm types. This paper tries to cover this gap and draws attention to what extent specialization helped production growth and how this contribution has been realized by farm types and within that by farm sizes by countries in EU 10.

2The following specialized farm types give the basis for analysis: 1. Specialized in cereals, oilseed and protein crops (cereal). 2. Specialized in horticulture indoor (horticulture in-door). 3. Specialized in horticulture outdoor (horticulture out-door). 4. Specialized in vineyards (vine). 5. Specialized in fruit and citrus fruit (fruit). 6. Specialized in olive oil (olive). 7. Specialized in dairy farming (dairy). 8. Specialized in cattle-rearing and fattening (cattle). 9. Specialized in pig production (pig). 10. Specialized in poultry production (poultry).

3 category 1: below 5 ha (UAA), category 2: 5-19.9 ha, category 3: 20-49.9 ha, category 4: 50-99.9 ha and category 5: 100 ha and above

4 Bulgaria, the Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia and Slovakia

Literature review

The issue of farm restructuring in EU 10 deserved the attention of experts and research groups for years. Researchers gave a feedback to policy makers to develop policy measures more tailored to small farms (EP resolution, 2014; Davidova S, Bailey A, 2014; Davidova S, 2014). Davidova, S. et al. (2012) emphasized that in 5 out of EU10 member states the poorest small farms constitutes the largest group and CAP instruments are not efficient to provide help them. Erjavec, E., et al. (2014) found that most Semi-Subsistence Farms exist to survive rural poverty, and off-farm employment is to become the predominant strategy. Bojnec, S., et al. (2014) found pushing up standard of leaving in agriculture and rural economy strategy should be based on increasing technical efficiency in agriculture and rural development.

Research works were also carried out to investigate the possibilities of how small farms could adjust to the changing social and economic environment. Research outcomes underlined, small farms must find the best development path for survival (Csaki C., – Forgacs C., 2008; Gordon M., et al., 2014). Forgacs (2016) concluded small, specialized farms achieved higher growth in total productivity backed by using more labour than non-specialized small farms. Large farms in the EU 28 have focused more on taking advantage of specialization by extending their land (EUROSTAT 2018, pp. 20). Davidova, S., et al., (2006) estimated the ratios of agricultural profitability and productivity by using survey data and concluded among the Czech Republic, Hungary and Poland, Hungarian farms have best prospects according to their profitability, but family farms are less productive than corporate farms both in the Czech Republic and Hungary. The concentration process in land use was more pronounced in the EU 10 than in the EU 15 during 2005-2013, with an increasing share of large farms and rapidly declining one in small farms (EU Agri C. Workshop studies, pp. 95). Csaki, C., Jambor, A. (2018) focused on convergence/divergence issue in CEECs and Commonwealth of Independent States in agricultural productivity and got findings that CEE and CIS countries have experienced a limited convergence to Western-European standards. Forgacs (2019) concluded that specialized farms in the EU 10 have increased productivity at a higher speed than non-specialized farms. Concerning specialization directions in CEE countries, Forgacs (2020) found that in production growth, the three leading specialization types of farms were cattle, cereal, and fruit farms. Forgacs (2021) pointed out, from 2005 until 2016 growth of area, labour, and total productivity of specialized farms in EU 10 well exceeded that of EU 15. Their levels, however, were still only around 43 per cent, 25 per cent and 20 per cent of that of EU 15 in 2016.

Research question: Which farm types and at what farm sizes in EU 10 backed more production growth and productivity development over 2005-2016 period?

Methodology

The paper uses statistical analysis of 10 types of specialized farms with UAA in five categories by physical size to show an in-depth farm structure development of EU 10 using EUROSTAT data of 2005-2016 period (variables: number of farms, UAA used by farms, AWU used by farms and Standard Output of farms of ten different types and five size categories by physical size). Dimensions of indices analysis include dynamics of resource use, production, farm size and productivity; a comparison between average figures of specialized farms by types and countries compared to EU 10 and EU 15 averages; a comparison between CEE national averages to EU 10 average; dynamics of EU 10/EU 15 ratios in production and productivity indicators by types, size classes and countries' averages; distribution of farms by farm size classes and

farm type categories; ranking of farms by dynamics of production, productivity indicators by farm types and farm size groups against EU 10/EU 15 averages.

Research results

Change in farm structure of specialized farms

Number of farms in EU 27 declined by 28.6% from 2005 to 2016 affecting more non-specialized farms both in EU 15 and EU 10. In EU 10, 30% of small farms below 5 ha (over half million) quit farming and sold or rented out the land. However, small, specialized farms in EU 10 were less affected and only one quarter of them ended farming in 2016 on 2005 basis. Decrease of total specialized farms is accounted to 15.8% in EU 10 and it was higher in EU 27. Apart from cereal and cattle farms, decline of specialized farms in EU 10 took place exclusively in small farms (below 5 ha) in 9 out of 10 farm types and in all pig farms apart from farm size. Number of specialized farms with 5 ha and above significantly increased in all farm size categories in EU 10 but varied by country. The share of larger farms (50-99.9 ha and 100 ha and above) more than doubled over the analysed period. Apart from Czechia and Romania, largest specialized farms (100 ha and above) more than doubled their share at EU 10 average. Leading position in growth went to cattle farms followed by cereal farms 79.8% and 14.8% respectively. Number of farms of all other farm types in EU 10 (except olives which is not significant in EU 10) decreased with a range of 0.7% (vine farms) and 57.5% (pig farms).

In 2016 compared to 2005, the number of cattle farms was 18 times higher in farm category 5-19.9 ha in Bulgaria. It was more than 16 times so in small farms (below 5ha), more than 14 times in farms with 5-19.9ha and eleven times more in largest farms (100ha and above) in Latvia. Number of cattle farms was twelve times more in Latvia, more than tripled in Poland and Slovakia and doubled in Bulgaria in 2016 on 2005 basis and created a strong regional cluster of fast developing cattle farm specialization.

Highest dynamics of number of cereal farms surprisingly went to small farms below 5ha and to 5-19.9ha farm size in Latvia and Lithuania, to farm size 20-49.9ha in Bulgaria, Poland, and Slovenia and, to farm size 50-99.9ha in Slovenia, Lithuania, and Poland. In case of largest farms number of cereal farms more than doubled in the three Baltic states and in Slovenia. Apart from Slovenia, the Czech Republic, and Estonia the growth of number of cattle farms was high in 7 out of EU10 countries and was outstanding in Latvia.

Increasing Land use of specialized farms

EU27 had 172 mill ha UAA in 2005 48.5 % of which went to specialized farms but majority of UAA (55.8%) was already cultivated by specialized farms in 2016 a bit higher than that in EU10 (54.7%). In EU10 leading farm size in land use was the largest one (100ha and over) with 51.7 % share in 2005 and 57% in 2016, second place went to farm with UAA 50-99.9 6.8% and 8.7% respectively. Small farms in total lost some 30 % of their land from 2005 to 2016 in EU10 that was only 2.5% in case of specialized small farms. Concerning farm type cattle farms extended land area by 149.7%, cereal farms by two third, fruits farms by 26.2% in 2016 on 2005 basis. Pig farms lost close to two third of the land and, land of horticulture in-door farms also went down by 41%.

In CEE member countries, cattle farms used two and half more land in 2016 on 2005 basis where growth observed in all farm size categories. Growth of UAA was near 300 % in farms with 20-49.9ha and 50-99.9ha categories and at 130% in categories 5-19.9ha and 100ha and over each, while even small farms increased their land by 52.9%. Land use of cereal farms went up in all farm size categories at a two third

average. Fruits farms also increased land area by 26.2 % with the highest growth of farm size 50-99.9ha (69.8%) and of 5-19.9ha and 20-49.9ha farm sizes near 50 % each.

From 2005 to 2016 in EU10 a big shift in land use of specialized farms reflected in the expansion of cattle, cereal, and fruit farms at most in farm categories 5ha up to 99.9ha.

Structural change in production of specialized farms

In 2005, production (SO) of EU10 total amounted to only 17.4% of that of EU15 that went up to 19.9% in 2016. This ratio was 10.3 % and 16.1% related to specialized farms. Growth of production of specialized farms of EU10 more than doubled between 2005 and 2016 (two and a half times more in Lithuania and Slovakia) and, well exceeded that of EU15 average (29.6%). It was a general picture in all five farm size categories and, well above the EU10 total non-specialized farm averages. Specialized farms with UAA of 20ha and up have reached very high growth and increased production significantly in seven farm types compared to EU15. Only in case of horticulture in-door and pig farms where the gap between EU10 and EU15 practically could not be narrowed.

Specialized farms with 5-19.9ha in the Czech Republic reached 308.6 % growth, 20-49.9ha 424.8% in Bulgaria, 50-99.9ha near 300 % in Bulgaria and 255-283% in Lithuania and Slovenia. In 2016 on 2005 basis EU10/EU15 ratio in production growth was 217.6% (50-99.9ha), 179.5 % (20-49.9ha) and 136.4% (100ha and over) respectively.

Cattle farms had the most dynamic production development e.g. 28 times higher in 2016 compared to 2005 in Latvia, 10 times higher in Lithuania, in Poland and in Slovakia. Fruit farms produced 8 times more in Estonia. Concerning poultry farms some countries also reached extremely high growth of production e.g. Latvia above 630 %, Lithuania 353.3%, Czechia 308.7%, and Slovenia 221.9%. Looking at figures by farm types in EU10 cattle farms produced 242.6% more in 2016 compared to 2005 basis and it was 216.4% in cereal farms. High growth of cereal farms' production was general across EU10 countries crossing 500% line in Latvia, 400 % in Lithuania and Poland and near that in Slovenia (Table 1). Apart from the Czech Republic growth of production in cereal and cattle farms was accompanied by high growth of number of farms (Table 1).

Specialized farms slowed down pushing labour out from the sector

EU27 used 12.5 million AWU in 2005 that declined to 8.9 mill in (28.2%) in 2016 meanwhile EU10 lost more than one third of its labour mostly affecting non-specialized farms. In 2005, 1.8 mill AWU worked in EU10 specialized farms (56.8% of that of EU15) that decreased only by 4.6% reaching 63.3% of that of EU15 in 2016. Production development of specialized farms in EU10 has been accompanied by extending labour use helping to keep jobs as much as possible.

Apart from small farms AWU of specialized farms increased in all 4 farm size categories in EU10 led by 50-99.9ha category with an increase of 84.6% and of 20-49.9ha category by 30.6%. Specialized farms in Poland, in the Czech Republic and in Lithuania even increased labour use in 2016 compared to 2005. Labour use of EU10 went up in 5 countries in all farm size categories except the small farms. Farms with 50ha and above also offered more jobs for people in 8 out of EU10 in 2016 on 2005 basis however, the picture of labour use varied by country very much. Although, in Latvia specialized farms in total used less labour in 2016 compared to 2005 but cattle farms used 10 times more labor in 2016 on 2005 basis. Apart from very large farms the smaller the farm size the higher the growth in labour use from 2006 to 2015.

Table 1

Ranking of Dynamics of Total Productivity (SO/farm) of Specialized Farms (TOP3) with UAA by Farm Types and Size Categories in EU10/15, % (2016/2005)

Countries	below 5ha	5-19.9ha	20-49.9ha	50-99ha	100ha and over
Bulgaria	1. Poultry: 909.6 2. Pig: 432.1 3. Cereal: 292.0	1. Poultry: 869.1 2. Pig: 308.8 3. Cereal: 245.8	1. Cereal: 229.3 2. Dairy: 133.8 3. Vine: 108.6	1. Cereal: 219.9 2. Dairy:153.3 3. Vine: 139.9	1. Cereal: 257.7 2. Dairy: 142.4 3. Vine: 141.6
Czechia	1. Poultry: 590.8 2. Cattle: 547.7 3. Vine: 312.9	1. Poult.:2989.9 2. Pig: 2487.5 3. Vine:141.8	1. Cereal: 179.1 2. Vine:178.5 3. Dairy: 178.2	1. Cereal: 185.0 2. Dairy: 82.5 3. Fruit: 145.0	1. Poult.: 340.7 2. Cereal:215.3 3. Dairy: 199.4
Estonia	1. Fruit: 415.6 2. Dairy: 388.2 3. Cereal: 254.2	1. Fruit: 318.8 2. Dairy: 229.0 3. Cattle: 206.4	1. Fruit: 314.9 2. Cereal: 207.6 3. Cattle: 204.1	1. Dairy:237.9 2. Cereal: 211.7 3. Cattl:114.0	1. Dairy: 273.1 2. Cereal: 248.6 3. Cattle: 148.3
Latvia	1. Hort o.: 238.4 2. Cereal: 230.8 3. Cattle: 143.5	1. Hort o.: 213.3 2. Cereal: 203.0 3. Dairy: 165.0	1. Hort o.: 291.9 2. Cereal: 249.1 3. Cattle: 238.4	1.Hort o:.849.6 2. Cattle:264.2 3. Cere: 251.2	1. Pig: 706.3 2. Cattle: 414.2 3. Hort o.:325.9
Lithuania	1. Cattle:228.3 2. Pig: 189.7 3. Cereal: 187.2	1. Pig: 1236.8 2. Cereal: 167.3 3. Cattle: 149.9	1. Dairy: 192.7 2. Cereal: 172.0 3. Fruit: 98.7	1. Dairy:203.4 2. Cereal: 193.0 3. Cattle: 164.4	1.Dairy: 221.1 2. Cereal: 186.1 3. Pig: 182.5
Hungary	1. Dairy: 473.8 2. Cereal: 241.2 3: Fruit: 229.8	1. Pig: 745.4 2. Cattle: 199.4 3. Fruit: 197.6	1. Fruit: 187.2 2. Poultry: 168.1 3. Cereal: 167.9	1. Cattle: 227.0 2. Fruit: 207.9 3. Pig: 185.6	1. Poult.: 241.5 2. Dairy:170.8 3. Cereal: 158.0
Poland	1. Poult:1355.1 2. Hort o: 559.2 3. Fruit: 497.4	1. Pig: 259.9 2. Poultry: 256.2 3. Cere: 246.3	1. Cattle: 559.2 2. Poultry: 244.9 3. Pig: 244.7	1. Pig: 243.8 2. Cereal: 233.8 3. Poult:194.6	1. Poult.: 282.6 2. Pig: 255.6 3. Hort o: 251.6
Romania	1. Hort o: 206.9 2. Dairy: 174.9 3. Poultry: 150.2	1. Pig: 3396.4 2. Vine: 227.5 3. Hort o:176.0	1. Poultry: 373.8 2. Cattle: 206.9 3. Hort o: 185.4	1. Dairy:174.0 2. Vine: 170.3 3. Cereal: 154.6	1. Cattle: 200.2 2. Dairy: 197.5 3. Cereal: 138.6
Slovenia	1. Poult: 706.4 2. Pig: 267.7 3. Hort o: 265.9	1. Vine: 286.8 2. Pig: 231.0 3. Cereal: 185.1	1. Cattle:265.9 2. Cereal: 260.8 3. Vine: 200.4	1. Cereal: 193.1 2. Dairy:141.5 3. Cattle: 117.1	1. Cereal: 144.7 2. Dairy: 60.3 3. no farm
Slovakia	1. Pig: 1867.8 2. Vine: 1270.2 3. Hort o: 318.3	1. Vine: 205.2 2. Dairy: 173.5 3. Cereal: 170.5	1. Cattle: 318.3 2. Cereal.:175.7 3. Vine: 167.0	1. Cattle:221.3 2. Fruit: 194.3 3. Vine: 185.9	1. Pig: 381.1 2. Poult.: 300.5 3. Vine: 296.6
EU10	1. Fruit: 251.5 2. Cereal: 215.9 3. Hort o: 194.9	1. Pig: 412.6 2. Poultry: 223.5 3. Cereal: 204.4	1. Pig: 241.3 2. Poultry: 218.1 3. Cattle: 194.9	1. Pig: 233.9 2. Cereal:193.2 3. Dairy:192.7	1. Pig: 238.3 2. Poult.:234.9 3. Cereal:178.8
EU15	1. Poultry: 243.4 2. Pig: 242.4 3. Vine: 182.0	1. Pig:193.7 2. Cereal:149.3 3. Poult: 148.5	1.Hort in: 182.2 2. Cereal: 170.7 3. Pig: 169.6	1. Cereal:169.0 2. Pig: 151.8 3. Poult.:150.8	1. Cereal: 169.5 2. Pig: 168.7 3. Dairy: 162.2

Source: author's own calculation based on EUROSTAT data

Average physical farm size increased

Average farm size is measured by physical size that increased both in EU15 and EU10. In EU15 it amounted to 21.4ha in 2005 and 27.8ha in 2016 while the distance of figures of EU10 compared to EU15 average were 74.4% (5.5ha) in 2005 and 70.5% (8.2ha) in 2016.

Distance of farm size average between EU10 and EU15 is narrower in case of specialized farms 62.8% in 2005 and 52.7% in 2016. Growth of land concentration of specialized farms exceeded that of non-

specialized ones in EU10 and, amounted to 67.4% in 2016 against 31.5% of EU15 average in 2016 on 2005 basis. The gap between average farm size in EU10 and EU15 narrowed in 6 farm types. It was significant in horticulture out-door, poultry, fruit, and dairy farms but increased in cereal, horticulture in-door and pig farms. Looking at farm size by farm types concentration of land use in EU10 exceeded that of EU15 in small horticulture out-door and fruit farms and was below that in small pig farms. On the other side data show clearly that land concentration of largest farms continued in EU15 (by 20% up to 35%) compared to EU10 among them in fruit farms (one third), dairy and cattle farms (one quarter) each due mostly to decline of average land area of largest farms in EU10 by 20-25%. Growth of land concentration of specialized farms in EU10 reached 28.7% against 10.9% of EU15 average narrowing the gap especially in horticulture out-door, fruit, cattle, and cereal farms and, substantially further widening in pig and to a less extent in horticulture in-door and poultry farms. From 2005 to 2016 average labour use (AWU/farm) in EU15 increased by 4.6% both in specialized and non-specialized farms on 2005 basis meanwhile, it went down at same level in EU10 farms total with an increase by 13.3% in specialized farms. Apart from olive farms AWU/farm ratio has gone upward in all specialized farm types both in EU10 and EU15 but with different direction concerning farm types.

Growth of total productivity (SO/farm) is driven by specialized farms in EU10

Farm productivity (SO/farm) of total farms in EU10 amounted to only 11.8% of that of EU15 in 2005 that increased to 15.2% in 2016. Related figures of specialized farms of EU10 are 13.4% and 20.4% respectively. In 2005 the EU10/EU15 ratio of total farm productivity reflects a wide range by farm types from 23.8% in cereal to 0.9% in poultry farms meanwhile in 5 farm types (poultry, pig, dairy, vine, and horticulture out-door) EU10 average was still below 10%. Due to higher growth in total productivity of CEE specialized farms the relative distance between EU10 and EU15 average declined in 2016 with a range of 29.9% in cattle farms to 1.5% in poultry. Catching up to EU15 average is still a challenge for poultry, pig, and vine farms in EU10 as their ratio are still below 6% in 2016.

In 2016, total productivity of specialized farms in EU10 increased by 141.1% compared to 2005 with 481.3% in Slovakia in one end and, 65.5% in Slovenia on the other. Farm productivity growth was close the 300% or above in 4 out of EU10 countries. Looking EU10 average at farm size by farm types first place went to poultry (328.4%) followed by cereal and fruit farms. Starting from low basis, poultry farms more than tripled productivity in 2016 on 2005 basis at EU10 average and it was 60 times higher in Slovakia, more than 19 times in Poland and Bulgaria and 17 times higher in Czechia. (Table 2). In cereal farms an upward of productivity can be seen across EU10 countries and headed by small farms (below 5ha) in 5 out of EU10 countries with total average of 115.9% followed by 5-19.9ha farm size (104.4%). In EU10 the growth of productivity of horticulture out-door farms exceeded that of horticulture in-door farms and was close to double. Concerning the more capital-intensive horticulture in-door farms fastest growth was achieved by 5-19.9ha farm size. Small fruit farms achieved outstanding productivity growth by 151.5% of EU10 average. This figure was headed by Poland 397.4% and followed by Hungary. Farm size 50-99.9ha fruit farms of EU10 more than doubled total farm productivity from 2005 to 2016. Cattle farms put an upward in productivity by 90.6% more or less balanced by farm size. In small farms it increased by 424.7% in Czechia, 373.8 % in Hungary and 241.5% in Poland. Productivity growth of pig farms is significant and well balanced by farm size in Poland headed by small farms. At a lower growth level, it is similar in Hungary but led by 5-19.9ha farm size.

Table 2

Dynamics of EU10/EU15 Ratios of Specialized Farms with UAA by Size Classes, % (2005-2016)

EU10/EU15 ratios	below 5ha	5-19.9ha	20-49.9ha	50-99.9ha	100ha and above	Total spec. f.
Total SO, 2005	13.2	12.8	7.0	3.2	15.2	10.3
Total SO, 2016	17.7	20,.8	12.5	7.0	20.7	16.1
2016/2005, %	133.6	163.0	179.5	217.6	136.4	156.7
UAA/farm, 2005	60.1	92.2	91.8	98.0	218.6	37.2
UAA/farm, 2016	69.7	92.7	93.8	98.4	193.0	47.3
2016/2005, %	116.0	100.5	102.2	100.5	88.3	127.2
SO/farm, 2005	11.7	27.2	38.3	37.5	90.2	13.4
SO/farm, 2016	15.3	33.4	43.7	44.0	93.6	20.4
2016/2005, %	131.0	123.0	114.1	117.5	103.9	152.3
SO/UAA, 2005	19.4	29.4	41.8	38.2	41.2	36.0
SO/UAA, 2016	21.9	36.0	46.6	44.7	48.5	43.1
2016/2005, %	112.9	122.4	111.7	116.9	117.6	119.7
SO/AWU, 2005	13.9	24.2	29.5	30.9	29.1	18.3
SO/AWU, 2016	16.1	28.1	37.2	35.6	43.4	25.5
2016/2005, %	115.7	116.0	126.0	11.0	149.1	139.1

Source: authors' own calculation based on EUROSTAT data

The EU10/EU15 ratio in total farm productivity was rather low in 2005 with a moderate narrowing in 2016. Growth of productivity of specialized farms in EU10 developed faster than that of non-specialized ones and varied by farm types and size classes in all EU10 countries. Leading performance farm productivity varied by farm sizes, countries, and farm types. The distance in per farm production between EU10 and EU15 average is still one to five in 2016 and higher than one to fifteen in pig, poultry, and vine farms. The bigger the farm size generally the higher the EU10/EU15 ratio slowly approaching one to one. Farm productivity of largest specialised farms in EU10 reached the level of that of EU15 in case of dairy and cattle farms in 2005 and kept in dairy but went back by one quarter in cattle farms in 2016.Catching up farm productivity of EU10 it is more significant in cereal, in dairy and in fruit farms. As far as farm size is concerned small farms have achieved good results in farm productivity growth especially in fruit, cereal, and horticulture out-door farms.

Change in area productivity of specialized farms

Concerning area productivity of total farms EU10 average was less than half of that of EU15 in 2005 (46.3%) that went up to 51.6% in 2016. The gap was higher in case of specialized farms 36% and 43.1% respectively. Looking at all farm sizes, only small farms (below 5ha) in the Czech Republic had area productivity above EU15 average both in 2005 and 2016 by 7.5 %, and 23% respectively. The distance between EU10 and EU15 average was narrower in larger farms (20ha and up) in 2005 and further narrowed in 2016 but still below 50%. Looking at national average of area productivity of EU10 by farm sizes the picture is scattered very much. In 2016 all farm size categories in all Baltic states and Romania were well behind EU15 average. But in Czechia farms with 5-19.9ha had already a ratio of 96.1 %. Concerning farm

size 20ha and up only Slovenia has ratio above 75% and, close to EU15 average in case of largest farms (99.3%).

Analysing farm size by farm types in EU10 countries only cereal farms have a good average of 63.8%, more balanced by size, compared to EU15 in 2005 and 71.7% in 2016 with highest ratio in farm category 20-49.9ha and 50-99.9ha (80.4-84.3%). In 2016, second place went to poultry farms reaching 63.8% of EU15 average where farms with 50-99.9ha already exceeded that of EU15 average by 20.3%. Catching up area productivity was also remarkable in cattle farms reaching 59.1% of EU15 average in 2016 and dairy farms where the ratio went up to 48.5% in 2016 from 40.6% in 2005.These figures also grew in fruit farms (43.9%) not varied significantly between farm sizes and, in vine farms (34.5%) more scattered by farm size. In 2016, horticulture in-door and out-door farms still had a ratio near 30% or below. Small poultry and pig farms are very much behind (below 10%), meanwhile in fruit farms it is 39.9%.

Area productivity in EU10 increased highest in pig and poultry farms (by 179.8 and 101%), from 2005 to 2016. Growth of area productivity of EU10 from 2005 to 2016 exceeded that of EU15 in all farm categories and was the highest (60-70%) in the two largest farm size classes in most of the CEE countries

Labour productivity growth in EU10

Labour productivity in EU10 compared to EU15 average was rather low in 2005 (14.8%) which went up to 20.9% in 2016. Specialized farms had higher ratio both in 2005 (18.1%) and 2016 (25.5%). No single farm size of specialized farms in EU10 can be found with higher labour productivity than that of EU15 average. Czechia has the closest ratio in this respect with 49.1% national average. In 2005, top two ratios of EU10 went to Slovenia in farm size 50-99.9ha (65.2%) and to Poland in 100ha and over category (51.7%). The picture changed in 2016. Czechia had two top ratio average figures, one belongs to small farms (40.1%), the other goes to farm with 5-19.9ha category (74%). Two top ratios go also to Slovenia with 20-49.9ha (51.2%) and 50-99.9ha (46.1%). As far as largest specialized farms concerned, Poland's ratio amounts to 63.2%.

Concerning labour productivity of different farm size categories by farm types in 2016 the gap between EU10 and EU15 average is most narrow in cereal farms in Slovakia in all farm size categories except the largest one (range 78.8%-83%). Largest farms in Czechia show labour productivity 64.2% of EU15 average in 2016. Concerning total national average of specialized farms labour productivity in EU10 compared to EU15 average was the highest in Czechia both in 2005 and 2016 87.8% and 92% respectively. The distance of EU10 average from that of EU15 is between 27% up to near 50 % in cereal farms with an increase of farms below 20ha and, decrease in larger farms (20ha and up). The gap narrowed in horticulture in-door more than horticulture out-door farming but still below 50 % in 2016. Labour productivity in dairy farms is 65-90% behind EU15 average less in larger farms. Labour productivity of EU10 increased more than 50 % in all farm size categories of specialized farms and more than doubled in largest farms from 2005 to 2016.

Discussion

EU27 average figures are practically can be derived from EU15 and EU10 average (weight of Cyprus and Malta is not significant from this point of view). For EU10 it is important to measure the results of agriculture production and productivity development against EU15 averages to see the progress of catching up. Looking at production growth of farms in EU10 average cattle farms got first place in 3 farm size categories and second place in two. While cereal farms got first place in two farm size categories and three in the second place. Poultry farms were on the third place in three categories, while fruit and dairy farms in one each.

Increasing influence of specialization in EU10 agriculture is also measured by farm types, farm size classes and countries by using scoring. Scores were aggregated by types and size classes at EU10 level. Scoring the TOP3 farm types in all 5 farm size categories and in all EU10 countries according to production growth between 2005 and 2016 brings evidence of the main directions of specialization. In case of largest farm category, cereal farms have achieved the highest growth in all EU10 countries. In one more farm size 9 countries, and another two farm size categories 8 countries ranked cereal farms' production growth on first place.

Dynamics of total farm productivity at EU10 average are dominated by pig farms in all farm size categories, except the small one, with growth 230-241% in farms 20ha and up, and 410% in farm category 5-19.9ha. Growth indices were also above 200% in 3 categories (5-19.9ha, 20-49.9ha and 100ha and above) in poultry farms. Cereal farms reached high growth in all farm size categories except one (20-49.9ha) with a range of 178-215%. Outstanding growth showed by small farms in fruit and horticulture out-door farms 251.5% and 194.9% respectively. Level of growth of farm total productivity of EU15 average is moderate compared to EU10 average and is more scattered by types. First place went to 4 different farm types (poultry, pig, horticulture in-door and cereal). Pig farms got second place in three and cereal farms in two categories. Four farm types are present on the third place (vine, pig, and dairy farms in one each and poultry in two).

Concerning area productivity both pig and, to a less extent, poultry farms in EU10 faced real challenges in adjustment. However, high dynamics of area productivity were achieved by pig, poultry, and cereal farms in all farm size categories with 20ha and up. The growth was above 190% in cereal, 194% in poultry and the highest 229% in pig farms. Small pig farms increased area productivity higher than that of larger farms above 20ha.

Conclusions

Key drivers of catching up EU10 agriculture were specialization and concentration between 2005 to 2016. Growth of production in 2016 on 2005 basis went up by 103% in specialized farms (only by 1.5% in non-specialized ones) reaching 57 % in total production in 2016. EU10/EU15 production ratio was 10.3% in 2005 and 16.1% in 2016. Leading farm type in production growth was cereal in all EU10 countries and in most of all farm sizes (86%) followed by cattle (72%, but TOP1 in all farm sizes in Slovakia, Latvia, and Hungary), fruit (40%), vine (26%) and dairy farms (24%). Leading of production growth belonged to three farm sizes as UAA 5-19.9ha, 20-49.9ha and 50-99.ha.

EU10 average of growth of total farm productivity of specialized farms was 241.1% of labour productivity 209.9% and of area productivity 144.1%. In all three productivity indicators, highest growth went to farm size categories of 5ha up to 99.9ha headed by pig farms in all three farm size categories and followed by poultry and cereal farms both in total farm and area productivity. Concerning the growth of labor productivity cereal, fruit, horticulture out-door and dairy farms were among the TOP3 in three farm size categories (5ha up to 99.9ha). Growth of both area and labour productivity in EU10 scattered very much by countries and by farm size classes.

EU10' specialized farms have achieved good results in growth of production and productivity indicators, in most of the cases, well above that of EU15 averages. At the same time national specifies in farm structure development and growth of indicators increased in EU10. The EU10/EU16 ratios related to the level of production and land and labour productivity still show wide gaps between EU10 and EU15 averages.

Labour use of specialized farms in EU10 declined only by less than 5% against total 35% in 2016 on 2005 basis. Growth of labour productivity was behind that of area productivity in EU10 but still exceeded

that of EU15 average in all farm sizes classes above 5ha to a less extent in largest ones. However, labor productivity growth in small farms of EU15 was higher in cereal farms 215.9% against 167.8% of EU10 average. Small pig and poultry farms also doubled labour productivity in EU15. It was also high in fruit and dairy farms in EU10 (193.9% and 178.8% respectively). Growth of labour productivity in all larger cereal farms (20ha and up) in EU10 are ranked in TOP3. That of fruit farms was among TOP3 in three categories but not in the two largest farm sizes.

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