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in Transition Economies

Efficiency and Profitability of Ukrainian Crop Production

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Ukrainian crop production

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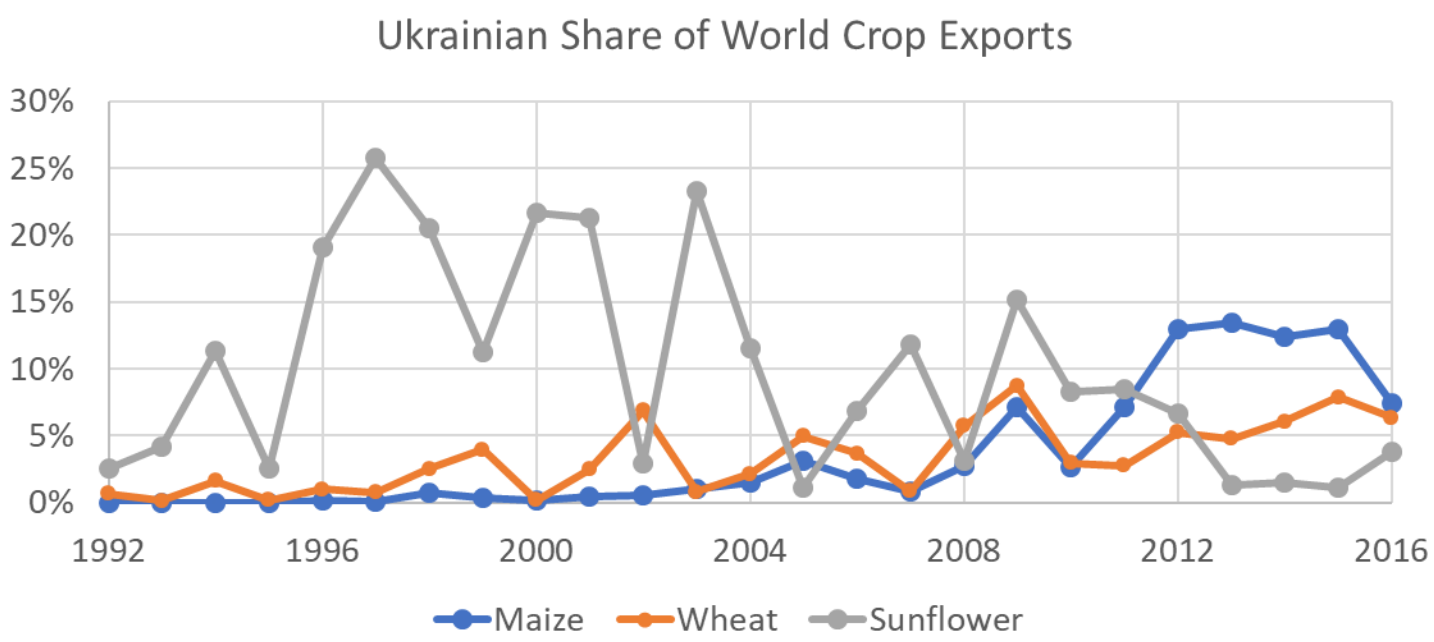

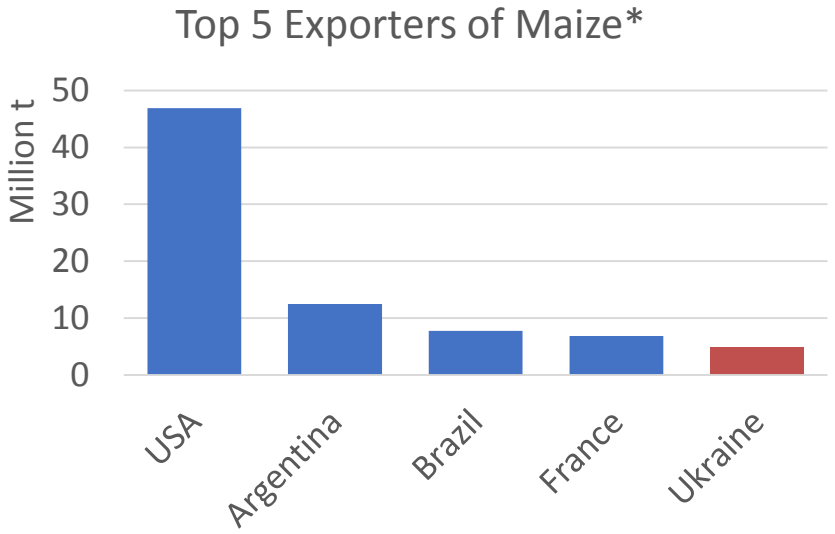

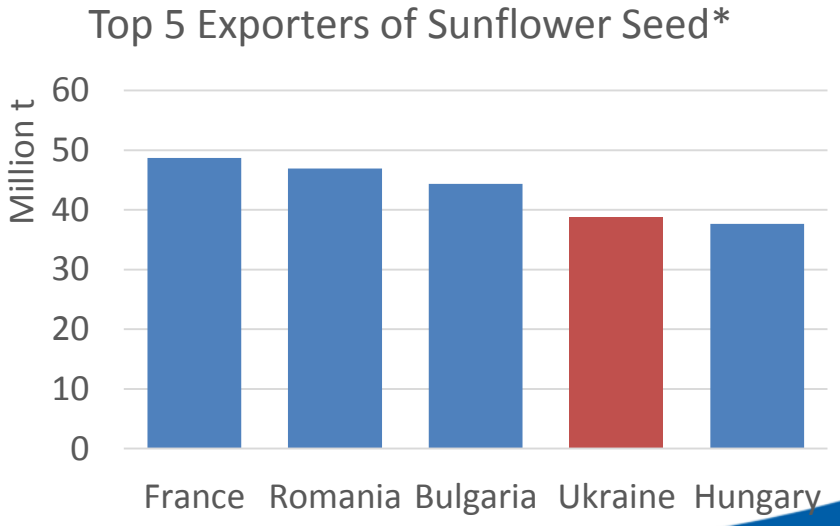

Source: FAOSTAT

** Average export quantity between 1991 to 2016*

Agricultural production in Ukraine

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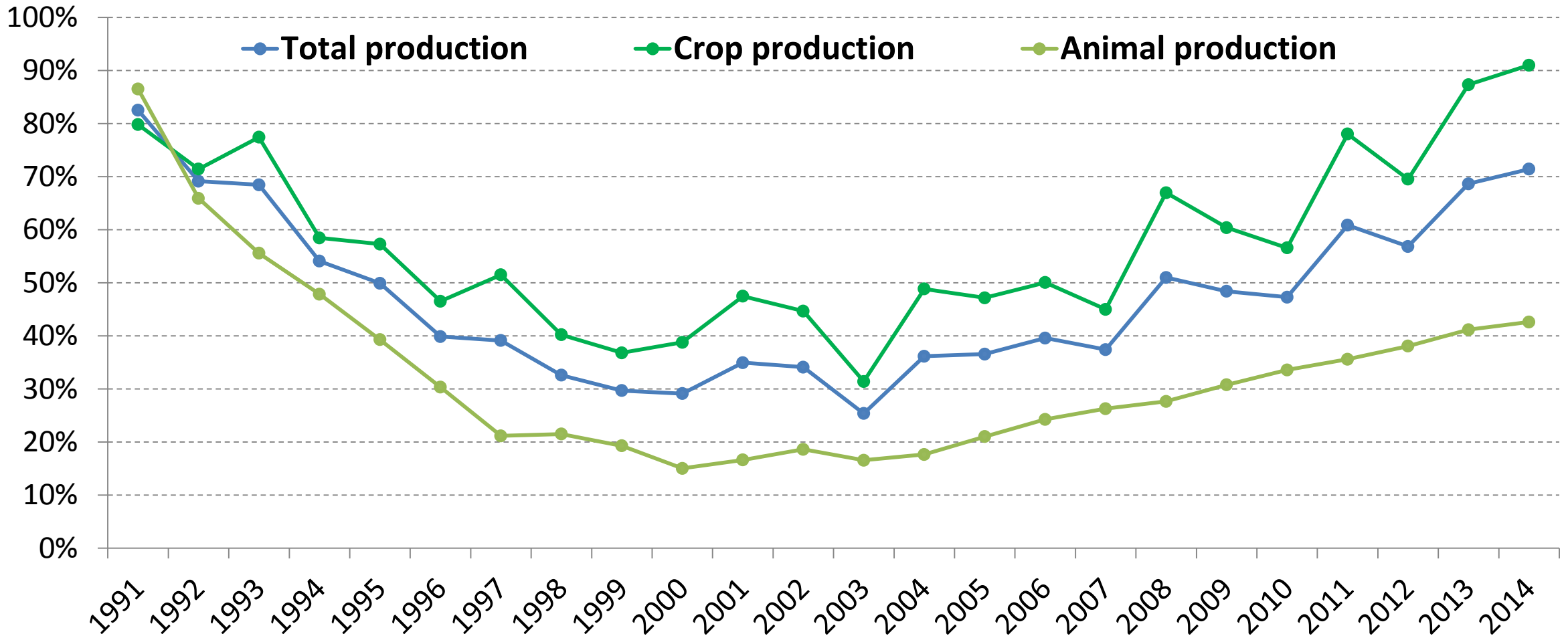

Note: Statistics for agric. enterprises only, 1990 = 100

Source: SSSU

Agricultural production development

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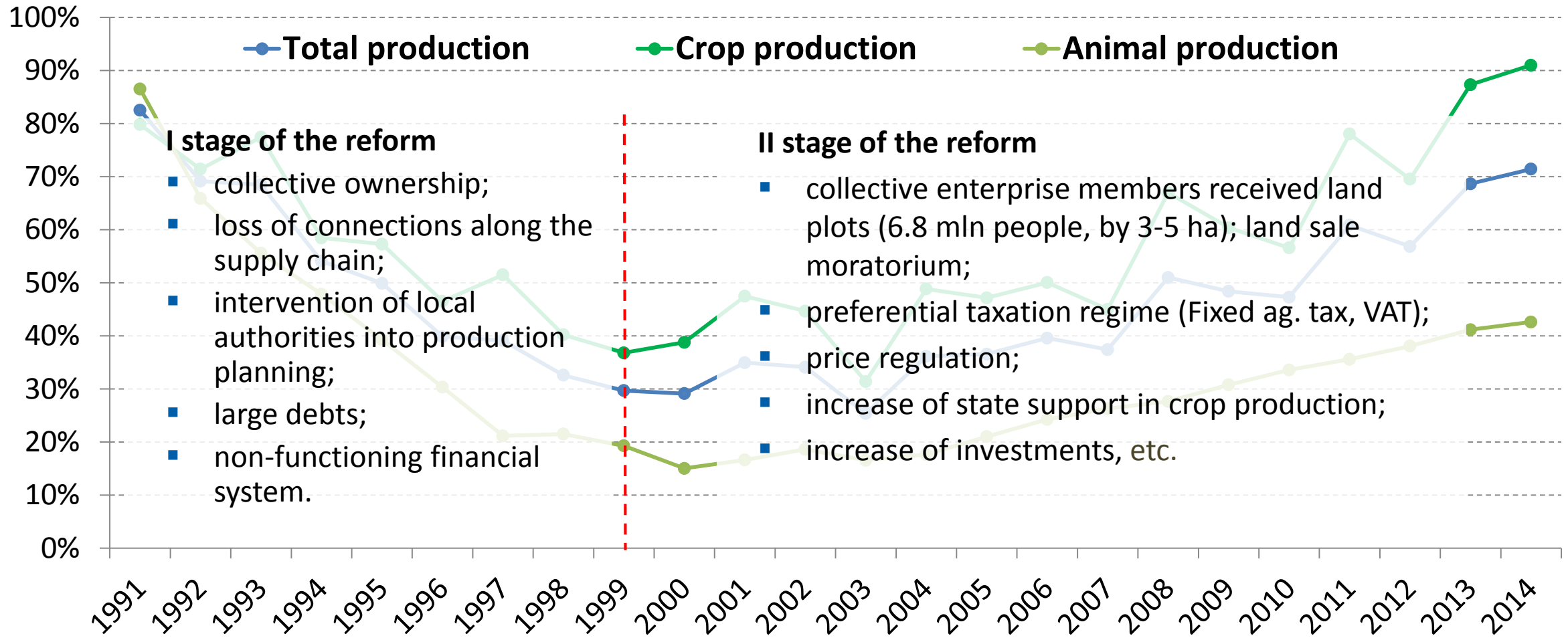

Note: Statistics for agric. enterprises only, 1990 = 100

Source: SSSU

Yield developments

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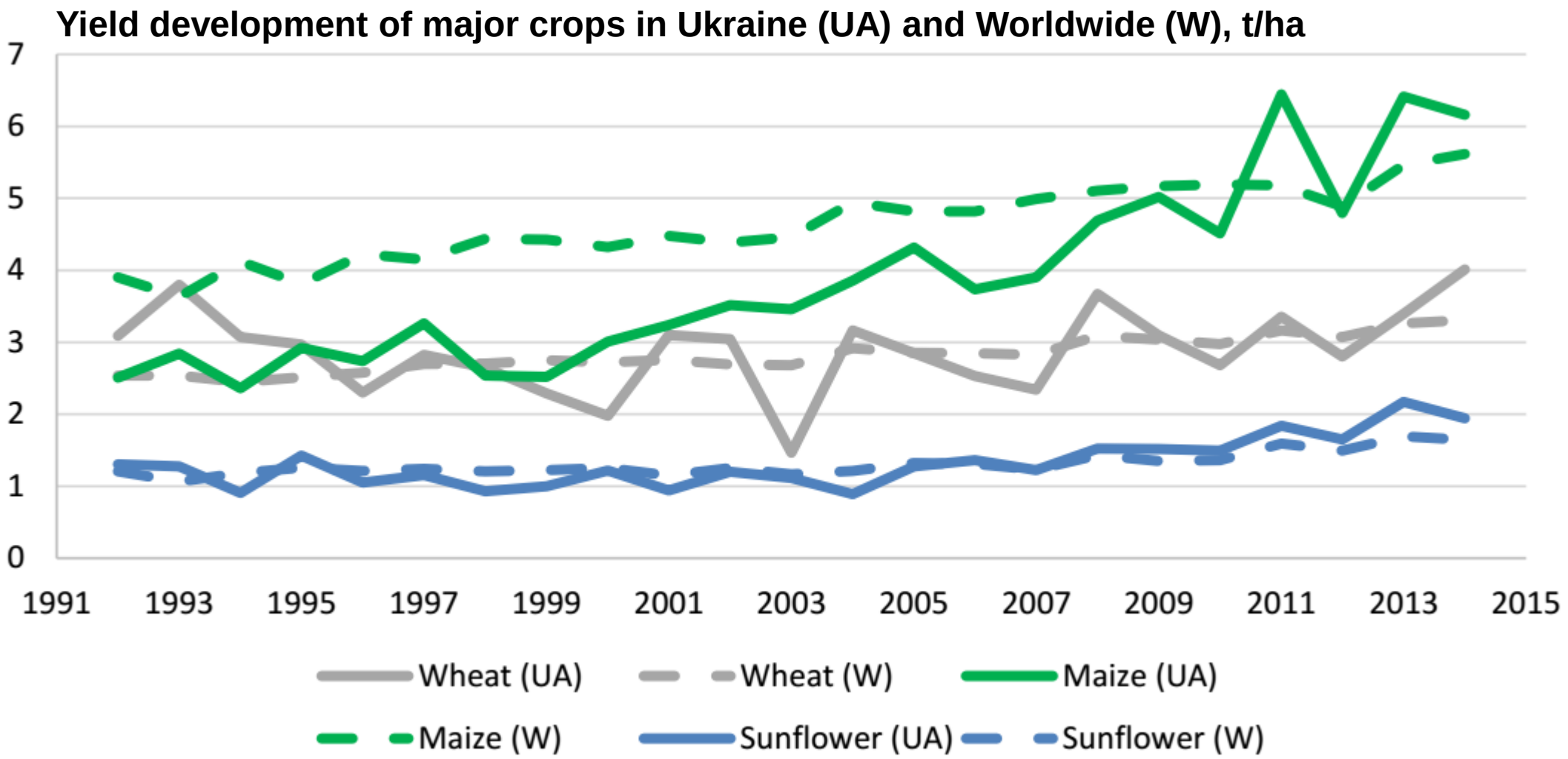

Source: FAOSTAT, own calculation

Yield developments

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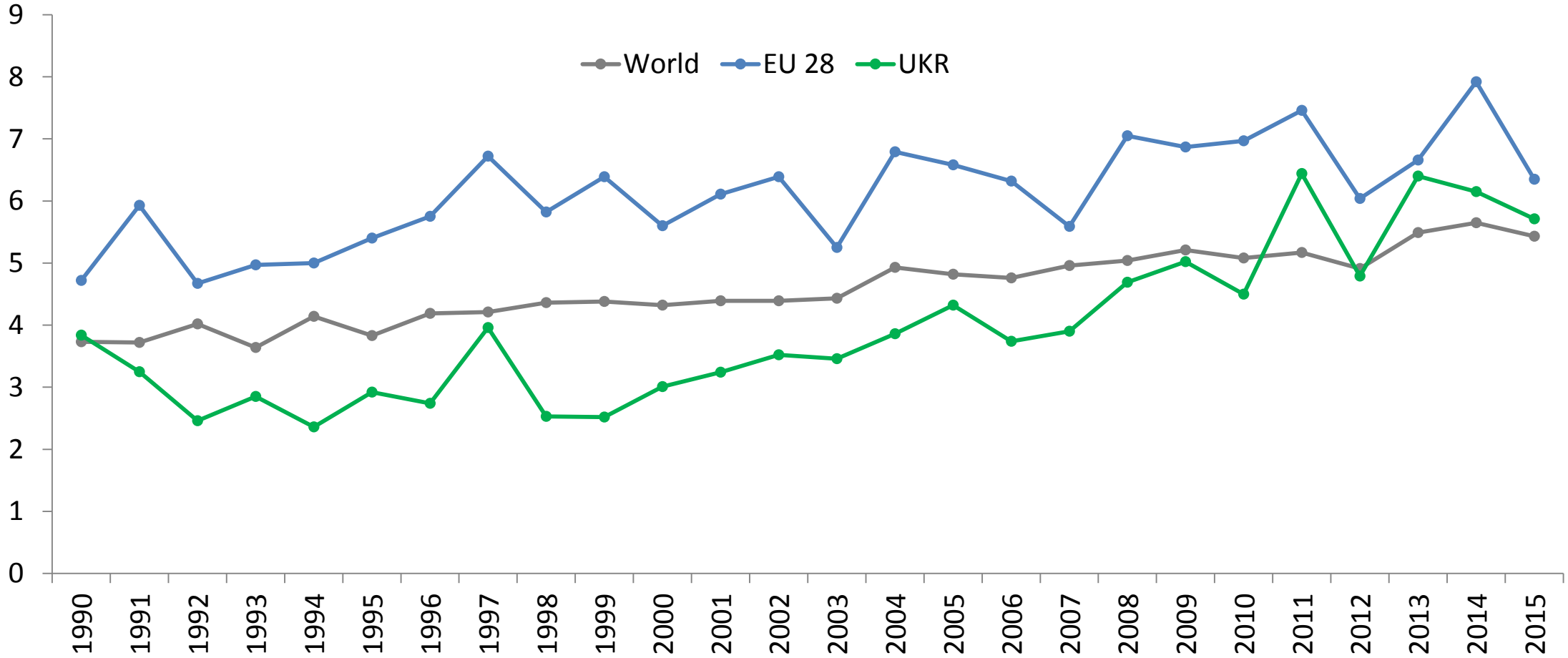
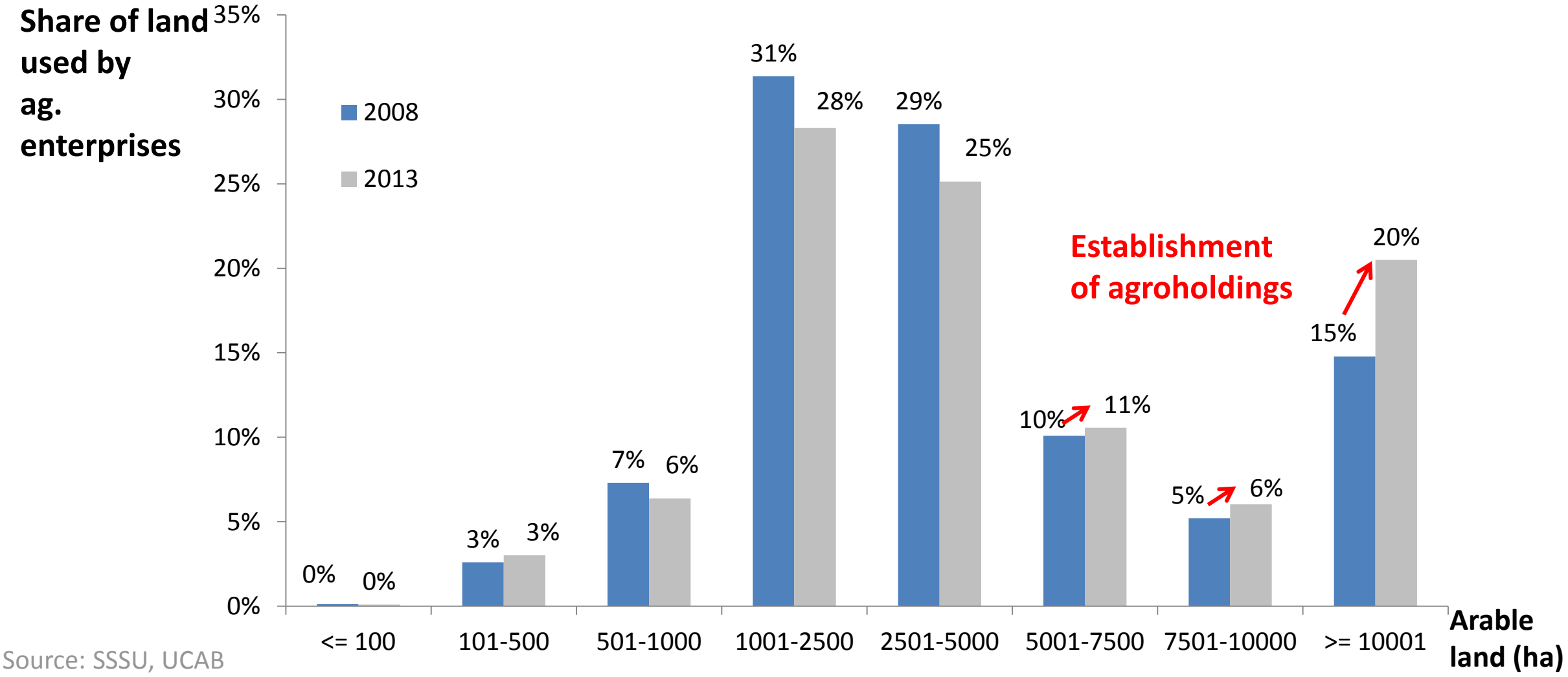
Maize yield, t/ha



Source: USDA

Land distribution



Source: SSSU, UCAB

Crop Producers

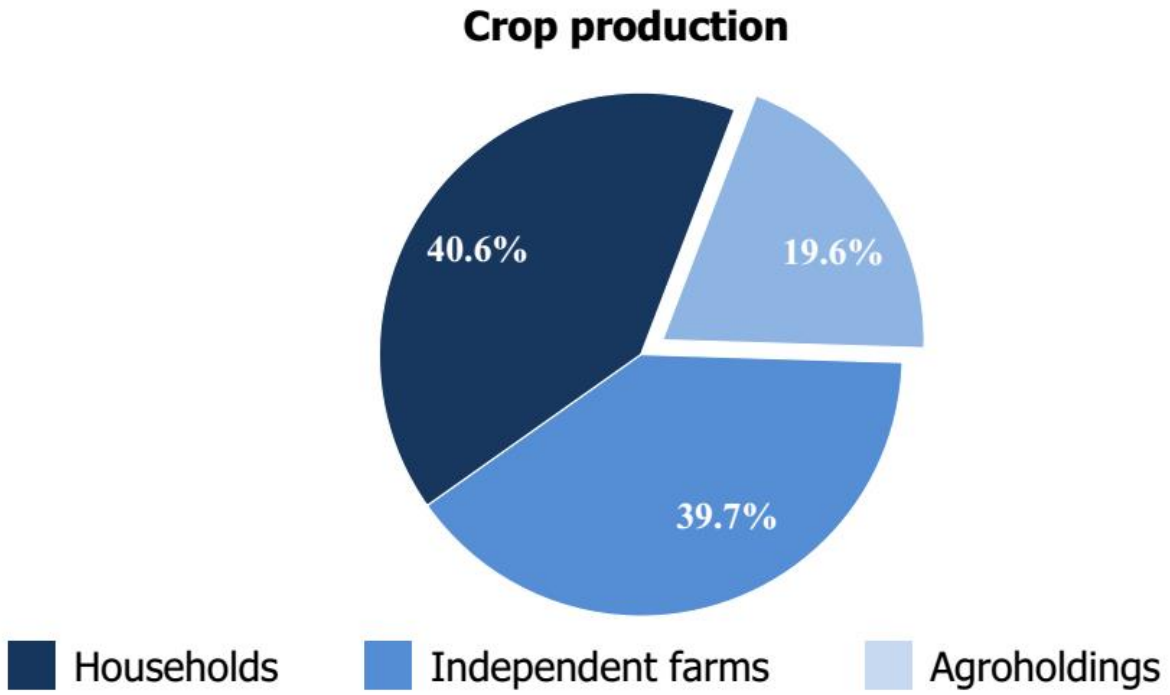
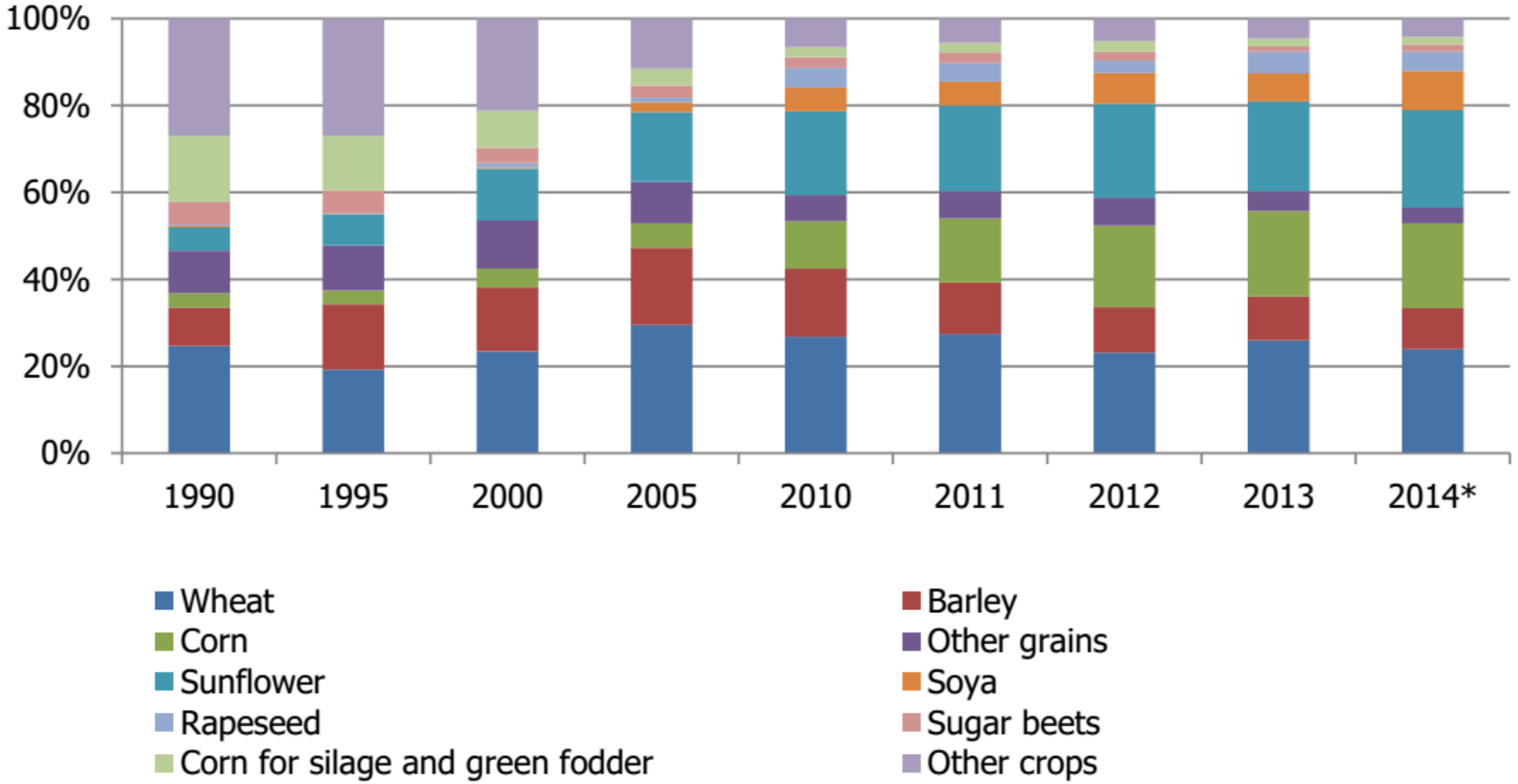


Figure 10. Share of agroholdings in crop production in 2014

Source: AgriSurvey, 2015

Major crops - sowing areas



Crop production structure

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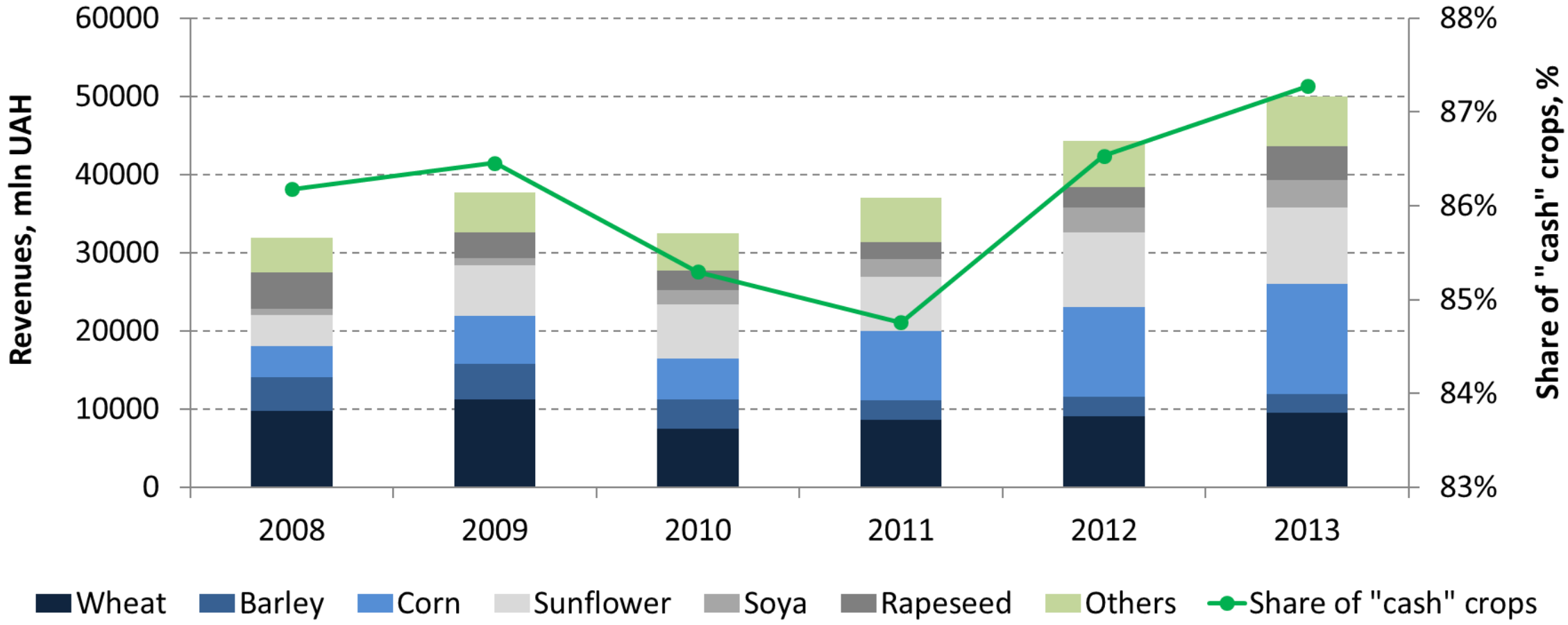
Revenues from the sales of crops by farms of Ukraine, mln UAH (in constant prices of 2008)



Source: own calculations based on SSSU (multiple years)

Crop production - cost and revenues

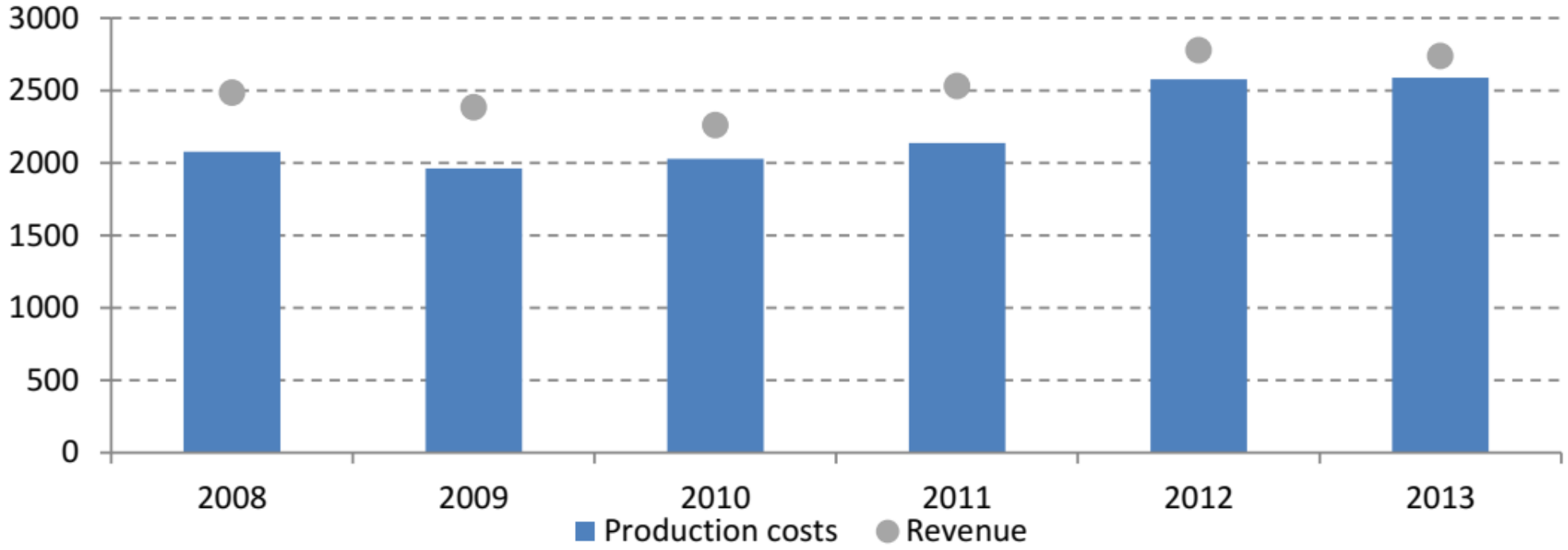


Figure 8. Total costs and revenues per hectare in crop production by farms, (inflation adjusted)

Source: own calculations

Background/Motivation

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- Ukraine is an important producer/exporter of ag products
- Despite favorable natural conditions, crop yields only recently exceed world averages

1. Can Ukrainian farms significantly increase agricultural?
   – "Yield gap" discussion: Difference between potential (under optimal conditions) and actual yield
2. What are economic reasons for the existence of a yield gap?

Methods

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- How efficient are Ukrainian crop producers?
  - ➢ Data Envelopment Analysis
- What determines efficiency and productivity of Ukrainian crop farms?
  - ➢ Multiple regression analysis
- What are differences between successful (profitable) and not so successful farms?
  - ➢ Treatment effect analysis

Data Envelopment Analysis (DEA)

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= linear programming to construct a nonparametric piecewise surface (frontier) over the data which allows deriving efficiency scores relative to this frontier (Coelli et al., 2005)

- Single output - multiple input problem
  - Output: crop production value
  - Inputs: Land, labor, and capital costs
- Output-oriented optimization with constant returns to scale

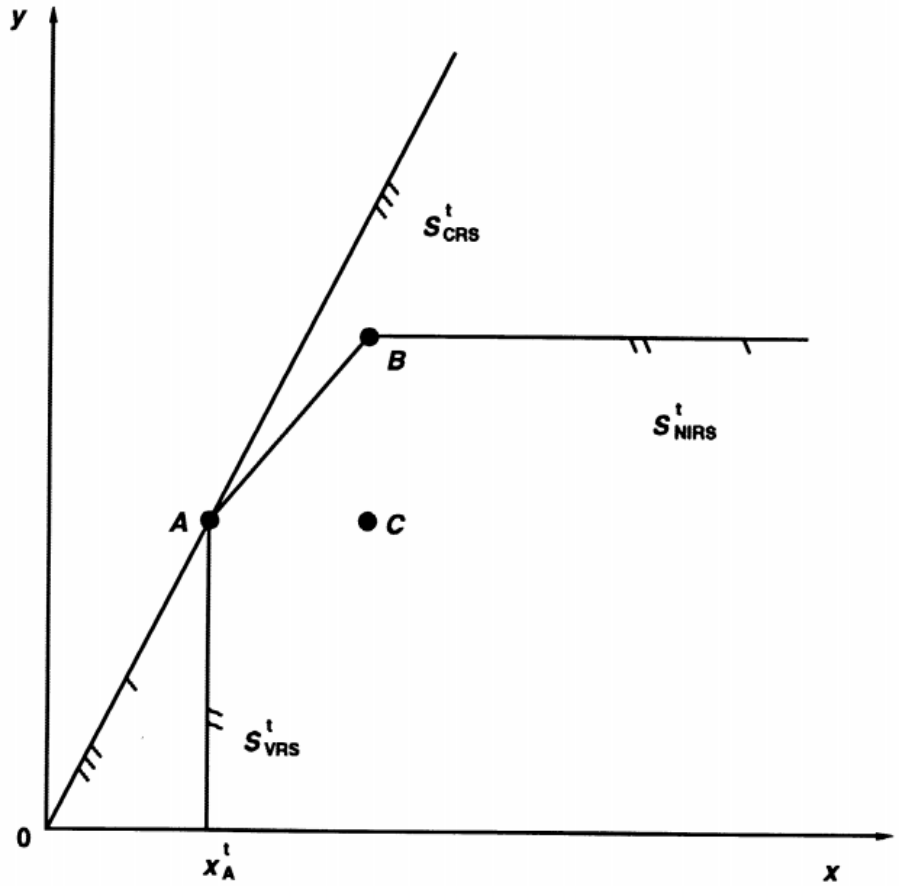

FIGURE 2. CONSTRUCTION OF REFERENCE TECHNOLOGY S'

Source: Färe et al. (1994), AER

Regression Analysis

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- Determinants of
  - yield → simple ordinary least squares (OLS) regression
  - technical efficiency scores → truncated regression model
- Explanatory variables:
  - several structural farm characteristics (e.g., size, specialization, input use intensity, …)
  - control variables (time and holding membership)
  - climatic zones

Treatment effect analysis

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- to explain the differences between more and less profitable crop producing farms
- matching procedure: comparison of treated and non-treated group
  - comparing farms (“neighbors”) with similar structural characteristics (i.e., location, size, costs structure, state support, performance)
  - treated group: crop production profitability above median of the base year (2008) group
  - profitability is measured by the relation of profit to total costs

Data

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- Accounting data 2008-2013 of crop-specialized farms (>= 90% crop sales);
- Representative sample for agricultural companies (covers 92% of land);
- The original dataset: 51,686 observations of farms with various legal forms and sizes engaged in crop production;
- Information on affiliation to holding companies - ca. 7% of holding subsidiaries.

Data

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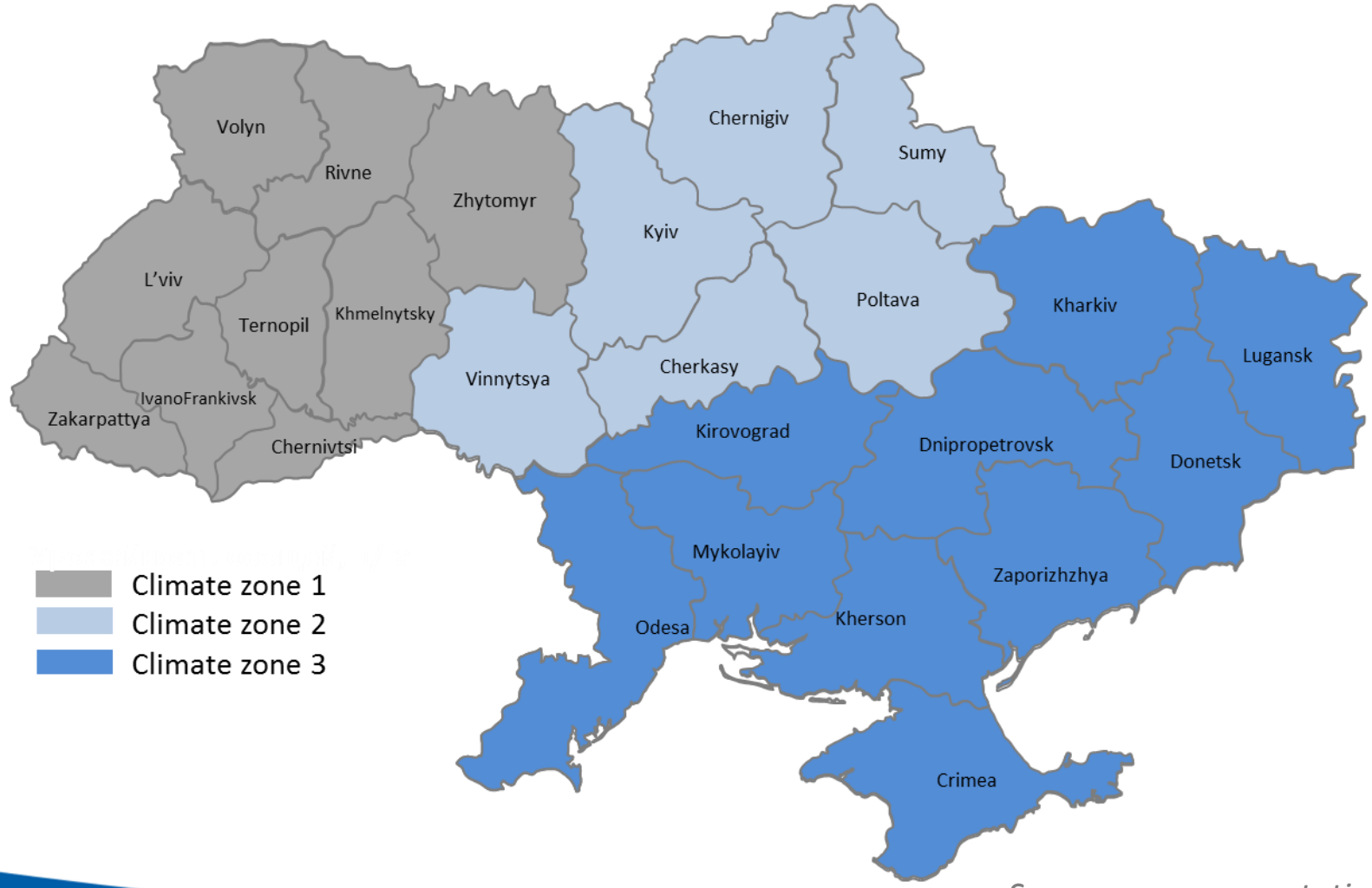
The three Ukraine climatic zones (production regions)



1st climatic zone – enough moisture, moderately warm;

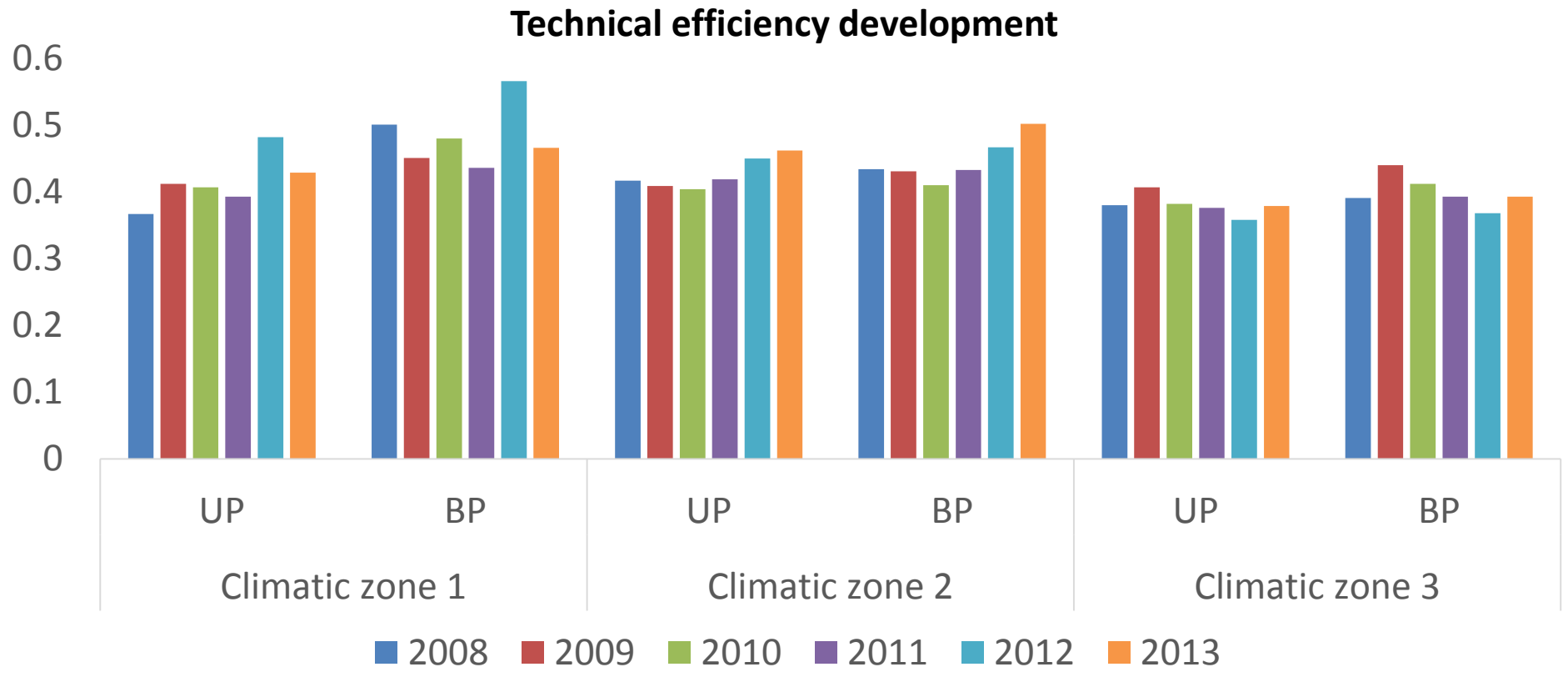
2nd climatic zone – not enough moisture, warm;

3rd climatic zone – (very) dry, very warm.

Source: own presentation based on Bulava (2008)

Results – technical efficiency

- Surprisingly low technical efficiency among Ukrainian farms, slightly improving;



Source: own calculation

Results - productivity

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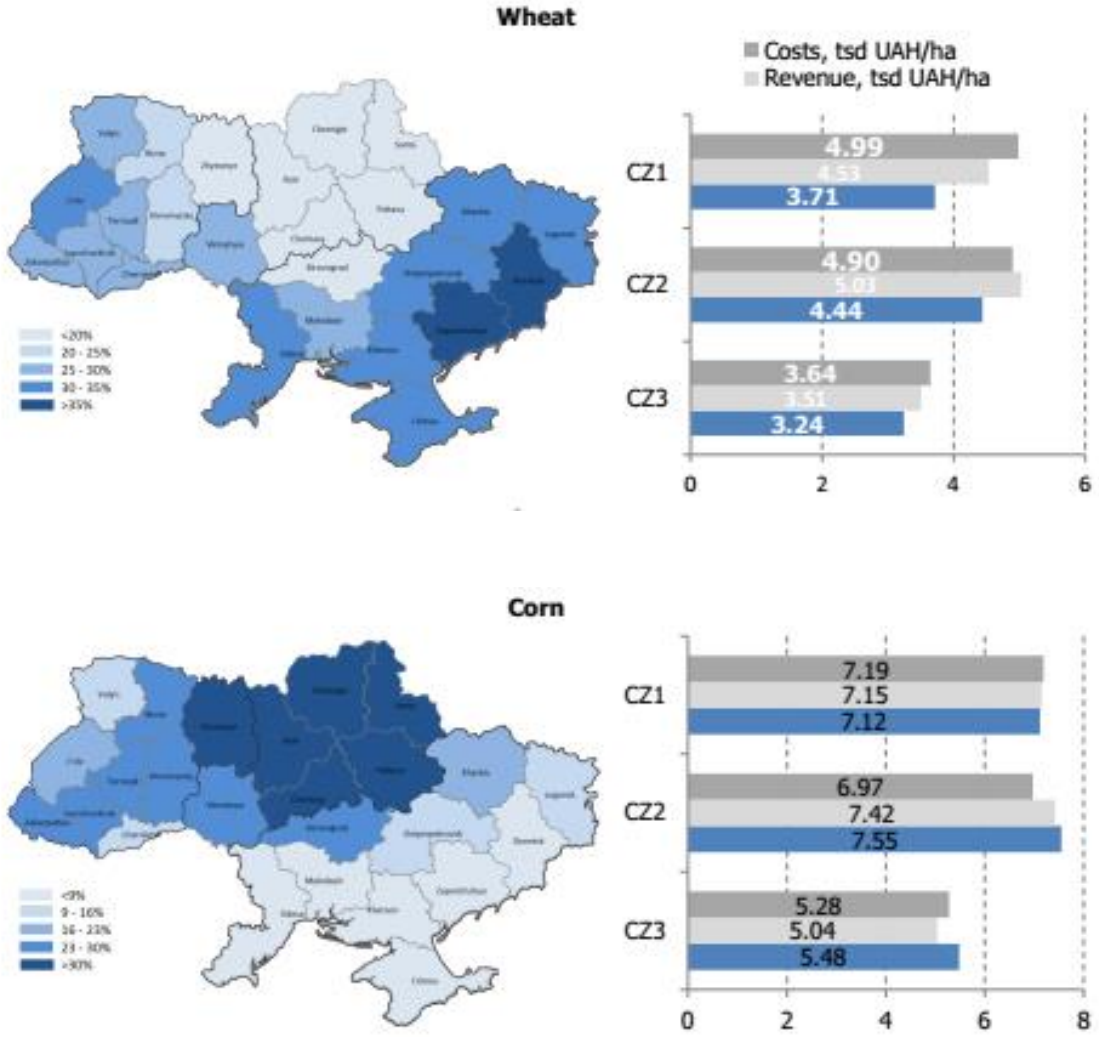


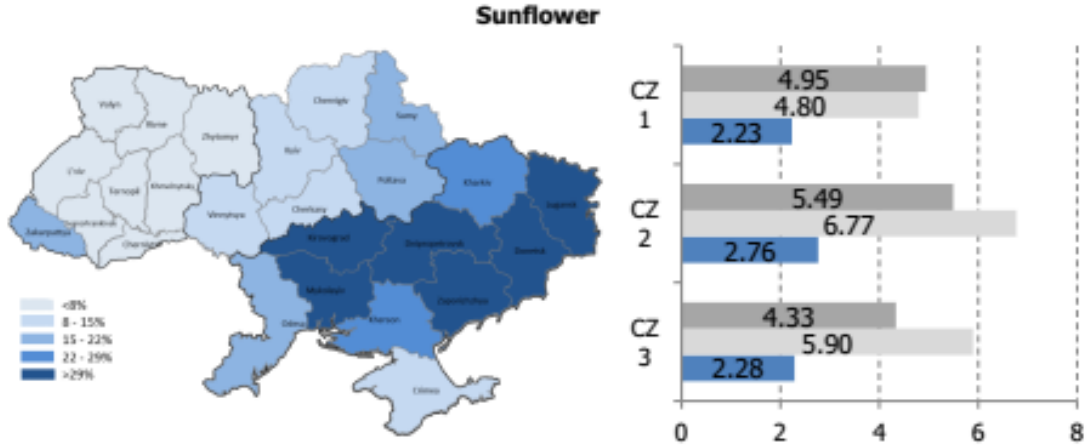
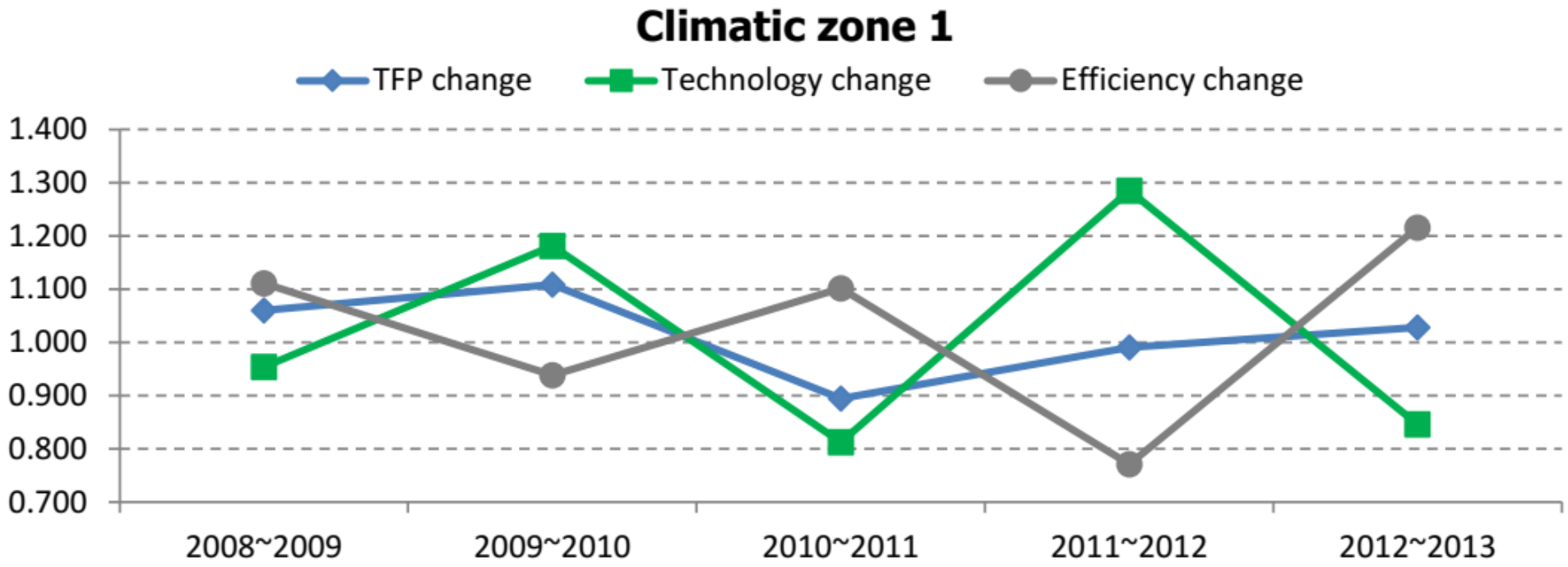


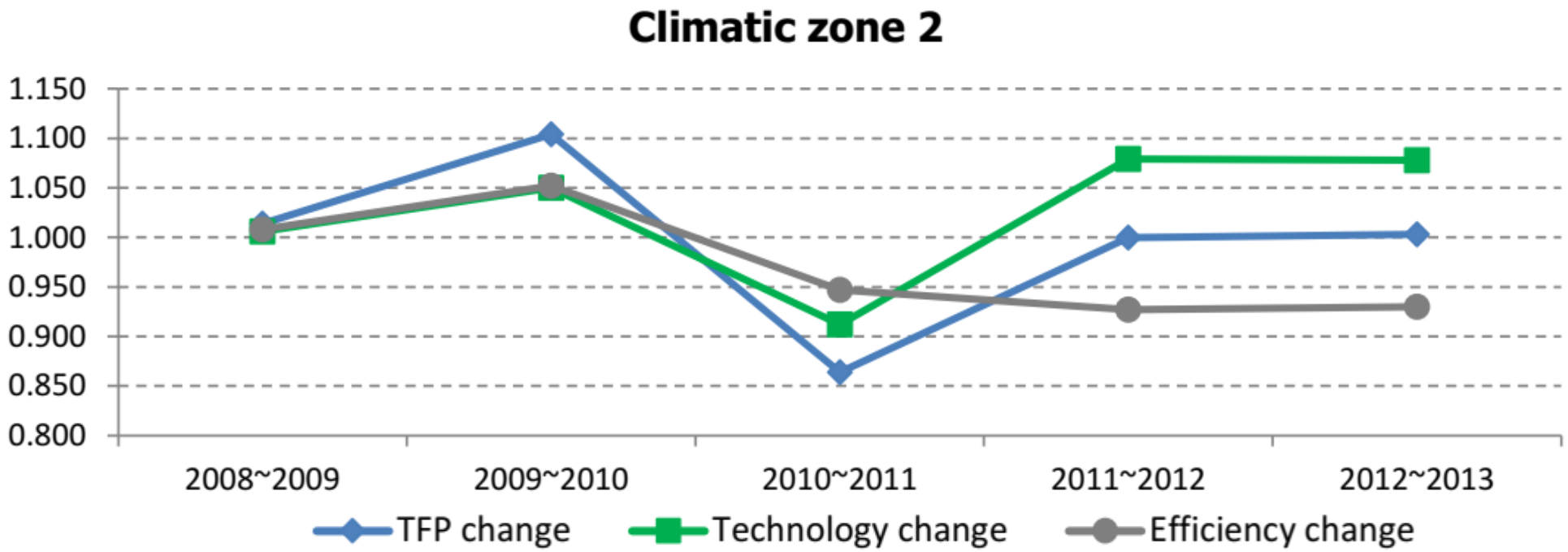
Figure 13. Distribution of sowing areas, production costs, revenues and yields in Ukraine in 2013

Source: SSSU (2013), own representation.

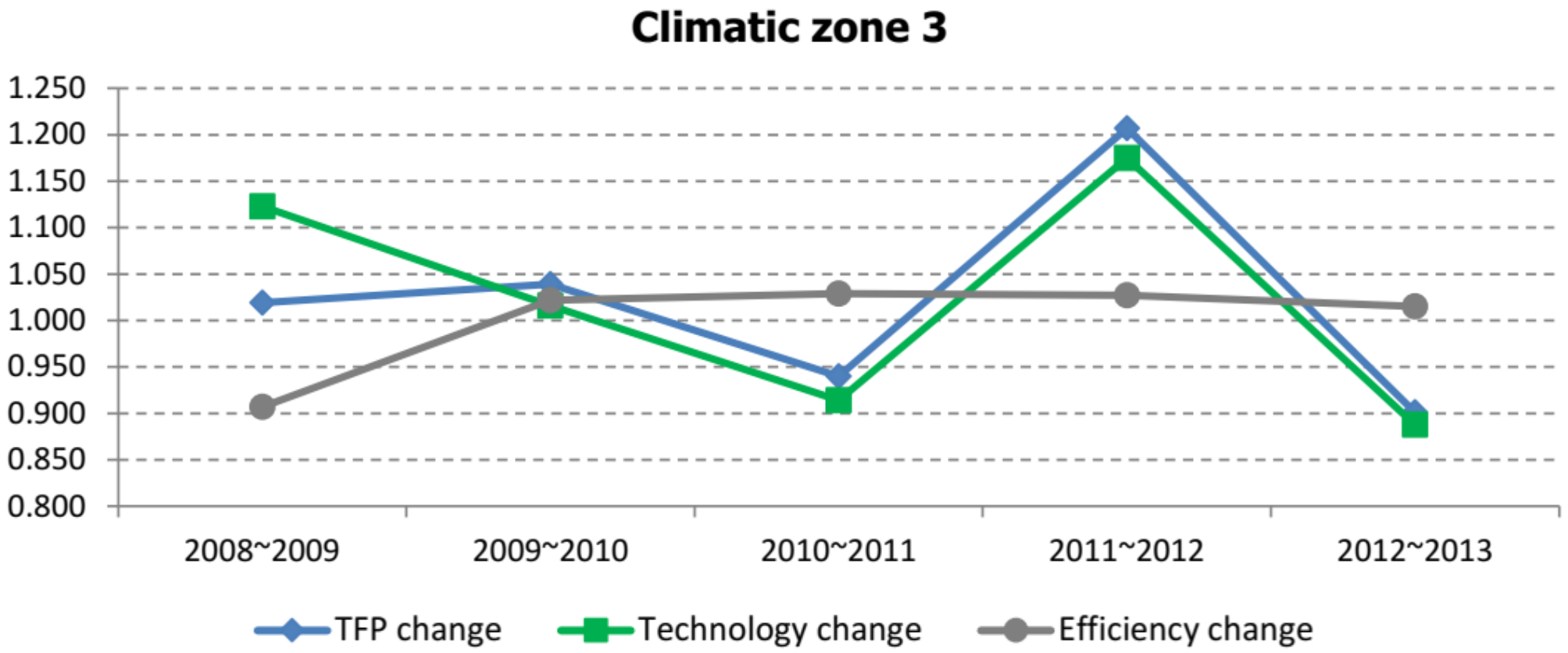
Results - productivity



Results - productivity



Results - productivity



Results – technical efficiency

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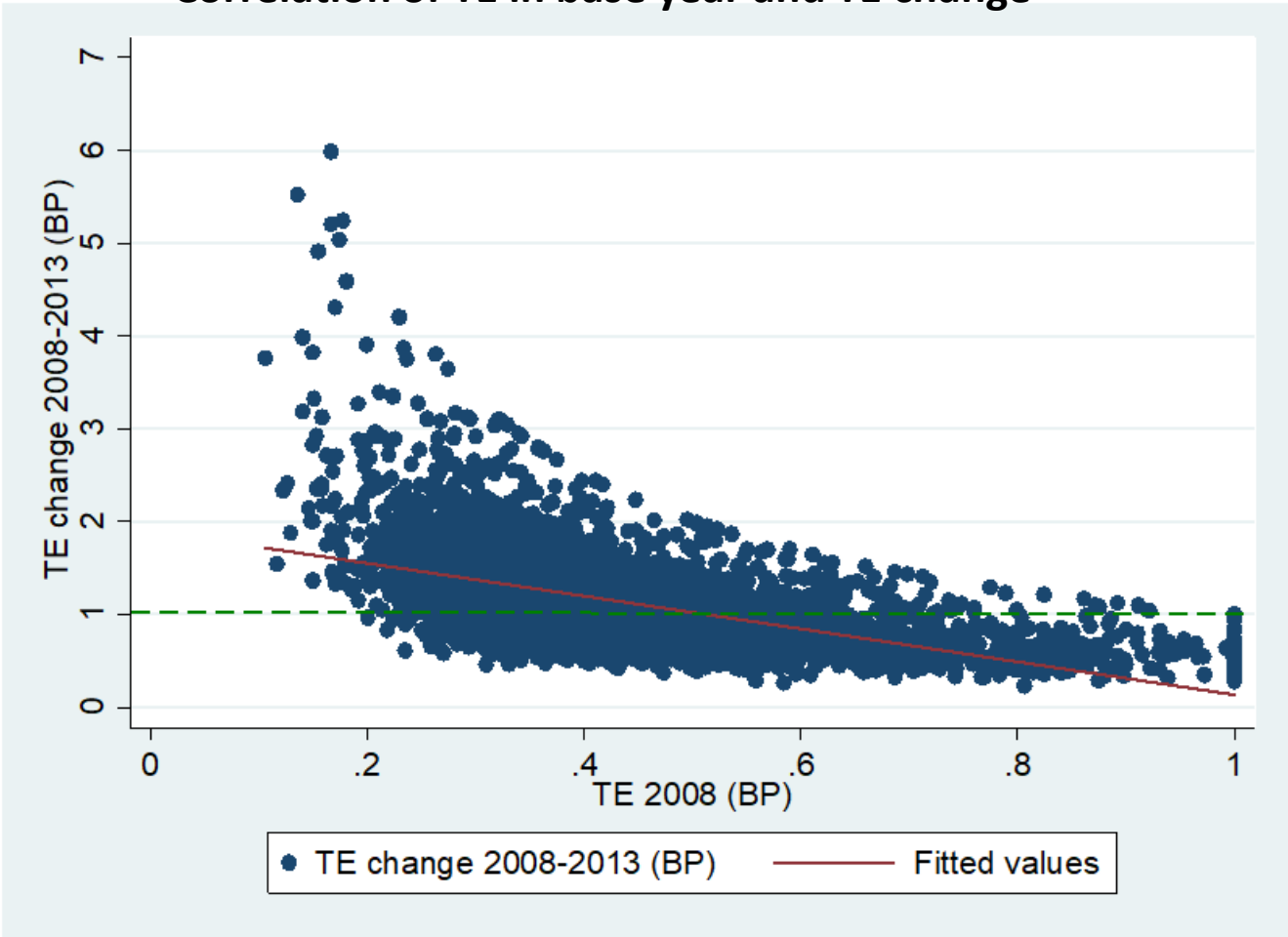
Correlation of TE in base year and TE change



Source: own calculations

Results – technical efficiency

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- Surprisingly low technical efficiency among Ukrainian farms only slightly improving
- High heterogeneity among farms, ca. 15-30% of unprofitable entities annually
- Balanced panel (BP) farms show higher technical efficiency: inefficient farms leave the sector at some point and / or new (or merged) farms run through an adjustment period and might require some time to improve their performance;
- Being efficient does not imply staying efficient in future, since many farms are often able to raise their efficiency while the opposite is true for other farms.

Results – yield determinants

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Costs:

- **Material costs** are the main driver of crop yields (particularly fertilizers and seeds).
- **Fertilizers** affect yields less in regions that are less specialized in production of specific crops due to unfavorable climatic conditions (i.e. sunflower production on western farms).
- **Seed** costs are an important factor in all regions in corn and sunflower production while the effect of seed costs on wheat yields is insignificant.
- Yields are sensitive to **land quality** (approximated by rental payments). This correlation is higher in regions with less favorable soil (i.e. West) and climatic (i.e. South-East) conditions.

Results – yield determinants

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Size effects, concentration:

- The size of particular crop **harvested area** does not affect yields itself, but the **share of particular crop** in total sown areas of the farm has heterogeneous influence, mainly implying negative effects of specialization.
- The **farms above the median size** experience positive effects on yields in regions specialized in production of specific crops.
- We observe only minor and heterogeneous effects of **holding affiliation** on yields.

Profit, state support, learning:

- The **profit** gained in the previous year (as a lagged variable) positively influences yields.
- The effects of **state support** on the yield level is specific (i.e. negative effect in regions with predominant cost-minimizing behavior of farmers, while positive in others).
- The **experience** of growing a particular crop contributes positively to yields in most regions.

Results – treatment effect analysis

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- More profitable farms are characterized by higher crop production value;
- There is no statistically significant difference between more profitable and less profitable farms in terms of land and labor use;
- More profitable farms follow intensification rather than land expansion strategies.

Dependent variable	Number of observations	Coefficients		
		2008	absolute growth	2013
Crop production (CP) value	4497	1537.5***	-1398.8***	138.7
Arable land	4497	87.1	-55.4	31.7
Labor in CP	4497	1.1	-0.5	0.6
Share of niche crops	4497	0.005*	0.02***	0.02***

* - statistical significance on 10% level; ** - 5% level; *** - 1% level

Results – treatment effect analysis

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- More profitable farms had:
  - lower land rent costs (significant differences within the Central-North and South-East climatic zones);
  - lower use of material costs per ha, but the result is significant in 2008 only;
  - farms with higher profitability seem to use superior (modern) technology (indicated by higher capital assets).

Dependent variable	Number of observations	Coefficients		
		2008	absolute growth	2013
Land rent per hectare	4301	-0.02***	-0.02**	-0.04***
Material costs in CP per hectare	4497	-0.03***	0.04	0.01
Depreciation in CP per hectare	4163	0.01***	0.04***	0.05***

* - statistical significance on 10% level; ** - 5% level; *** - 1% level

Results – treatment effect analysis

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  - less profitable farms rather rely on third-party services and have a tendency to increase their use.
  - the treated group has lower labor costs per hectare;
- More profitable farms have higher crop production value and yields per hectare.

Dependent variable	Number of observations	Coefficients		
		2008	absolute growth	2013
Third-party services in CP per hectare	4497	-0.02***	-0.03*	-0.05***
Labor costs in CP per hectare	4497	-0.03***	0.01*	-0.02***
CP value per hectare	4497	0.42***	-0.30***	0.12***
Crop yield	*4497*	*0.42****	*-0.22****	*0.20****

* - statistical significance on 10% level; ** - 5% level; *** - 1% level

Summary & conclusions

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- Ukrainian farms feature low technical efficiency, which highlights considerable farm heterogeneity in terms of production performance
  - Besides weather, local conditions and/or managerial potential play an important role
  - Considerable potential to increase crop yield by intensification
    - Almost any indicator reacts positive towards intensification
    - Low input levels signal cost minimizing strategy
- Positive trend in terms of productivity, and less pronounced efficiency
  - Mostly due to a small number of farms, including agroholdings

Summary & conclusions

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- A number of key issues are external to the farm sector:
  - Limited access to required capital
  - Land market imperfections
  - Exposure to different types of risk
  - Underdeveloped supply chains

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Thank you for attention!