Growth and development in Ukrainian agriculture: evidence based policy dialog

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Overview

1. Ukrainian agriculture: background
2. Are mega-farms the future of Ukrainian agriculture?
3. Security of Property Rights and Transition in Land Use
4. Land reform: next steps
1. Ukrainian agriculture: background

- Population: 46 mln.
- Land used in agriculture: 41.2 mln ha (2017)
- Agricultural production – 10.2% GDP (2017)
- Agricultural export -17.7 billion USD (28% of Ukrainian export), 2017
1. Ukrainian agriculture: structure

**Individual (subsistent)**
- 14 M rural population (32%)
- 6.9 M land plots (on average 5 ha)
- Cultivate individually – 16 M ha
- Subsistence farming - 48% of agricultural output

**Corporate**
- Two types of corporate farms:
  - 32,400 small farms – 2.5 M ha (average 75 ha)
  - 9,500 large farms – 17.5 M ha (average 2000 ha)
- 99% of land is rented

99% of land is rented
Index of agricultural output, Ukraine, 1995–2012

1. Ukrainian agriculture: land reform

Source: Center for Land Reform Policy in Ukraine
1999 - 2002: Start of Structural changes in Ukrainian agriculture

- Establishment of rental market
- Entry of new operators
- Productivity growth and emergence of super large farms (Agroholdings)
- Change in crop mix and investment patterns
2. Are mega-farms the future of global agriculture? Exploring the farm size-productivity relationship for large commercial farms in Ukraine

*World Bank Economic Review (2017)*, with Klaus Deininger, Denys Nizalov and Sudhir Singh
Questions

1. Whether the new technology in agricultural production change the negative relationship between farm size and productivity?
2. Are mega-farms the future of global agriculture?
3. What should be the focus of government policy?
2.1. Farm size and productivity in agriculture

- **Large scale farms** – plantations vs. capital intensive new technologies (new varieties, GPS-enabled equipment – *Deininger and Byelee 2012*)
- Economies of scale in production, processing and distribution; better access to capital and other input markets
- BUT: weak empirical evidences; monopoly power on local markets; political lobbying for subsidies and protection (beyond economic efficiency – *Barro 2000*)
2.2. Data and structural changes in Ukrainian agriculture during 2001-2012

- State Statistics Committee of Ukraine
  - 2001-2012 annual, farm level (unbalanced) panel, universe
- 2010 real USD
- Sample:
  - 100,600 obs (on 17,101 farms above 200 ha)
### 2.3. Increase in the average farm size and inequality in distribution

<table>
<thead>
<tr>
<th></th>
<th>Initial</th>
<th>End</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area cultivated (mln ha.)</td>
<td>20.59</td>
<td>17.87</td>
</tr>
<tr>
<td>Avg. farm size (ha)</td>
<td>2,061</td>
<td>2,320</td>
</tr>
<tr>
<td>Median farm size (ha)</td>
<td>1,625</td>
<td>1,422</td>
</tr>
<tr>
<td>Land Gini</td>
<td>0.316</td>
<td>0.471</td>
</tr>
<tr>
<td>Area under farms &gt; 10,000 ha</td>
<td>654,755</td>
<td>3,633,922</td>
</tr>
<tr>
<td>Area under farms &gt; 20,000 ha</td>
<td>255,572</td>
<td>2,200,557</td>
</tr>
<tr>
<td>No. of farms &gt; 10,000 ha</td>
<td>40</td>
<td>163</td>
</tr>
<tr>
<td>No of farms &gt; 20,000 ha</td>
<td>7</td>
<td>54</td>
</tr>
<tr>
<td>Maximum farm size (ha)</td>
<td>88,032</td>
<td>154,148</td>
</tr>
<tr>
<td>Profit/ha</td>
<td>8.13</td>
<td>43.99</td>
</tr>
<tr>
<td>Output /ha</td>
<td>172.31</td>
<td>547.71</td>
</tr>
<tr>
<td>Cost/ha</td>
<td>164.18</td>
<td>503.72</td>
</tr>
<tr>
<td>No. of obs</td>
<td>9,992</td>
<td>7,701</td>
</tr>
</tbody>
</table>
2.4. Value of output and cost/ha
2.5. Farm Size and Productivity

C-D Production function model:

\[ Y_{it} = \zeta + \beta X_{ipt} + \eta Z_{it} + \alpha_{ij} + \varepsilon_{it} \]

- \( Y_{it} \) - output (in log of monetary terms)
- \( X_{it} \) - inputs \( m \) (labor, land, seeds, fertilizer, fuel and energy, capital, spare parts, services)
- \( \alpha_{ij} \) – unobservable productivity shock for farm \( i \) located in rayon \( j \)
- \( Z \) – Controls

Estimated on a sample of single-unit farms for 2004-2012
### 2.5. Crop production function estimates, Single farms 2004-12

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>Rayon FE</th>
<th>Farm FE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land (ha)</td>
<td>0.159***</td>
<td>0.224***</td>
<td>0.334***</td>
</tr>
<tr>
<td></td>
<td>(35.794)</td>
<td>(51.045)</td>
<td>(45.263)</td>
</tr>
<tr>
<td>Labor</td>
<td>0.123***</td>
<td>0.109***</td>
<td>0.117***</td>
</tr>
<tr>
<td></td>
<td>(43.450)</td>
<td>(40.705)</td>
<td>(33.746)</td>
</tr>
<tr>
<td>Seed</td>
<td>0.171***</td>
<td>0.174***</td>
<td>0.149***</td>
</tr>
<tr>
<td></td>
<td>(51.317)</td>
<td>(55.429)</td>
<td>(43.308)</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>0.140***</td>
<td>0.137***</td>
<td>0.096***</td>
</tr>
<tr>
<td></td>
<td>(63.641)</td>
<td>(66.017)</td>
<td>(42.001)</td>
</tr>
<tr>
<td>Machinery</td>
<td>0.115***</td>
<td>0.087***</td>
<td>0.069***</td>
</tr>
<tr>
<td></td>
<td>(47.272)</td>
<td>(38.071)</td>
<td>(26.083)</td>
</tr>
<tr>
<td>Fuel &amp; energy</td>
<td>0.252***</td>
<td>0.202***</td>
<td>0.147***</td>
</tr>
<tr>
<td></td>
<td>(65.424)</td>
<td>(56.713)</td>
<td>(37.729)</td>
</tr>
<tr>
<td>Other</td>
<td>0.117***</td>
<td>0.096***</td>
<td>0.085***</td>
</tr>
<tr>
<td></td>
<td>(68.691)</td>
<td>(59.659)</td>
<td>(47.861)</td>
</tr>
<tr>
<td>Constant</td>
<td>-3.06</td>
<td>0.145</td>
<td>1.306**</td>
</tr>
<tr>
<td></td>
<td>(-0.000)</td>
<td>(0.000)</td>
<td>(2.131)</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.841</td>
<td>0.812</td>
<td>0.554</td>
</tr>
<tr>
<td>F-stat for CRS</td>
<td>795</td>
<td>114.6</td>
<td>0.181</td>
</tr>
<tr>
<td>P-value</td>
<td>0.000</td>
<td>0.000</td>
<td>0.671</td>
</tr>
<tr>
<td>Sum of coefficients</td>
<td>1.077</td>
<td>1.029</td>
<td>0.997</td>
</tr>
</tbody>
</table>

Observations: 64,513
Rayons FE: 554
Farms FE: 13,456
2.5. Farm and rayon fixed effects by farm size, 2004-2012
2.5. Farm fixed effect by nature of entry/exit

The graph shows the cumulative probability of farm fixed effect by nature of entry/exit. The x-axis represents the farm fixed effect, ranging from -1 to 1, while the y-axis represents the cumulative probability, ranging from 0 to 1. The graph includes four lines, each representing a different category:

- Solid line with dots: Exiters
- Solid line with dashes: Stayers
- Dashed line: Temporary entrants
- Dotted line: Permanent entrants

The cumulative probability is calculated for each category, showing the proportion of farms that fall below a given value of the farm fixed effect.
2.6. Summary and Policy Implications

- We **reject** the hypothesis of economies of scale in production for modern capital intensive farms.
- The large farms’ superior performance can be attributed to **unobserved rayon (district)- and farm-specific attributes** (access to infrastructure and managerial skills).
2.6. Summary and Policy Implications

Implications for policy:

• Creation of large farms by itself **WOULD NOT** lead to efficiency gains (as would be the case with economies of scale)

• Success in agricultural development **WILL BE contingent on** provision of complementary public goods and the ability to create, attract, and retain agronomic and managerial talent.
2.6. Summary and Policy Implications

- **Causal interpretation** of the temporal coincidence of productive recovery with growth of mega-farms may be a fallacy.

- Exit of inefficient farms during the early years of reform up to 2006, and entry of more efficient ones - most though not all below 3,000 ha - that peaked in 2007-2009, emerge as **key drivers** of improved agricultural productivity in Ukraine.
2.6. Summary and Policy Implications

Implications for policy:
• **Removing exit/entry barriers** (instead of protection) would facilitate productivity growth in agriculture

Beyond Ukraine:
• **Development of modern agriculture** becomes similar to most other industries and is conditional on managerial and entrepreneurial abilities and innovations
3. Security of Property Rights and Transition in Land Use

3.1. Share of Rented Land, 2001-2012

**Farm size and share of rented land**

- **Land rental market:**
  - Tenants power

- **Uncertainty:**
  - Ceiling;
  - Preemptive rights;
  - Rights to buy

- **Response:**
  - Landlords – short contracts
  - Tenants - underinvestment
3.1. Land Rental Market

Share of rented land, Ukraine, 2001

Share of rented land, Ukraine, 2011
Questions:
1. Does the institutional uncertainty affect investment decisions in Ukrainian agriculture?
2. Are small farms more vulnerable than the mega-farms?
3.2. Theoretical Model

**Switching model** (e.g. Turnbull 2002)

Switch at $t_0$, when:

- $\text{NPV(annuals)} \leq (\text{NPV(perennials) - Investment})$

\[ \text{(1)} \quad \text{NPV} = \int_0^\infty W(k, t, y) e^{-rt} \, dt \]

\[ \text{(2)} \quad \max_{t_0} \text{NPV} = \int_0^{t_0} W(k = 0, t, y) e^{-rt} \, dt + \int_{t_0}^\infty W(k > 0, t, y) e^{-rt} \, dt - Ke^{-rt_0} \]

$W$ – revenue per year

$k$ – investment

$t$ – time trend

$y$ – plot specific productivity

$r$ – discount rate

$t_0$ – time of switch

$\Theta$ – risk of taking

• Assumptions
3.2. Empirical Model

- **Dependent variables:**
  - Share of *perennial* crops
  - Share of *grains*
  - Share of *oil seeds*

- **Independent variables:**
  - Share of rented land t, t-1, t-2, t-3 – *Exposure to the risk of taking*

- **Controls:**
  - Year dummy
  - District (rayon) dummies
  - Farming area, prices, lag of dependent variable, labor market

- **Tobit (SUR)**
## 3.4. Share of crop among the crop producers

<table>
<thead>
<tr>
<th></th>
<th>0.1-200 ha</th>
<th>200.1-1000</th>
<th>1000.1-2000</th>
<th>2000.1-5000</th>
<th>Above 5000.1 ha</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perennials</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>23.94</td>
<td>9.36</td>
<td>6.15</td>
<td>2.45</td>
<td>0.93</td>
<td>3.23</td>
</tr>
<tr>
<td>2012</td>
<td>41.99</td>
<td>16.16</td>
<td>6.47</td>
<td>2.70</td>
<td>0.61</td>
<td>2.65</td>
</tr>
<tr>
<td><strong>Oil crops</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>21.64</td>
<td>12.04</td>
<td>12.34</td>
<td>13.88</td>
<td>14.77</td>
<td>13.69</td>
</tr>
<tr>
<td>2012</td>
<td>40.19</td>
<td>33.06</td>
<td>30.40</td>
<td>28.75</td>
<td>26.32</td>
<td>28.51</td>
</tr>
<tr>
<td><strong>Grains</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>61.01</td>
<td>49.46</td>
<td>46.63</td>
<td>45.47</td>
<td>46.36</td>
<td>46.33</td>
</tr>
<tr>
<td>2012</td>
<td>64.74</td>
<td>50.83</td>
<td>50.71</td>
<td>47.47</td>
<td>50.07</td>
<td>49.33</td>
</tr>
</tbody>
</table>
3.5. Effect of land insecurity across farm size

**Perennial Crop Share Response**

<table>
<thead>
<tr>
<th>Rental Effect</th>
<th>Rented share (t-1)</th>
<th>Rented share (t-2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.025</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.025</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.05</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

-0.37

Above 5000 ha
2000.1-5000 ha
1000.1-2000 ha
200.1-1000 ha
0.1-200 ha
All
3.5. Effect of land insecurity across farm size

**Grain Crops Share Response**

<table>
<thead>
<tr>
<th>Farm Size</th>
<th>Rent Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above 5000 ha</td>
<td>Rented share (t-1)</td>
</tr>
<tr>
<td>2000.1-5000 ha</td>
<td>Rented share (t-2)</td>
</tr>
<tr>
<td>1000.1-2000 ha</td>
<td>Rented share (t-3)</td>
</tr>
<tr>
<td>2000.1-5000 ha</td>
<td>Rented share (t-4)</td>
</tr>
<tr>
<td>0.1-200 ha</td>
<td></td>
</tr>
<tr>
<td>All</td>
<td></td>
</tr>
</tbody>
</table>

-0.075 -0.025 0.025 0.075 0.125
3.5. Effect of land insecurity across farm size

Oil Crops Share Response

Rent Effect
- Rented share (t-1)
- Rented share (t-2)
- Rented share (t-3)
- Rented share (t-4)

Above 5000 ha
2000.1-5000 ha
1000.1-2000 ha
200.1-1000 ha
0.1-200 ha
All
3.6. Security of Property Rights: Conclusions

- Uncertainty in Ukraine’s land tenure system *constrains farmer’s choice* of perennial crops (and likely other long term investments: livestock, dairy, greenhouses, irrigation).

- *Lower-value annual crops will likely dominate* Ukraine’s crop mix until the land purchases and sales are better supported by the policy regime.

- Ukrainian agriculture will face *under-investments* before the Land Reform is over.
3.6. Security of Property Rights: Conclusions

- Uncertainty in Ukraine’s land tenure system constrains agricultural and rural development
- Farms below 2,000 ha are most affected
- Improving quality of land governance in Ukraine would improve investment attractiveness of the sector and further productivity growth
4. Land reform: next steps

1. Opening land market, stimulating competition and investments
2. Improving access to finance and legal protection of small farms
3. Improving access to information and transparency
Land Transparency
Supporting Transparent Land Governance in Ukraine

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