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PRODUCTION MODEL FOR AGRICULTURE SECTOR IN DONETSK AND LUHANSK REGION: SYSTEM DYNAMIC EVALUATION

Donetsk and Luhansk regions had an industrial-oriented economic structure and a big impact on the whole Ukrainian economy. However, the beginning of the war led to a reduction in the activity of enterprises and migration of the region's population. This led to a decrease in gross domestic product, investment, exports, and rising unemployment in the region. Until 2013, the share of Donetsk region in the GDP of Ukraine averaged about 12%, and Luhansk 4%. The war changed the situation - during 2014-2020 Donetsk region produced an average of 6% of GDP, for the Luhansk region only 1% of GDP.

The model “Dynamic Planning Model for Donetsk and Lugansk Regions” is performed by David Wheat and MAEX Group for Ministry of Economic Development and Ministry for Reintegration of the Temporarily Occupied Territories of Ukraine.

Value added by a sector is the difference between production and inputs from other sectors. Production is a function of production capacity and capacity utilization. Total sales depend on final demand by households, government, and business and intermediate demand from other business firms that need for their own production processes. This relationship is considered in the Inputs Source module. Ordering of inputs is based not only on the desired product but also on the imports.

The territory of Donbass in terms of agricultural land area and yield was one of the leading in Ukraine. However, the beginning of the war in 2014 in Donbas region led to decreasing the agriculture products. Figure 2 describes changes over time of Output inventories in Donetsk and Luhansk region.

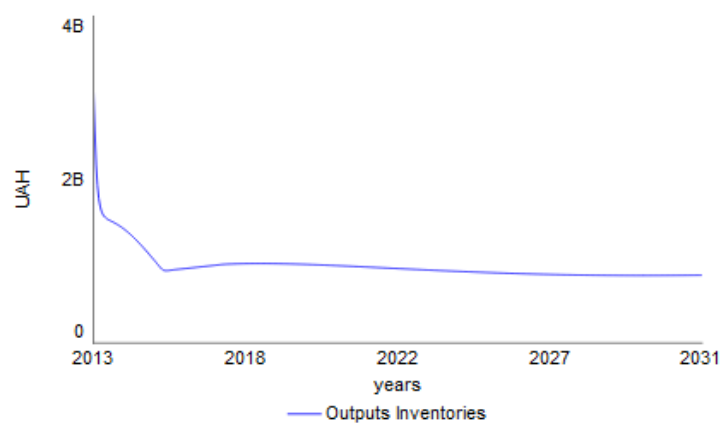


Figure 2. Output inventories

Dynamic problem is the decline of the Value Added in the Agriculture sector. Figure 3 shows projection of historical data and simulated data of Value added from 2013 to 2031. The model behavior is reasonably replicated with historical data. On the graph Value added rapidly decreased during the first two years from 8,78 billion UAH in 2013 to 4,69 billion UAH in 2015. And after 2015 still slowly decrease. As a result, the government projection for 2031 is only 5,42 billion UAH.

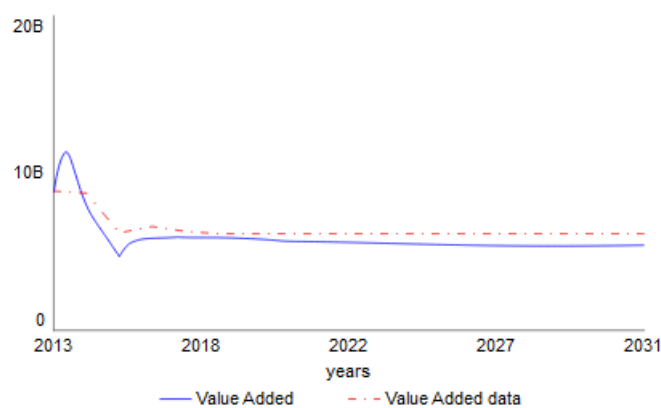


Figure 3. Value Added by Agriculture sub-model

The policy idea is to increase Value added by renovating agricultural production, increase grain exports, installation of new technologies and lastly, increase employment.

Table 1. Model Documentation for Production and Sales Sector

Variable	Equation	Units
Outputs_Inventories(t)	Outputs_Inventories(t - dt) + (production - sales) * dt INIT Outputs_Inventories =(final_demand_for_AG+intermediate_demand_AG) *desired_inventory_coverage	UAH
production	production_capacity *capacity_utilization	UAH/year
sales	MIN(max_sales; final_demand_for_AG +intermediate_demand_AG)	UAH/year
Production capacity	Employed*labor_productivity	UAH/year
capacity_utilization	MIN(1,2; desired_production/production_capacity)	unitless
desired_production	MAX(0; SMTH1(sales; 1/12)+desired_inventory_adj_rate))	UAH/year
desired_inventory_adj_rate	(desired_inventories-Outputs_Inventories) *inventory_gap_adj_speed	UAH/year
desired_inventories	SMTH1(sales; 1/12)*desired_inventory_coverage	UAH
value_added	production-intermediate_demand_AG	UAH/year
max_sales	Outputs_Inventories/min_inventory_coverage	UAH/year
intermediate_demand_AG	SMTH1(AGIS.order_AG_inputs +SVIS.order_AG_inputs +GDIS.order_AG_inputs; ,25; 16608206373,6)	UAH/year
final_demand_for_AG	SMTH1(ds.nominal_AD[AG]; ,25) /(1+0*d.Expected_Price_Index)	UAH/year

Various obstacles can stand in the way of policy implementation:

- One of the key problems of the Donbass development is security risk. The problem is that insurance companies do not guarantee and reimburse damages related to hostilities.
- A long-term obstacle to the development of the agricultural sector is the mining of areas (about 7,000 square kilometers of Ukrainian side of the demarcation line). But reducing the level of mine contamination of agricultural land requires significant amount of funds.

- Due to climate change, agriculture has faced the following problems:
 - the problem of lack of moisture in the soil, which makes it impossible to develop crops without the introduction of irrigation. And insufficient development of irrigation systems due to lack of investment.
- Because of the war infrastructure was declined, which makes it impossible to effectively logistics agricultural products. Insufficient railway network leads to overload and road destruction when farmers use road transport.

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