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ECONOMIC COSTS OF THE UKRAINIAN CONFLICT IN DONBASS

The Donbass war has taken a severe toll on Ukraine, claiming over ten thousand casualties and triggering a severe economic recession. Yet, to the best of our knowledge, there is no empirical evidence on the overall costs incurred by Ukraine as a result of the war. Thus, the goal of this paper is to start filling this gap by quantifying Ukraine's economic indicators foregone due to the Donbass war.

The 2014 Ukrainian war between pro-Russian separatists and the government in the Donbass region, Ukraine's productive core, has taken a severe toll on the country. Using cross-country panel data over the period 2006-2019, this paper quantifies the short-term causal effects of the Donbass war on Ukraine's economy. In this research, we want to show what the economy of Ukraine would be without war.

For more than five years, Russian forces and their proxies have waged a bloody war against Ukrainian forces in the Donbas region of eastern Ukraine. The War in Donbass is an armed conflict, that has claimed more than 13,000 lives, driven almost two million people from their homes, and caused immense material damage. The crisis has had many effects, both domestic and international. According to an October 2014 estimate by the World Bank, the economy of Ukraine contracted by 8% during the year 2014 as a result of the crisis. Since about 2015 there has been a growing number of Ukrainians working in the European Union, particularly Poland. Eurostat reported that 662,000 Ukrainians received EU residence permits in 2017, with 585,439 being to Poland. The head of the National Security and Defense Council of Ukraine has estimated that up to 9 million Ukrainians work abroad for some part of the year, and 3.2 million have regular full-time work abroad with most not planning to return. World Bank statistics show that money remittances back to Ukraine have roughly doubled from 2015 to 2018, worth about 4% of GDP.

The war in Donbass caused a coal shortage in Ukraine, as the Donbass region had been the chief source of coal for power stations across the country. Many coal mines have purposely or accidentally been flooded or damaged in other ways. Lot of metal equipment belonging to coal mines and various plants have simply been robbed and sold as scrap metal usually somewhere in Russia. Furthermore, Zaporizhia Nuclear Power Station was forced to close down one of its reactors after an accident. The combination of these two problems led to rolling blackouts across Ukraine during December 2014. Miscellaneous technical difficulties forced hundreds of Donbas' factories to either limit or totally stop the production. All this means that Donbas, which once was an industrial heart of the whole Ukraine, will not be economically useful for Ukraine for many years ahead. Nowadays after all these unfriendly actions of the Russian Federation, Ukraine faces economical crisis, because all economic indicators after 2014 have declined rapidly and continue to decline to this day.

The main purpose of my research is to give the answer for the next question: **what could be the economic situation of Ukraine without war?** For this, I built the model in which considered three economic sectors: Capital, Labor and Price.

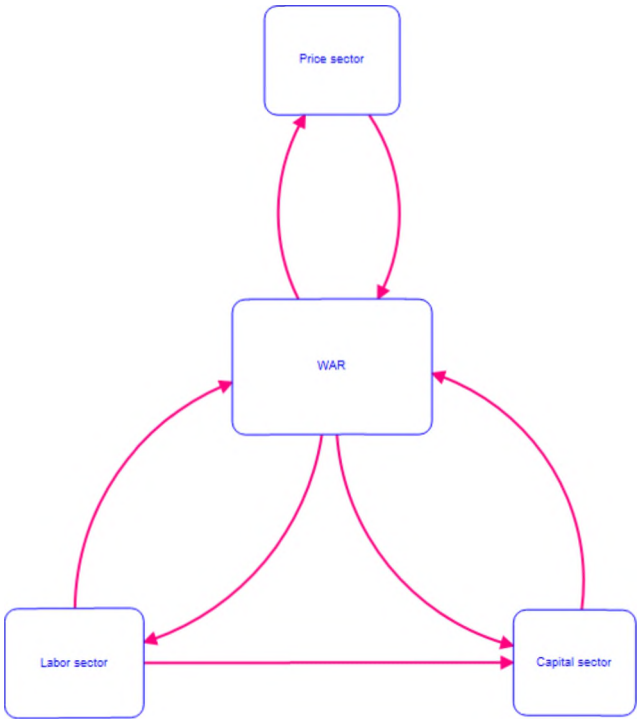

Figure 1. The main modules of the system dynamics model

The model can run in two modes: historic (with war since 2014) and experimental (without war). In historic mode, stocks take on the initial values that existed in the particular historical year in which the simulation begins (2006). In the experimental model, we assume that there is no war and we use self-predicted data from 2014 to 2019.

After the simulation begins in historic mode, however, stocks change endogenously based on the same equations used in the experimental mode. Each year, Theil statistics shows assessment of the accuracy that simulated by model and precision of the year economic forecasts that we have been generating since 2014 for experimental mode and since 2017-2019 for historic mode (data after 2017 are not available).The forecasts are, of course, compared with actual behavior in the Ukraine economy. About three-fourths of the equations reflect hypotheses about the structure of economy—how the pieces fit together, the incentives that give rise to decision rules, and the decision rules themselves. Less than ten percent of the equations are definitional relationships. The remainder (less than twenty percent) are exogenous parameter estimates— numerical constants that provide quantitative detail to the basic structure. Unless indicated otherwise, all delay structures are modeled as firstorder delays.

In this paper I'll describe results only for Labor sector. So, let's talk about Labor sector.

Hypothesis

The dynamical hypothesis is based on a deterministic mathematical model utilizing system dynamics methodology. That means that the system does not take into account randomness and it will always reproduce the exact same result given an input.

As we can see on the reference behavior patterns illustrated above, after 2014 Ukraine faces economical crisis. That is why the hypothesis in our model is a war. So we decided to simulate the economic crisis of Ukraine and show what the economy of Ukraine would be if there were no war.

The model boundary assumes that we consider three economic sectors of Ukraine: Labor, Capital and Price sector. In labor market we do not include the

number of informally employed persons and the number of Ukrainians who work temporarily abroad and money which they have transferred to Ukraine.

The structures of the model in the present research are based on generic SD structures and have been developed in accordance with the best System Dynamics practices for analyzing economic theories. The model takes an endogenous perspective on most of the structures.

The labor sector is displayed in figure below, contains a corresponding feedback loop diagram. In Figure below, loop B3 is a counteracting feedback loop connecting employment, the unemployment rate, nominal wages, and desired labor. Assume desired labor increased suddenly, due to an increase in aggregate demand. That would set in motion a hiring process that would eventually raise employment and lower the unemployment rate. It is likely, however, that another counteracting loop B1 would have been expanding the labor force ever so slightly. When the unemployment rate fell initially (and wages rose),the employment outlook would have improved and the opportunity cost of remaining unemployed would have risen. Thus, the initial drop in unemployment would set inmotion forces that would eventually constrain the demand for labor and - at the same time - boost the labor supply. Unemployment would not keep falling.

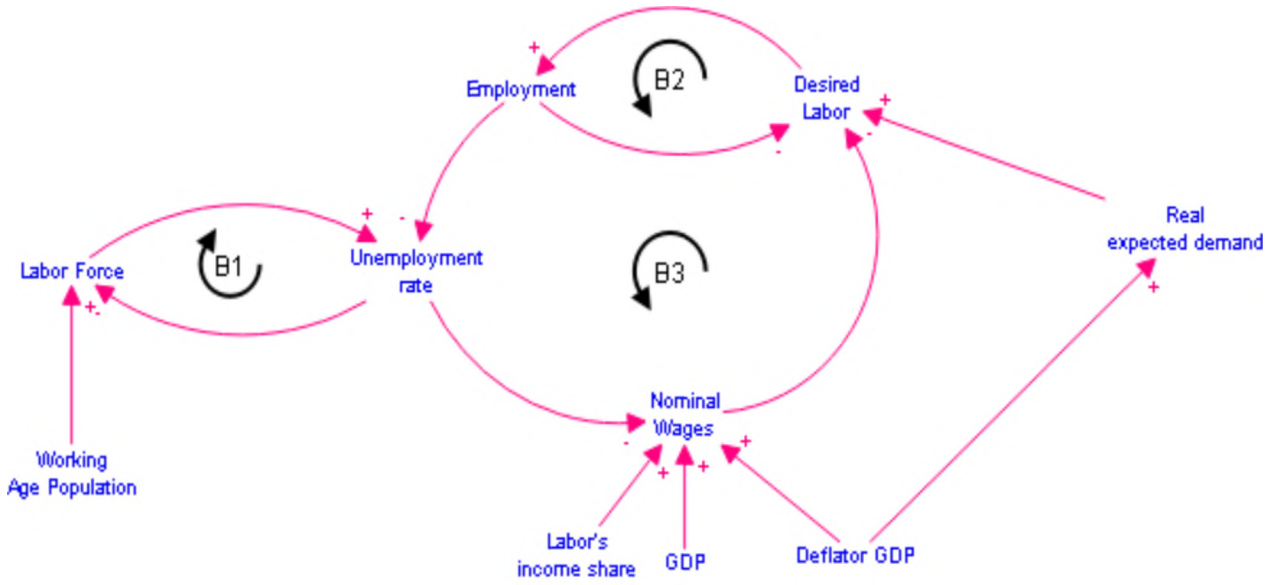

Figure 2. System Dynamics

Modeling is based on the assumption that the Labor market determines the demand for labor based on the average Labor's Productivity and Aggregate demand (Real Aggregate Demand), so therefore Desired Labor is calculated.Textbooks emphasize that the level of employment depends on both the supply and demand for labor (Mankiw ch. 10;McConnell/Brue, ch. 8). In the labor sector, the demand for labor is called "desired labor," and it depends positively on expected demand for goods and services and negatively on average wages— total wages divided by Employment.

More precisely, desired labor (in the equations table) depends on the nominal expected demand and nominal wages. Above-average profit opportunities exist when product prices are rising faster than the price of labor. An increase in the perceived demand for goods and services causes an increase in the demand for the labor required to produce those goods and services. An increase in the average nominal wage reduces the demand for labor, ceteris paribus. Indicated nominal wages is, therefore, a function of GDP, labor's share of income, the rice index, and the unemployment rate.

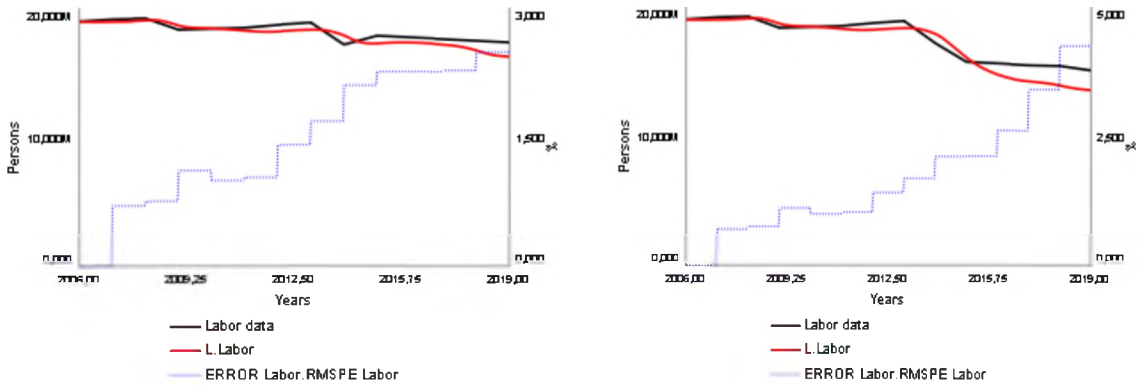

Figure 3. Historical (left) and Experimental (right) graphs of the Labor

Exogenously, in the sector is determined Working Age Net Growth, Joining Rate, Labor's Income Share. Inputs from other sectors are the level of GDP (Real GDP), Real Aggregate Demand, prices (Price Index).

Now let's look at the results and analyze them. From these figures below we can see what the economic situation in our country is now and what it could be without war on separate figures, where in historic mode I compare real data with model simulation and in experimental mode compare extrapolated data with model simulation. Also pay attention for Theil's statistics, which help us to understand the accuracy of our model and measure how wrong we are (in percentage). Here the solid red line is a simulated by model data, solid black line – real or estimated data, dotted blue line – percentage error.

The green color on the graph shows us estimation for a non-war economy, and the blue color shows the real situation now. As we see after 2014, all economic indicators are declining rapidly. But we have decided to demonstrate some of the main indicators of Ukraine's economy. The experimental model shows the much better situation of the Ukrainian economy that we can see in terms of capital and labor.

When the entire system is subjected to a shock, that is mean that War.Swith convector equals 1(Experimental mode), when War.Swith=0 then we have historical mode – with war. So we shows you what would be with Labor, Capital, Price of Ukraine without war.

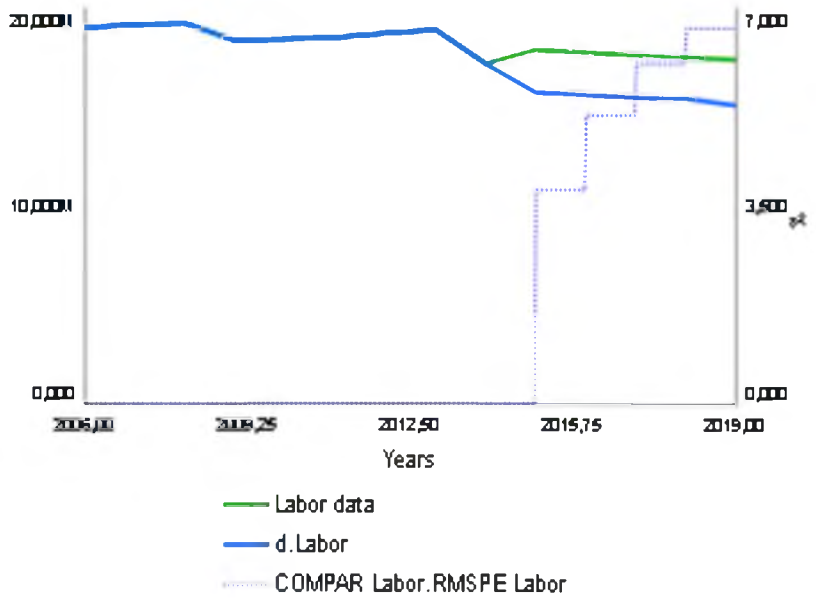

Figure 4. Comparing graphs of the Labor

Before talking about result, it is worth repeating the distinction between experimental mode and historic mode. In the Historical mode, users see actual historical data on the time series graphs. In historic mode, the model is trying to replicate the actual historic behavior of the Ukraine economy. It does so by beginning the simulation with the same conditions that existed at that "time" in Ukraine history. For example, if the simulation began in 1990, the initial values for the employment, interest rates, etc., would be the actual values that existed in 1990. After that initial beginning, however, the behavior of the model would depend on all the relationships in the model. It would not keep using actual data through out the simulation. In experimental mode, the model depends on the same structural relationships as in historic mode, but in 2014 the entire system is subjected to a shock (because we assume that there is no war in Ukraine) and data which we use for comparison were estimeted in Excel. Figure above illustrates two mode simulation, in which the two patterns diverge near the end of the simulation period.

As we can see: *Labor could be largen then 6%.*

Policy and Implementation

The first research sub-question of the main question – What is the dynamics of Ukrainian's economy during the pre-war period of 2006-2014 and during the war period of 2006-2019.

When I saw that all economic indicators after 2014 are falling rapidly, I decided to create a swith convector that would allow to show the dynamics of these indicators without war. So, when War.Switch =1 we are in experimental mode. The other sectors are subjected to a shock similary.

Experimental model was created to show how to solve economic crisis in our country. Thank's to it, I saw approximately how our country would develop and showed dynamics of different economic indicators. The experimental model demonstrates my policies and implementations.

My policy follows from the experimental model. We need to end the war that is still going on! It is also necessary to return the occupied territories because the Donbass is an industrial heart for our country.I have not seen the positive effects of the war and cannot say what they will be, because the war is not over yet and we

doubt that the war will end any time soon. As the war has intensified since 2014 and Russia continues to occupy our country.

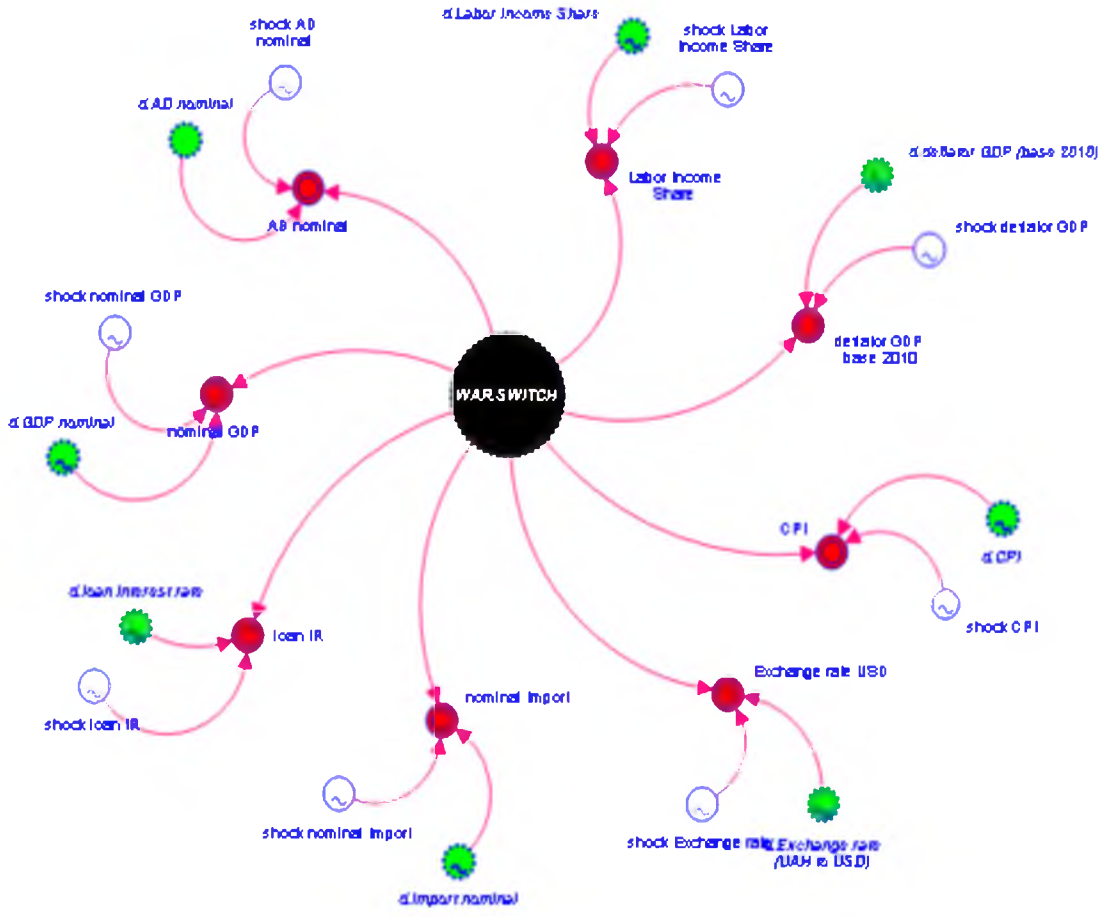

Figure 5. War Switch

According to this mode, I want to say, that war is death of the country's economy.

This model was developed based on the model of David Wheat. I am grateful for my results, David Wheat.

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