Hnatiuk Oleksandr
Master student, LNU
Kyrylych Volodymyr
Professor, LNU

ECONOMIC COSTS OF THE UKRAINIAN CONFLICT IN DONBASS: PRICE SECTOR

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 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.

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.

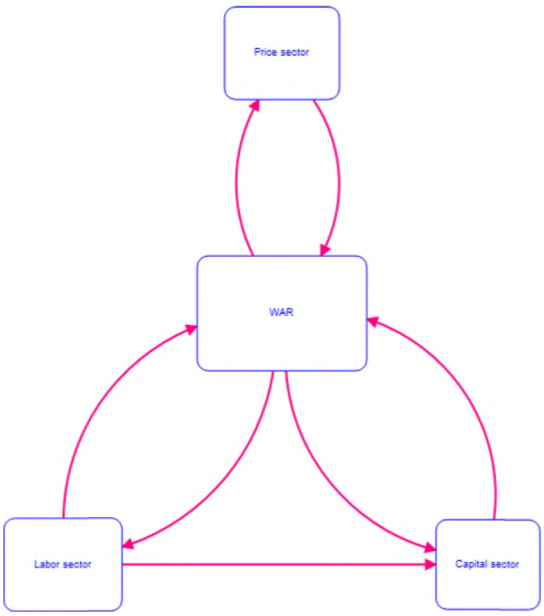

Figure 1. The main modules of the system dynamics model

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 Price sector and also compare the results for real GDP. The GDP deflator is a variable that is an indicator of a change in the price level until the base year 2010. The price level depends on the effect of two main influences: Demand Pull Effect and Cost Push Effect. Demand Pull Effect arises from exceeding the level of Real Aggregate Demand over Real GDP. Cost Push

Effect is shaped by change in Production Cost Growth. For the production of domestic products, it arises because of change in Raw Materials Cost Growth, again an indicator of such change is the price level (Price), and due to fluctuations in the cost of production factors to produce a unit products. For price Capital Cost Growth the model uses the Interest Rate on Loans and Average Life of Capital; Labor Cost Growth per unit of manufactured products is determined by the level of nominal wages and Nominal GDP. That is mean, the model assumes that the rise in the price level is provoked, on the one hand, by an excess demand for supply in the market, and on the other - rise in production purchase for resale of a unit of production. That is, the model assumes that the rise in the price level is provoked, on the one hand, by an excess demand over supply in the market, and on the other - rise in production costs or price for resale of a unit of production.

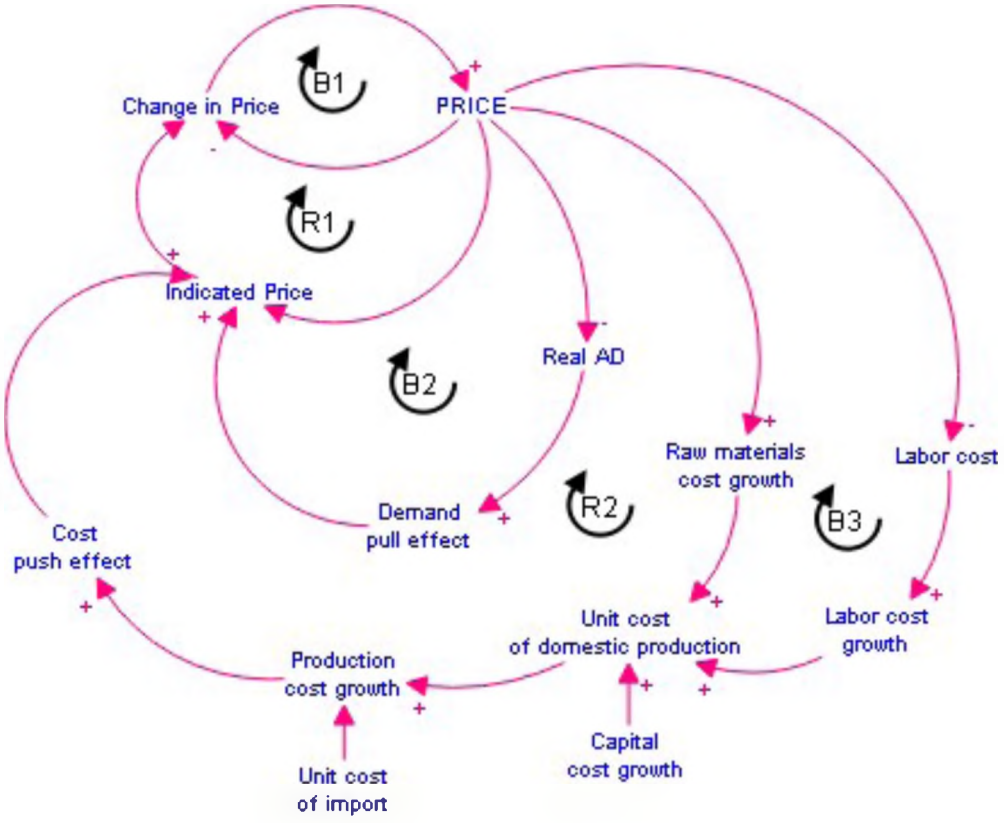

Figure 2. The feedback loop diagram for Price sector

The pricing sector is endogenously reflected the process of pricing (Price), Demand Pull Effect and Cost Push Effect. Inputs include GDP (Nominal GDP, Real GDP), Nominal Aggregate Demand, Nominal Wages, Avg. Life of Capital and Interest Rate on Loans. 8 The change in the price level in this model is only

endogenously affected of modeled factors, so there is no availability in the sector mechanisms of direct price restraint. However, the indicator the price level is influenced by the change in the level of Real Aggregate Demand, Nominal Wages, Interest Rate on Loans and Exchange Rate.

Variation in the price adjustment time has a significant effect on the behavior of the sub-model—in the obvious way of shortening or lengthening the phase-in of price changes. Moreover, when the full model is running, price plays a key role in several feedback loops, and variations in price adjustment time have both amplification and oscillatory impacts on the behavior of the full model. I estimated it to 0.1 of the year.

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.

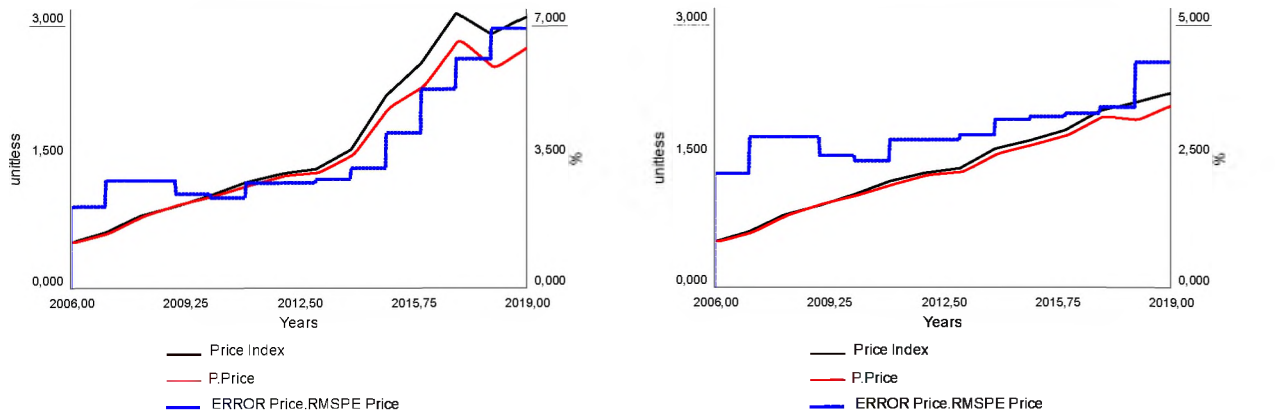

Figure 3. Historical (left) and Experimental (right) graphs of the Price Index

As we can see from graphs above, in Historical mode we got an error at around 7%, and for Experimental mode this number is equal to 4%.

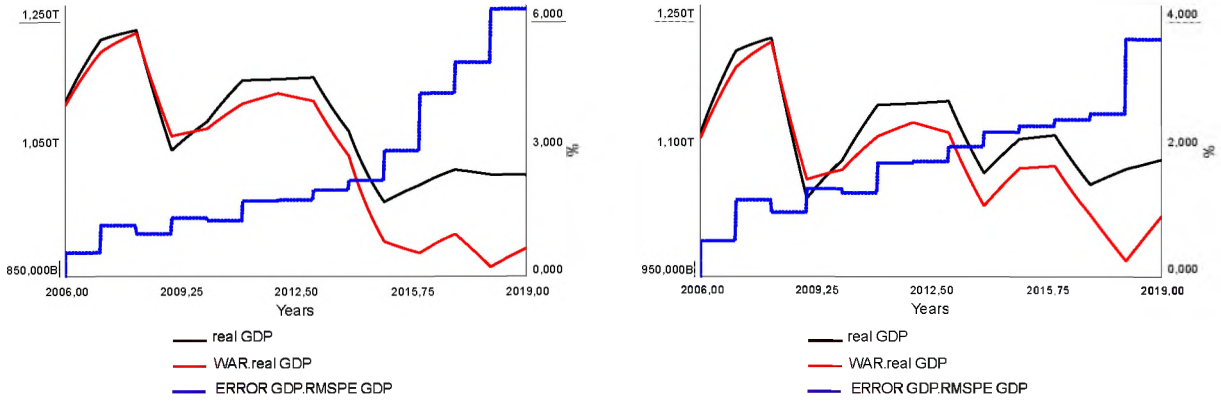

Figure 4. Historical (left) and Experimental (right) graphs of the Real GDP

Again, as we can see from graphs above, in Historical mode we got an error of 6%, and for Experimental mode this number is equal to 3.5%.

If we compare the results of two modes we will see that the Price Index could be less at 23% if there was no war in Ukraine (see graph below) (solid green line – Experimental mode, solid blue line – Historical mode, dotted blue line – percentage error between the two).

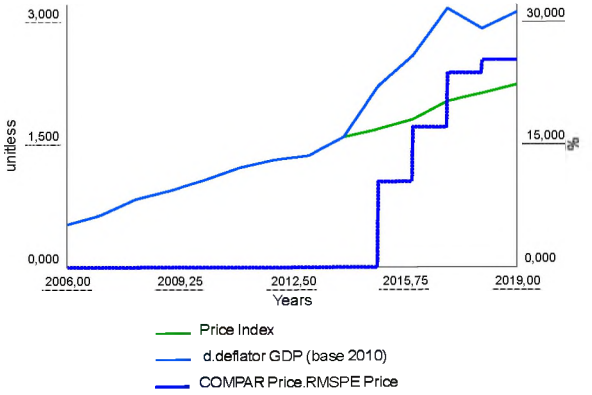

Figure 5. Comparing of the Price Index.

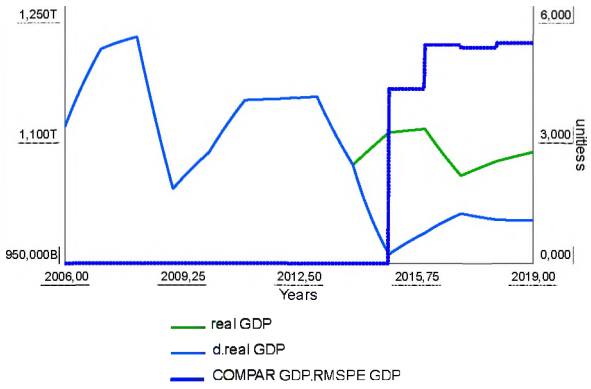

Figure 6. Comparing of the Real GDP

As for Real GDP, we get that it could be larger at 5% if the was nor conflict at Donbass area. So, now we clearly see what the situation would be with GDP, Price index if there was no aggression from Russia. Thus, these issues need further research, in particular through modeling.

References

1. Wheat, I. D. (2007). MacroLab Documentation.
2. Sterman, J. D. (1984). Appropriate summary statistics for evaluating the historical fit of system dynamics models. Dynamica.
3. Sterman, J. D. (2000). Business dynamics: System thinking and modeling for a complex world. Boston: McGraw-Hill.
4. Official site of the State Statistics Service of Ukraine. URL: http://www.ukrstat.gov.ua/.
5. Лук'яненко, І., Віт, Д. (2017). Системний аналіз формування державної політики в умовах макроекономічної дестабілізації.
6. Лук'яненко, І., Віт, Д., Оліскевич, М. (2020). Фінансова політика в умовах тінізації та дисбалансів на ринку праці: методологія та інструментарій.

Kaminskyi Andrii

Professor, Kyiv National University of Taras Shevchenko

Petrovskyi Oleksii

PhD student, NaUKMA

CONCEPTUAL FRAMEWORKS OF CREDIT SYSTEMS MODELING BY MEANS SYSTEM DYNAMICS TOOLS

Modern credit market is a complex system with rapidly increasing dynamic. This raises many interdependencies between constituent elements of this system. On of such component is set of interdependencies between market conditions and banks performance. Basically, banks develop their credit strategies in accordance of credit market conditions. But when banks realize their strategies it is changing the condition of the market with some delay in time. It is classical systemic effect. Typically changes concern to following market characteristics: Average deposit rate; Average time for issuing loan; Average interest rate; Number of potential borrowers; Average banks' profitability.

In the aggregate way in the long term it is reflected as a cyclic pattern of the credit market growth. Cyclic pattern was the subject of the investigation of Hyman Minsky. In his work "Stabilizing an Unstable Economy" ([2]) he shed light on the reason for such behavior of the credit systems. According to Minsky cyclic growth is inevitable result of income maximization by borrowers and creditors during the long terms of stability.