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MODELING NATIONAL INCOME RESPONSE TO EXTERNAL SHOCKS IN UKRAINE

To provide valid academic researches or implement proper policy, it is crucial to understand the behavior of the economy as a complex model. In our work we discover the impact of expenditure shock on open economy Simple Keynesian Model.

Simple Keynesian Model is accessible for its straightforward structure. The basic equation used in our model consists of the following parts:

E=Y	E - expenditures, Y - national income
E=C+I+G+NX	C - consumption, I – investments, G – government spending
NX=Ex-Im	NX – net export, Ex – exports, Im – imports
Yd=Y-Y*tx	Yd - disposable income, tx – tax rate

The classical income equation was replaced by initial value.

In Figure 1 we created a System Dynamics Version of Simple Keynesian Model for open economy.

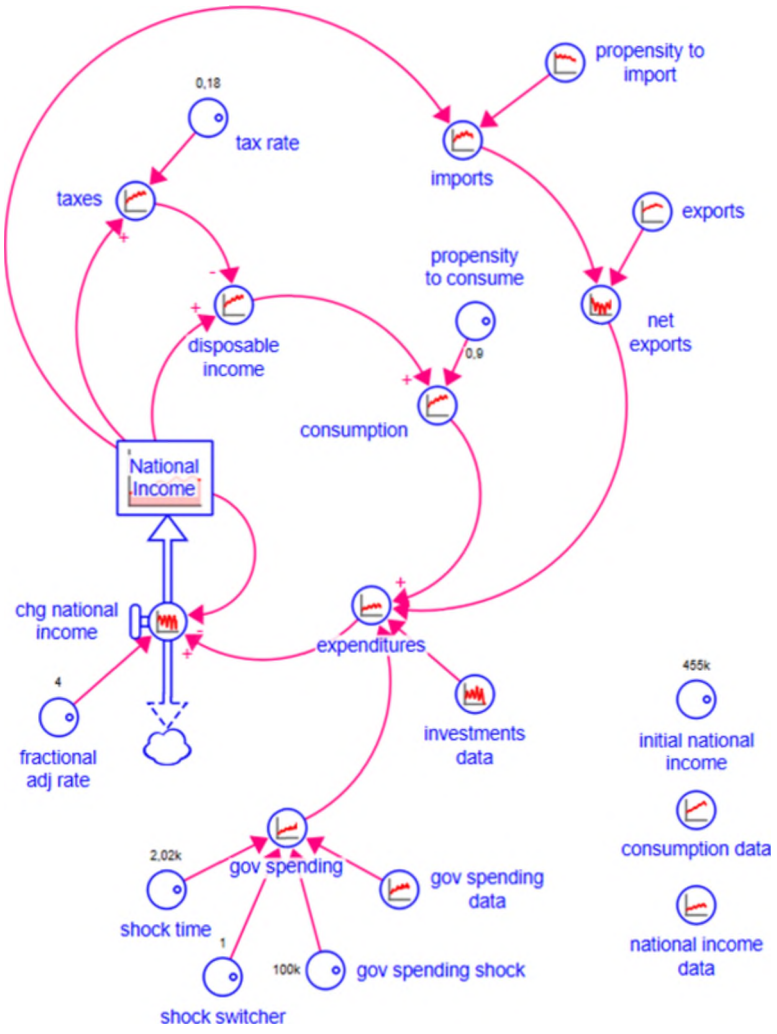

Figure 1. System Dynamics Version of Simple Keynesian Model for open economy

Source: created by the authors in Stella Architect Software

In System Dynamics Version of Simple Keynesian Model national income is a stock and expenditures variable is the new information coming in. National income changes gradually as we adjust to new information. Change in income is an inflow that equals to difference between expenditures and income multiplied by fractional adjustment rate. The difference between expenditures and national income is the gap and fractional adjustment rate shows how quickly the gap is closed. In this model there are 4 feedback loops.

In this model there are two types of equations: identity equations that are true by definition and behavioral equations that require a behavioral assumption. The key identity equation is that expenditures is the sum of consumption, investments, government spending and net export. Net export is the difference between exports and imports. Disposable income is the income after taxes have been subtracted. We assume that the tax rate is 18% as this is the key rate for income tax in Ukraine. Our second main assumption is that consumption equals disposable income multiplied by propensity to consume. Our hypothesis is that in Ukraine people are more likely to consume most of their income and as a result we adjusted propensity to consume to 90%.

On the graphs in Figure 2 we compare national income and consumption in the model with actual Ukrainian data from the first quarter of 2016 and till the second quarter of 2020.

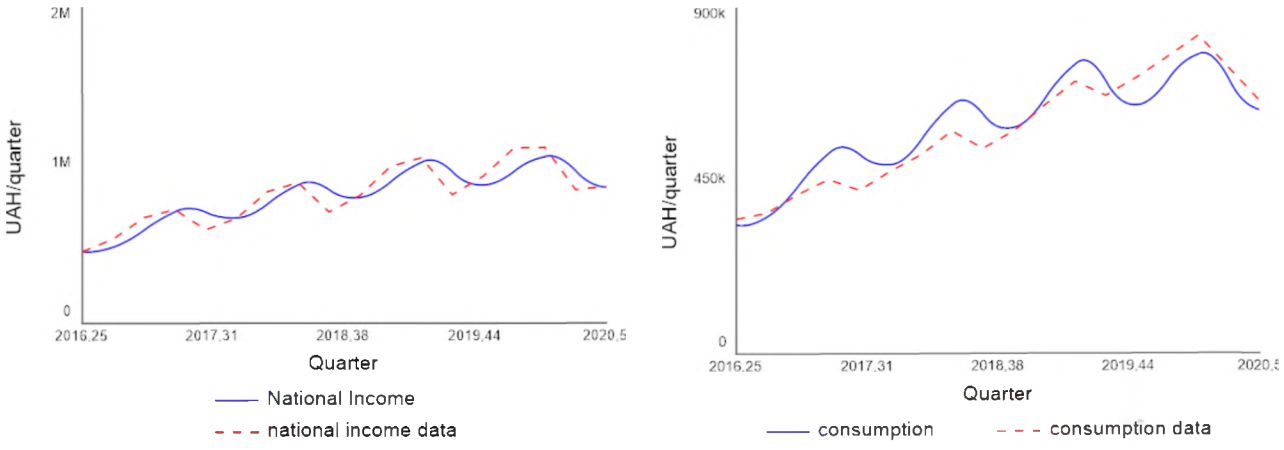

Figure 2. Dynamics of actual and estimated national income and consumption

Source: created by the authors in Stella Architect Software

In real life, when shocks occur, we would prefer to know how the economy will be affected and the model may give the insights about the way the economy responds to the exogenous shocks. Multiplier concept is needed to analyze how big the influence of a shock is.

In our model we created a shock in government spending as an increase of 100 billion UAH during the first quarter of 2020. Theoretical assumption is that in order to stimulate and heat the economy the government may decide either to decrease taxes or increase government spending that is our case. In our model we associate this government spending with expenditures on healthcare system, social welfare and small and medium businesses benefits during the lockdown in the first half of 2020. In Figure 3 we can see the shock impact, as follow: if government spending increases by 100 billion in the first quarter of 2020 then expenditures increases by 127 billion, consumption increases by 55 billion, and national income increases by 75 billion in the second quarter of 2020. It means that exogenous shock boosts national income with 0,75 multiplier, and effects expenditures with 1,27 and consumption with 0,55 multiplier. In practice it proves the existence of cumulative effect on expenditures which outweighs the amount of recourses used to increase government spending, as additional consumption rise takes place. At the same conditions we have national income increase, which is 25% smaller than the amount of shock.

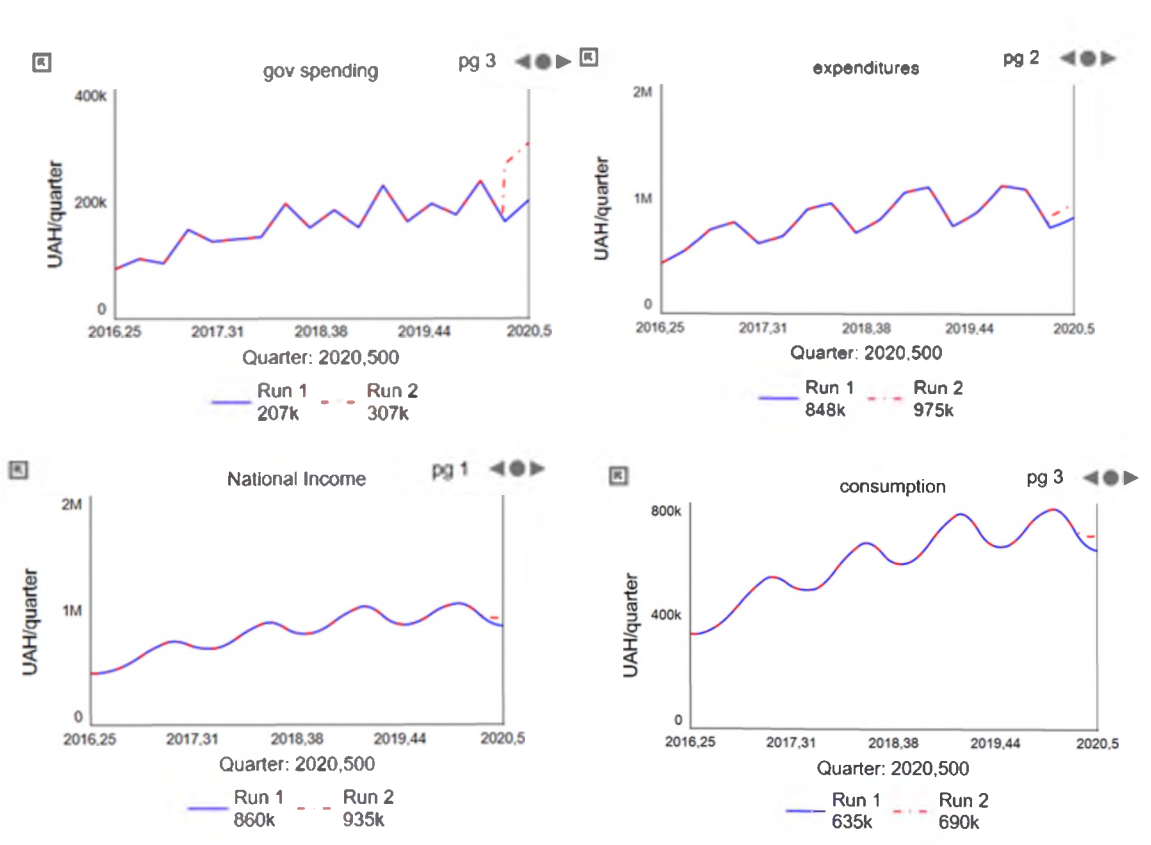

Figure 3. Economy response on government spending shock

Source: created by the authors in Stella Architect Software

Moreover, the source of the shock could have been different, we could have shocked investments by the same amount and the result would have been the same. It happens because these variables are both exogenous. Although shock can have different nature and influence, it is essential to understand the possible impact on the whole economy to moderate the potential outcome.

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SYSTEM DYNAMICS MODELING OF PRODUCTION TARGET FOR UKRAINE

Desired production is a short-term decision that typically calls for temporary under- or over-utilization of production capacity (e.g., 'overtime'). This model jumpstarts the production process by targeting the fraction of productive capacity that will be utilized. Once 'desired production' is determined, decisions on utilization of labor and capital will follow.

The main target of the model is to develop the system dynamics model about Production Target for Ukraine. The driving force is aggregate demand: the sum of household consumption, government consumption, and net exports. The desired production depends on aggregate demand and desired inventories.

Goods producers, wholesalers, and retailers maintain an inventory level that is proportional their sales. This would be the normal inventory sales ratio or fraction.