

REVENUES AND SPENDINGS OF LOCAL BUDGETS

The goal of the research is to create a simplified model of the process described as the problem by simulating the main sources of revenue and spending ways of local governments in Ukraine. Financial independence (autonomy) is identified as a share of local tax revenues (own revenues) in the total revenues of local budgets [2]. The formulation is based on the fact that local tax revenue (and other components whose share is too small to consider) is the only revenue that is generated specifically by local municipalities from their territories that is allocated straight to their budgets. Since some spending decisions affect revenues, they are to be included too. It is also important to note that the research is focused on aggregated municipal deposits and not a specific individual municipality. Therefore, a lot of processes described in the feedback story might not be true for all municipalities, but the majority. Based on the macroeconomic literature the following mechanisms were identified and summarized in the form of a causal loop diagram below (Fig. 1). There is a total of 4 reinforcing feedback loops and 2 balancing feedback loops, all of which are described in detail below.

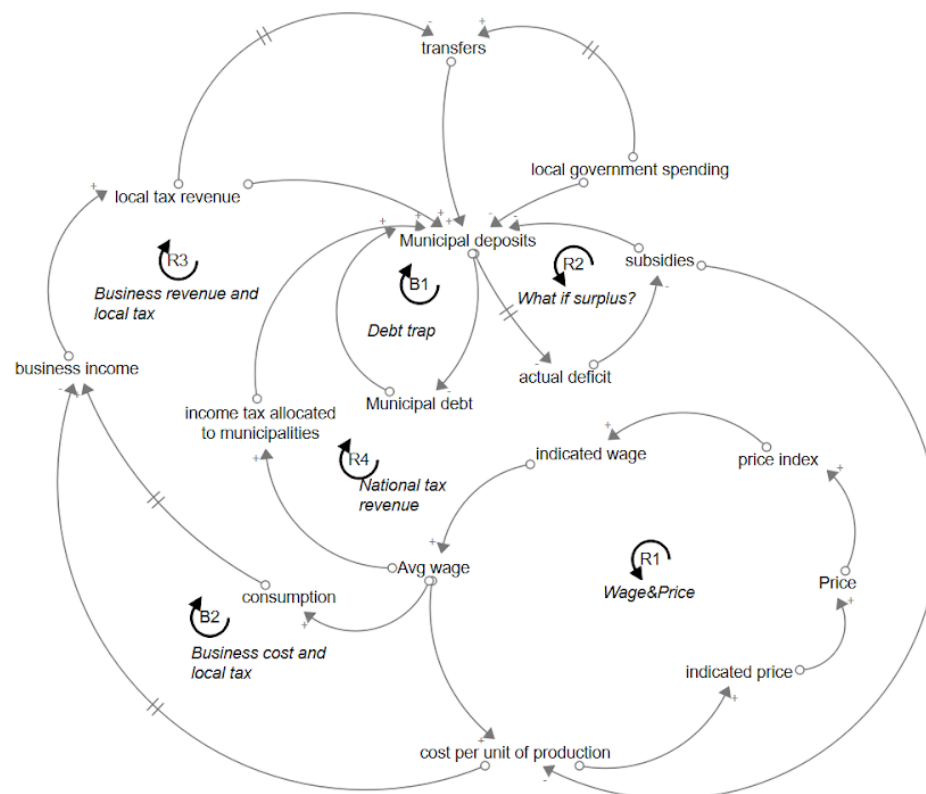


Figure 1. Causal Loop Diagram
Source: by the authors in Stella Architect

Wage and Price (*R1*). This reinforcing mechanism was inspired by the wage and price sub-model designed and introduced by David Wheat in «Feedback Economies» [3] and adapted for this model. The assumption is that the total production is labor-intensive, which is mostly true for Ukrainian production [6]; hence, the only wage is taken into consideration and other costs like capital or land are outside of the model boundary. As prices rise or fall, the wages also adjust accordingly and proportionally to the price index over time. This feedback loop describes the process of inflation/deflation influence on average wage and unit costs. Since Ukraine exercises a proportional tax system (flat tax), the taxes are set as a fixed percentage of the taxable base, which could be any income, property, etc.

National tax revenue (*R4*). Out of all taxes that are classified as national and collected by the central government the income tax from individuals (PIT) accounts for the biggest absolute revenues and is partially allocated to local municipalities. Since the wage is the main and largest income for most Ukrainians, it determines the total amount of income tax collected. Because income tax has the largest share of this process other national taxes are considered to be outside of the model boundary.

Business revenue and local tax (*R3*). From macroeconomic theory, an individual's income is split into two parts – consumption of goods and services and saving [4]. Goods and services are provided by the business and the more people spend on the consumption of goods and services, the higher the income of businesses will be. As the main local taxpayer, the entrepreneurial sector will pay more in tax if their income grows. It adds to local governments' total revenues and accumulates in municipal deposits.

If local municipalities find themselves in surplus (*R2*), it is assumed that they could spend these extra resources on some changes in their communities as, for example, subsidizing local businesses. These subsidies will be additional expenditures for them and, therefore, decreases deposits.

Business cost and local tax (*B2*). Allocated subsidies decrease the cost of unit per production that businesses have to invest from their own funds, which decreases costs for business in general, because governmental subsidies cover part of it. This means they will have higher profits and pay a higher amount in tax. This respectfully increases local tax collected and total revenues of municipalities in their deposits.

Debt trap (*B1*). This balancing mechanism describes the process of borrowing and outcomes from it. Municipalities that experience a deficit have to cover it to maintain planned spending and requesting a loan is often a way to cover an accumulated deficit. Additional borrowing increases accumulated debt and deposits as well since approved loans are added to deposits. However, any borrowing has repayments later, which are subtracted from the deposits as an expenditure.

Local government spending is not a part of any feedback loop, however, it is not exogenous, even though the simplified causal loop diagram does not include variables that affect it. Total labor productivity and labor force determine production, which is the equivalent to gross domestic product (GDP) in this research. Local government purchases, which are defined as a part of GDP by the standard macroeconomic equation of GDP being a sum of consumption, investments, government purchases, and net export, equal spending and decrease the municipal

deposits. Transfers as financial aid from the central government to partially cover money shortage of funds are paid before the spending fiscal year. That is why when local governments plan their next year, they report expected revenues from taxes and expected spending based on previous experience. Higher estimated revenues mean that a municipality needs less aid and higher spending required higher transfers to sustain the expenditures. Allocated transfers then are yet another source of revenue for municipal deposits.

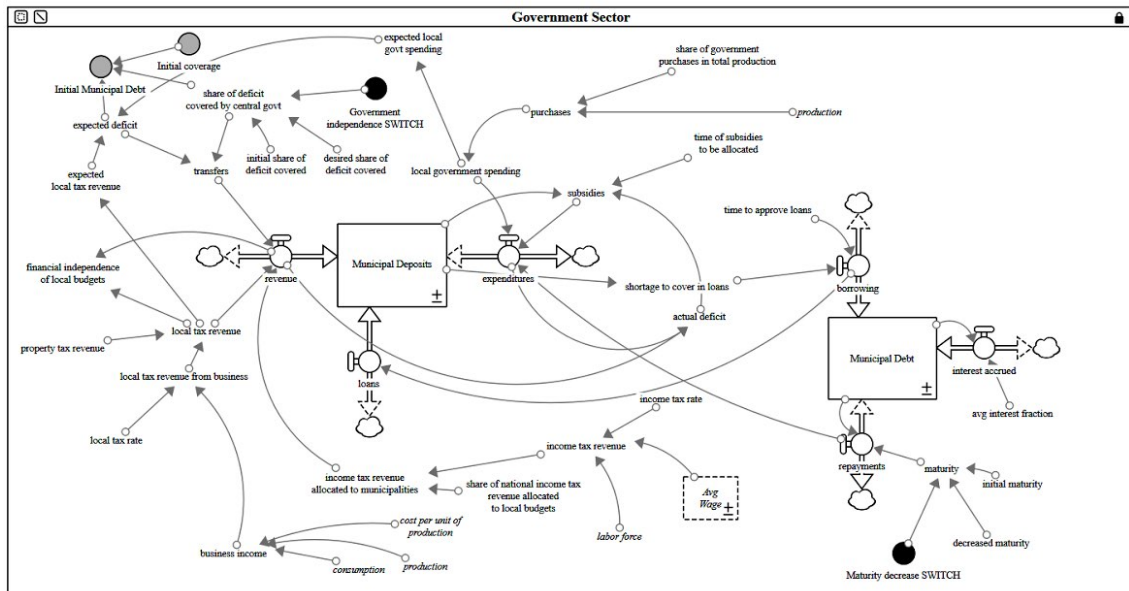


Figure 2. Government sector of the system dynamics model
Source: by the authors in Stella Architect

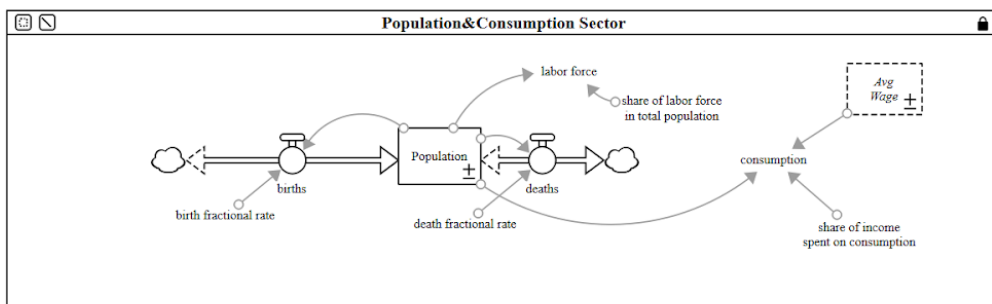


Figure 3. Population and consumption sector of system dynamics model
Source: by the authors in Stella Architect

The separate three main sectors of the model are presented in Fig. 2-4. To build confidence in the model and its simulation results, a series of validation tests were performed (including ones by [1]). Historical data behavior modes were closely replicated, which builds confidence in the model too. Exogenous variables are mostly

based on reliable data sources like the Ministry of Finance of Ukraine, the State Statistics Service of Ukraine, and the Worlbank. Model documentation was created according to guidelines [5]. Model validation details in terms of tests conducted include: structure confirmation test; parameter confirmation test; dimensional consistency; partial model testing and extreme conditions; integration error test; sensitivity analysis.

Figure 4. Wage and price sector of the system dynamics model
Source: by the authors in Stella Architect

The graph in Fig. 5 shows the simulation results of the baseline scenario meant to reproduce the reference mode of financial independence.

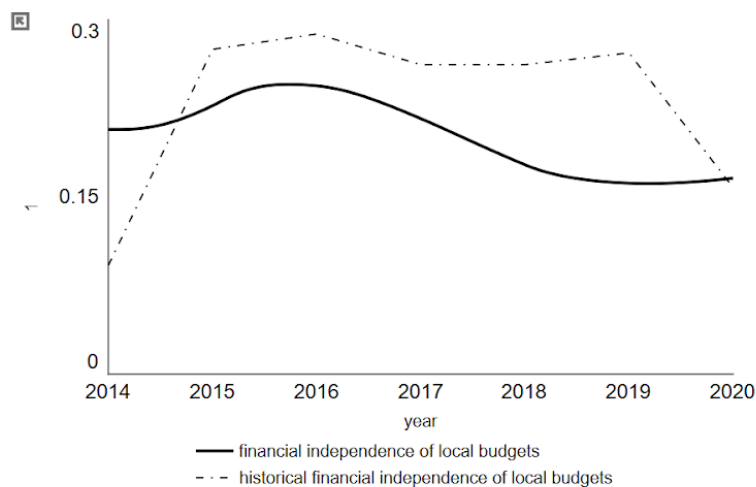


Figure 5. Reference mode replication results in the baseline simulation
Source: by the authors in Stella Architect

An explanatory system dynamics model has proven to be valid and real data-based, which allows finding sensitive points in the model to design proper policy strategy. A dynamic hypothesis and model revealed important feedback loops that determine the behavior of financial autonomy and general financial well-being of municipalities – higher deficit drives higher debt that drives higher deficit back, lower local tax revenues will bring higher transfers in the upcoming year, negative population growth decreases consumption, labor force, and other indicators, etc.

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