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ГРОМАД УКРАЇНИ В УМОВАХ ДЕЦЕНТРАЛІЗАЦІЇ / FINANCIAL
INDEPENDENCE OF MUNICIPALITIES IN UKRAINE DURING
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INTRODUCTION

A developed institution of local self-government is one of the foundations of the existence of any democratic country. As a part of the country's budget system, local finances are the main source for satisfying the needs of territorial communities (municipalities) and performing local authorities' functions. Decentralization reforms enabled strategic changes for local budgets, creating the opportunity to increase revenues to local budgets to provide better services, implement social and infrastructural projects, create conditions for business development, attract investment capital, and other meaningful initiatives that increase the standards of life. At this stage, the process of separate communities uniting into municipalities has ended, but local budgets of Ukraine are still in the process of deepening decentralization, which in turn exacerbates the problems of deficits, lack of own funds for operation and financial autonomy, management efficiency, imbalances and lack of a unified strategy for territorial development. Assessing financial independence is an important indicator and a fundamental part of planning future budget projects, as well as a basis for rethinking existing tax and budget systems and finding new approaches to enrich and effectively implement local budgets. The dependence of regional and local authorities on government transfers is the main problem of the domestic budget system, which slows down the development of the municipalities, and projects' implementation and determines **the relevance of this research topic**.

Currently, there are several approaches and professional thoughts on indicators to determine the level of financial independence of the local budget, so many Ukrainian and western authors offer authorial methods in their works. Issues of decentralization, independence of local budgets as well as using dynamic methods of assessing the Ukrainian public sector are considered in the studies of I. D. Wheat, I. Lukyanenko, A. Bohuslavska, A. Nabatova, M. Yevdokimova, D. Moretti, S. Bugil, A. Antonova, J. Sterman, and many others.

The purpose of the research is to assess the level of financial independence of the local budgets of Ukraine in the current conditions of decentralization using the currently available hard data and find policies to improve it. To achieve this goal, we provide solutions to the following **research tasks**:

1. literature review of different approaches to the concept of “decentralization” and “financial independence of the budget”;
2. identification and systematization of the main factors influencing the financial independence of the local budget;
3. review of the foreign experience of the functioning of local finances and financial autonomy management;
4. assessment of the current state, the structure, and dynamics of local budgets indicators in Ukraine using various statistical indicators and methods, including analytical equalization;
5. creating a dynamic hypothesis and simulating an explanatory system dynamic model of the process of forming and spending of municipal deposits in Ukraine over the horizon of 2014–2020 using the main stages of system dynamics research;
6. performing model validation, behavioral, sensitivity, and other forms of analysis to build confidence in the model and design appropriate policies;
7. substantiation of conclusions on the financial independence of local budgets in the context of decentralization, identification of urgent problems, and possible measures to improve the situation using research results and international experience.

The object of the research is the local finances of Ukraine in the context of the decentralization process. **The subject of the research** is theoretical and applied approaches to assessing the financial independence of local budgets in Ukraine currently and in the future.

The methods of the study that contribute to achieving the purpose are: generalization (in defining the concepts of “local finance in decentralization” and “financial independence of the budget”); analytical (identifying the main factors

that affect the financial autonomy of local budgets); systematic and structural (in determining the structure of local budgets, revenues, and expenditures); statistical research methods and indicators such as averages, relative and indicators of variation, as well as analytical grouping and analytical alignment in building a trend line for the share of own revenues of local budgets; system dynamics method in creating a dynamic hypothesis to the problem of financial dependence of local budgets and an explanatory model for replicating the reference mode of behavior and designing best policies.

The information basis of the study consisted of scientific and electronic sources that were used in writing the thesis: textbooks on finance, works and scientific articles by Ukrainian and foreign authors, data from the State Statistics Service of Ukraine, the Ministry of Finance of Ukraine and web portals based on these data (OpenBudget), reports of international companies and organizations (PwC, OECD, NASBO, FRED, the World Bank, etc.), reports of the National Bank of Ukraine, Budget and Tax Codes, laws of Ukraine, official decisions of central authorities of Ukraine and separate municipalities' councils, and so on.

The practical significance of the results is that the results and the conclusions drawn will serve as a basis for further research on the financial autonomy of local budgets and their dynamic behavior, development, and testing of other innovative policies and strategies to solve problems.

The novelty of the study. Research result expands and adds to available theoretical and practical aspects by upgrading the research methods and tackling new issues. The system dynamics method has not been comprehended for this topic and hence, enables us to look deeper at the problem, add non-linearities, and recalibrate to use by other scholars to suit their research interests.

This paper has the following **structure**: 3 chapters, placed on 61 pages, conclusions, and a list of references used. The study contains 24 figures, 6 tables, and 5 appendices.

CHAPTER 1

THEORETICAL BASIS OF THE FINANCIAL INDEPENDENCE OF LOCAL BUDGETS DURING THE PROCESS OF DECENTRALIZATION

1.1 The concept of decentralization and financial independence of local budgets in Ukraine

The process of decentralization of executive power in Ukraine began in 2014, as did many other important reform processes, on the brink of modern history. The basis of this state policy lies in the “European Charter of Local Self-Government”, which was initiated by the Council of Europe and introduces the protection standards for the municipal authorities’ rights. This document was ratified in Ukraine in the year of 1998. The main concept of the Charter was the commitment of 47 member states of the Council of Europe, on whose behalf the document was signed, to strengthen local self-government in Europe based on the principles of democracy and the building of a better society. According to Article 9 on financial resources, local governments have the right to their own adequate funds, collected by taxes and fees, which they may distribute within their powers [17, p. 3]. Concluding from the Charter, the category of local budget states for the sum of the financial resources of local government, partly formed by taxes and fees, which this body has the right to dispose of without hindrance.

The legislative document that gave impetus to the decentralization of executive power in Ukraine was the Concept of Reforming Local Self-Government and Territorial Organization of Power in Ukraine [34], approved in April of 2014 due to significant and urgent demographic, financial, political, administrative, and social issues, including lack of budgetary institutions of territorial communities. This resulted in changes to the legislation (Budget [8] and Tax Codes [53]), which made financial decentralization possible.

The problematic background of the decentralization decision-making in the rural area included various facts – most communities lacked executive bodies or budget institutions to be able to exercise granted power, while some communal budgets were 70–90% maintained on subsidies; the implementation of financial support through the district budgets of small territorial communities using the system of subsidies of equalization was burdensome for the state budget and hindered the development of villages; inefficiency of social development management; conflicts between government bodies at different levels of administrative-territorial structure [34]. The reform of decentralization aimed to push the interest of local governments in increasing revenues to local budgets, finding reserves to fill them, and improving the efficiency of tax and fee administration, which will result in the availability of sufficient resources for new opportunities for communities – provide better services, implement social and infrastructural projects, create conditions for business development, attract investment capital, and what not [1].

Local finances are a tool for effective influence on all processes of socio-economic development of the newly created united territorial communities, which are still being improved and trained in effective budget management. Their local budgets are part of the national financial system, which means that there are close links between the national budget, the population and enterprises of the administrative-territorial entity, budget regulation, and local budgets. The economic essence of local budgets is revealed in the purpose and functions that they must perform. According to M. Yevdokimova [60], there are four main functions of local budgets:

- 1) distributive – redistribution of net income, which forms the local budget as a result of social production, the concentration of financial resources, which are formed within the administrative-territorial unit by its economic entities, in the hands of local governments to meet the needs of society (social services and security), according to national parameters of budget expenditures;

- 2) stabilizing – the indirect impact of the local budget on consumption, inflation, employment, etc. through the movement of capital, labor, and economic growth in the region;
- 3) financial support of local self-government bodies;
- 4) controlling – implementation of financial control measures from the formation, planning to the efficiency of spending budget funds.

Financial stability is one of the indicators of the controlling function because it allows one to assess the state of budget receipts and expenditures for further control and balancing measures, as well as its efficiency. To ensure the financial stability of any local budget, even if it corresponds to a rural territory, means to generate enough revenues themselves to sustain the majority of local expenditures, and to be as independent from the central government as possible. To research financial stability with new possible perspectives, it is important to outline the main sources of revenues for local governments as well as their main expenditures.

The formation of financial resources, or revenues, of the local budget is the key to its existence and independence. There are multiple classifications of revenues that would be crucial for the study. Figure 1.1 below presents sources of local budget revenues.

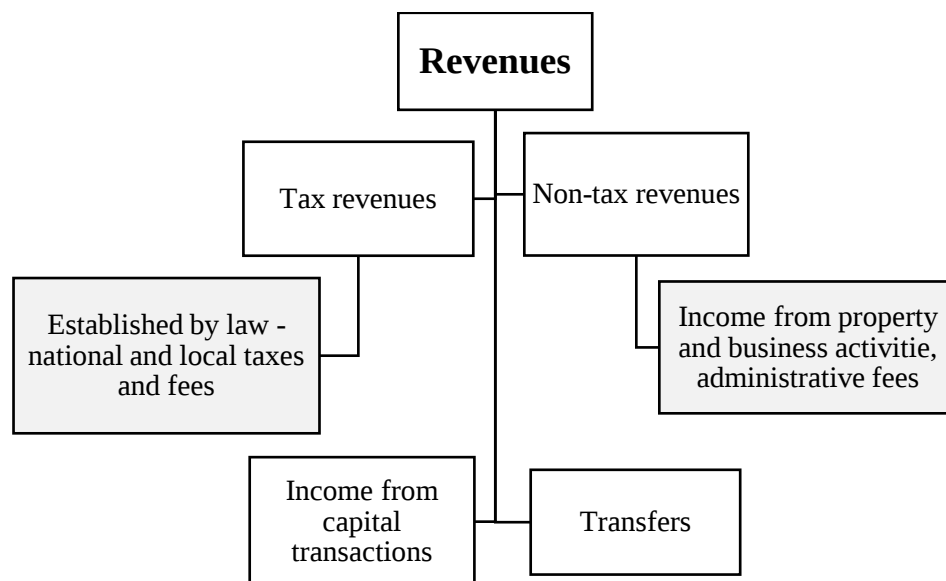


Figure 1.1 – Sources of revenues for local budgets

Source: by the author based on data [8].

Tax revenues are recognized as established by the laws of Ukraine on taxation national taxes and fees and local taxes and fees. Non-tax revenues include:

- 1) income from property and business activities;
- 2) administrative fees and charges, income from non-commercial economic activities;
- 3) other non-tax revenues.

Income from capital transactions is income from the sale of capital assets (fixed assets, state reserves, reserves, land). The composition of state budget revenues is determined by article 29 of the Budget Code of Ukraine. Some peculiarities of collecting and crediting certain types of income may also be determined by law about the State budget for the corresponding year [43, p. 3].

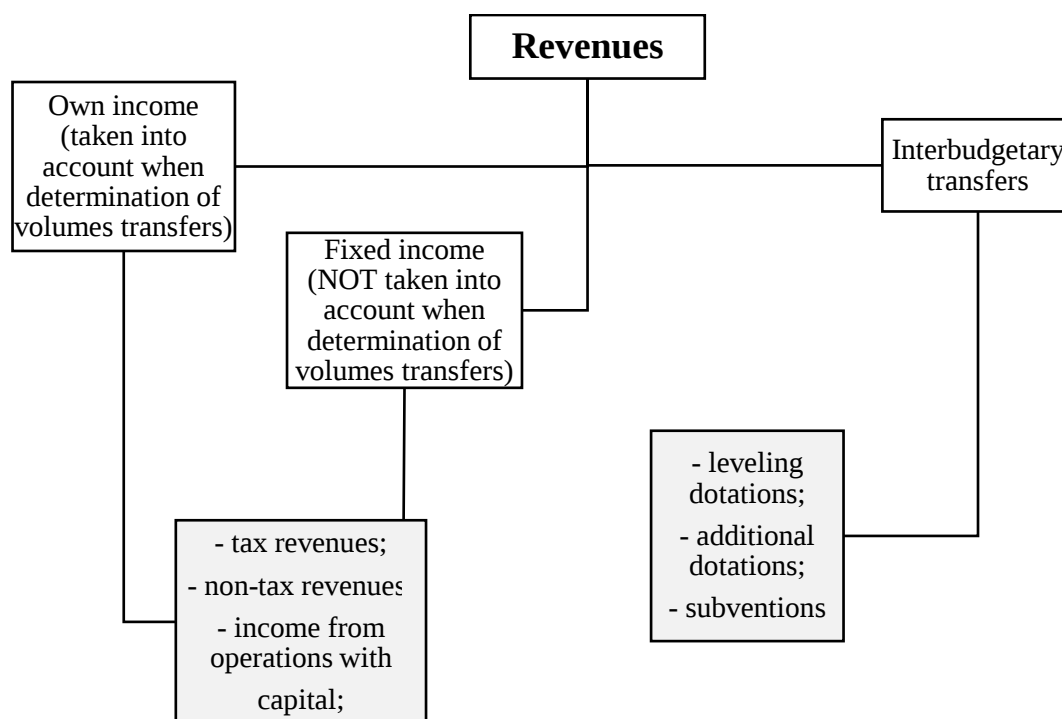


Figure 1.2 – Classification of revenues of local budgets

Source: by the author based on data [50, p. 21].

While tax revenues remain the largest share of budget receipts, the transfers still play a huge role. These are funds received from state authorities, authorities of the Autonomous Republic of Crimea, local governments, other states, or international organizations on a gratuitous and non-refundable basis. The higher the share of governmental aid in total budget receipts, the less the local budget is independent

of the country's authorities. There is another way of putting the revenues of local budgets into categories that are important for further research (Figure 1.2, above).

Own revenues are considered local budget revenues, which at the same time provide the following requirements:

- are territorially localized;
- directly depend on the functional activities of local authorities;
- local authorities fully control rates and volumes;
- are used for activities and programs identified in advance by local authorities taking into account priorities of socio-economic development of territories.

This type of revenue usually includes: local taxes and fees, income from sale and lease of communal property and communal property enterprises; administrative fines and sanctions, license fees, and certificates [18, p. 8].

Fixed income is income that is transferred from the central government to the local budgets on a long-term basis in full or in a certain legally defined proportion. The economic essence of the fixed revenues of local budgets is part of national taxes, fees, or revenues, like PIT, property tax, etc. This process basically gives municipalities a part of national taxes that are collected on a corresponding territory. Fixed revenues of local budgets form the basis for determining the tax capacity of the administrative-territorial community [50, p. 22]. Since fixed income is a part of national taxes that otherwise would be a part of the state budget and not straight local, it is still considered a form of dependence on the central government in this research. Therefore, only local taxes and fees (own income) forms the funds that ensure the independence of a municipality, since these are funds collected from a corresponding territory that fully and directly contribute to local budgets. The benchmark for the research is that municipalities should be able to cover fully or at least 60–80% [28] of their expenditures by their own income to be considered independent, which so far is not reached by Ukrainian municipalities. This is a major step back for a public financial system and indicates the negotiable success

of the reform. It also makes it very difficult to pursue the advantages brought up by these changes, which would improve the level of life in municipalities.

As mentioned above, local governments have the right to freely spend their own revenues within the current legislation. Possible expenditures for implementation in all local budgets are specified in article 91 of the Budget Code of Ukraine [8]. Among those stated in the legislature are expenditures on local fire departments, local government bodies, social security and social welfare, development programs of housing and communal services, cultural and artistic programs, cinematography and mass media support, development of physical culture and sports, transport, road management, etc.

The sources of formation and expenditure ways of budget funds are the main concepts for determining the financial stability and independence of the local budget. The state of revenues and expenditures of a local budget, which guarantees local authorities' effective performance of their duties on time - is the basic and simplest definition of financial stability, which, as mentioned above, plays a major role in the control function of the local budget. The level of budget stability is determined by the number of funds needed to ensure minimum budget expenditures, i.e., funds provided in the budget to finance constitutionally guaranteed measures on the level of life of the community. It depends on the financing of future development and, first and foremost, on the dependence on external sources. It is worth noting that financial stability and independence is a subject to assessment both instantaneously and in time. There is still no all-set definition and approach to assessing the level of financial stability or independence, and all studies are relatively new. Accordingly, the issues of financial stability of local budgets in Ukraine as decentralization processes are concluding are becoming increasingly important and need further research.

1.2 Factors contributing to the financial stability of municipalities' budgets in Ukraine

Financial stability is primarily the state of revenues and expenditures, and the factors that affect these two cash flows also affect the financial stability of the local budget. There are many such factors, which should be considered when planning and approving the budget annually, making forecasts, anticipating risks, and explaining certain phenomena of non-compliance or imbalance. Given the number of factors, they are classified into external (or national, which have a direct impact on the administrative-territorial unit and its budget as part of the whole financial system of the country) and internal (those related to the community, its economic entities, and relations between them). The financial independence of local communities is mainly depending on factors like the number of transfers and how much it weighs in expenses coverage. At the same time, there are different factors affecting the revenue flow and expenditure flow, which are laid as a basis for modeling municipal deposits. These factors are mainly based on A. Bohuslavskaya and Iu. Nabatova's research [6] as well as David Wheat's MacroLab [57; 58]; are represented in the table below and discussed further.

Table 1.1 Influencing factors of financial stability

Factors affecting revenues flow	Factors affecting expenditure flow
Labor productivity	Local government's spending
Level of production	Deficit
Population and labor force	Government purchases
Level of consumption	Level of production
Average wage and price	Capacity for subsidizing production costs
Tax and fee rates	Population
Business environment	Municipal debt
National policy on the distribution of national taxes between levels of the budget system	Time delays in economy
Deficit	
Municipal debt	
Time delays in economy	

Source: by the author based on data [6; 11].

The important aspect to mention is that these categories are mostly data-based factors that must be considered in dynamics as well as in static

measurements; for example, price index changes or the fact that the level of the previous year's deficit will affect next year's budget planning, loan management, etc. As local tax collection as own income (mainly business income tax), the share of national taxes collection (mainly PIT) and transfers form the majority of local budget receipts [36], the factors affecting revenues flow represent categories that directly affect these sources of revenue. Labor productivity influences the level of production (GDP), which with the level of consumption and cost per unit of production influences businesses' income. Businesses' income being the base of some local taxes directly contributes to municipal revenues. The share of national taxes that are distributed to local communities as another form of revenue mostly consists of individual income tax, which is affected by the level of the labor force (as a share of the total population) and average wages. Government aid in a form of transfers is a very sensitive matter as it is planned by a budgetary calendar, which means it is based on previous years' data and forecasts for an upcoming year. That includes expected own income, government spending, and deficit. This is also why time delays are crucial for revenues and expenditures flows. It takes time for economic processes like prices, wages, etc. to adjust to new conditions, which happens continuously. Different matters like certain approval times and the time it takes for money to flow from an account to an account also affect municipal deposits. Municipal debt is included as a factor for both types of flows since approved loans are added to revenues, however, it adds repayments as an expenditure. Factors affecting municipal debt include loan maturity, interest rates, demand for loans, etc.

The list of factors can be more detailed and expanded, however, the ones described above are the most important ones for this particular study. Some other factors to keep in mind for future development of the research would include the following:

- Economic: the presence of communal enterprises as their income contributes directly to the local budget as its own income, the level of GDP redistribution, foreign trading of the region and currency exchange

rates, technology progress, the availability of resources, shadow economy, etc.;

- Political and legal: the level of autonomy for decision-making in municipalities, presence of financial sanctions, etc.;
- Demographic: migration flows of population, unemployment rate, etc.;
- Social: taxation culture, payment discipline, level of life, etc. [15].

The availability of resources, production technological base, subsidies and various dotation, and well-established external relations have a positive effect on revenues and, consequently, on financial stability. External factors that can have both negative and positive effects are the political vector of the state, including tax, customs, and budget legislation (political and legal), demographic (social), as well as climatic and environmental (technological). The same category also includes the assessment of the share of the shadow economy, planning effectiveness, the level of trust in government, and the stability of the national economy [22, p. 85].

The range of internal factors is much wider. Financial stability is influenced by the professional competence of staff, effective debt management and inter-budgetary relations, the size of the territory, and the various macroeconomic indicators at the level of an administrative-territorial unit. Developed infrastructure and innovation processes (technological), as well as the quality of planning and cost-effectiveness (subjective), have a positive impact on financial stability. Tax evasion or the adoption of legislative acts that reduce their number in local budget revenues hurt financial stability. Equally important is the interest of local authorities in increasing their own revenues and finding ways to implement related projects, which is one of the long-term goals of decentralization reform.

When planning the revenue part of the local budget for 2020 and the forecast for 2021–2022 in terms of tax and non-tax revenues and other revenues, the Ministry of Finance of Ukraine was guided by the following indicators: GDP, consumer price index, and producer prices (according to the Cabinet of Ministers as of May 15th, 2019 №555 [35]), changes in the budget and tax system (including innovations in rents and crediting revenues to local budgets). When compiling the

expenditure part, they are guided by the need to pay salaries of employees of budgetary institutions by the terms of remuneration and settlements for the use of utilities by these institutions. It is important to plan expenditures with the thought of the increase in state standards (projected for 2020–2022 subsistence level, minimum wage, etc.), as well as the provision of loans to the state fund of regional development.

1.3 Global experience of decentralization and municipal financial independence management in the case-based overview

The process of decentralization in Ukraine, in particular budgetary and financial ones, is based on the experience of other countries that went through similar processes and struggles. However, the same experience differs for each country, depending on its characteristics, history, legislation, mentality, and other factors. First of all, when assessing budgetary decentralization, it is important to note the type of the budget system of the country, which depends on the form of government – federal countries have a three-level system with federal, regional, and local budgets (e.g., USA, Canada, Germany) and unitary states with a two-level system of national and local budgets (e.g., Ukraine, France, Italy, Japan).

Despite Ukraine's membership in the unitary "camp", the experience of federal countries is equally useful, as the values and challenges of decentralizing power and financial resources are quite similar in all countries. In the United States, the separation of powers is one of the key principles of the Constitution. Historically, the power has three levels – federal (national), regional (state level), and local (municipal). That is why the country did not have a long and painstaking path to decentralization, as we may witness in Ukraine.

The areas of influence are distinctively divided between the three levels, and therefore the functioning of local self-government bodies is carried out only within the defined competence, and there are no representatives of the central government in the local authorities. These characteristics mean that the United States is an

example of the Anglo-Saxon model of local self-government (along with Britain, Canada, Australia, and New Zealand) [42]. Due to the distribution of revenues between the federal government, state, and local governments, the municipalities receive up to 80% of certain tax revenues and there are also distinct divisions regarding certain areas of financing like education, healthcare, and others. Figure 1.3 below shows various elements of revenues to both federal, state, and local budgets combined.

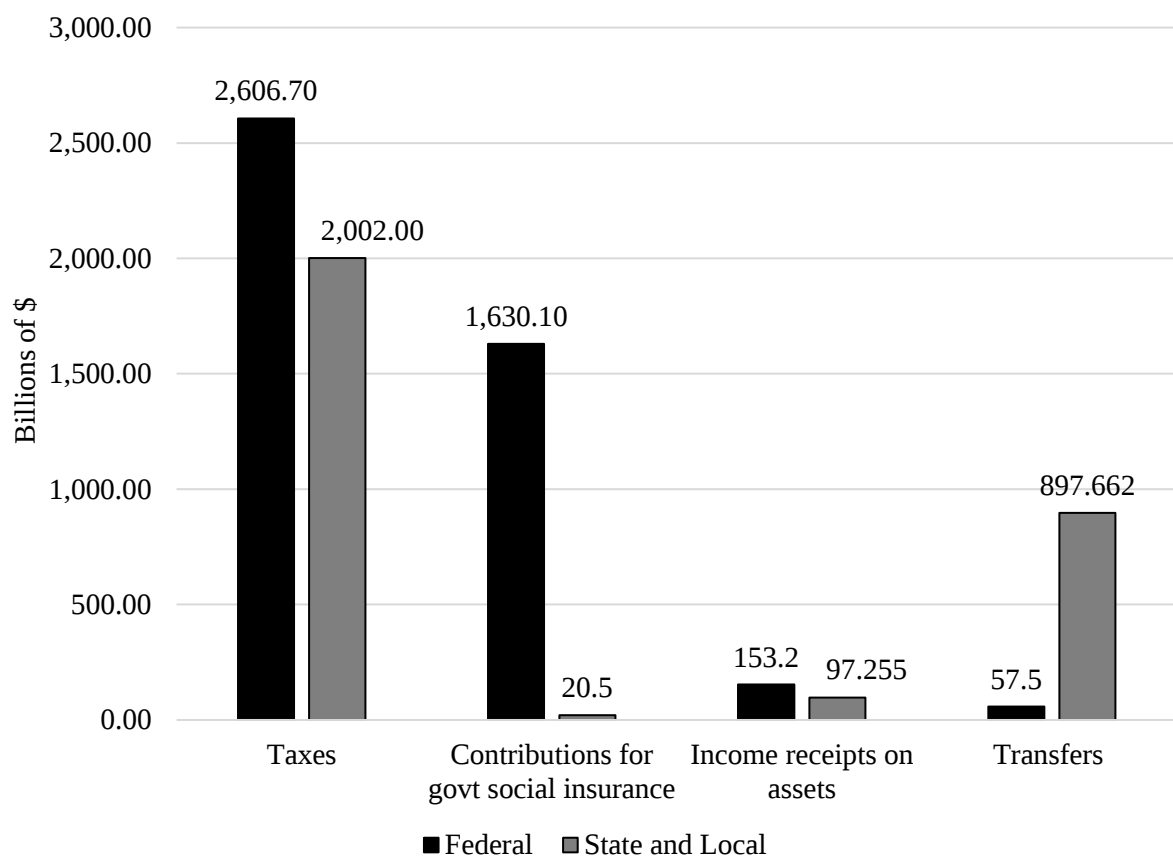


Figure 1.3 – Revenue receipts to federal, state, and local budgets of the United States in 2020

Source: by the author based on data [10].

We discuss the combination of state and local budgets as it is the closest alternative to our idea of local budgets in terms of connections to the national budget and its role in the financial system. The amount of tax revenues is pretty close – \$2,606T and \$2,26T respectively to federal and lower-level budgets, – which represents the quite equal distribution of taxes collected where the state and federal governments receive a fair share of revenues from taxes. Tax revenues hold

about 65% of total local budgets in the U.S. (Fig. 1.4, below), and if one counts all tax revenues as an own income, the local budgets qualify to be called independent from federal finances (the chosen benchmark for this research is 60–80% [28]) and mostly able to cover the majority of their expenditures. One of the most important financial independence indicators (amount of transfers allocated to local budgets) levels to about \$1,062B in 2020 and covers 31% of total revenues. Transfers to the local budgets in the U.S. mostly come in a form of federal grants-in-aid – payments in the nature of assistance made by one government to another government [12]. Income receipts on assets are also very similar in amount – \$153,2B and \$99,6B respectively, – however, this source of revenue only covers 3% of local budgets’ revenues, which, in fact, is similar to Ukrainian local budgets’ revenues structure (discussed in Chapter 2). Contributions to government social insurance are mostly allocated to the federal budget (\$1,63T and \$22,8B respectively) as the national authority is generally the only provider of mentioned services to the public and, therefore, covers 1% or less of local budgets revenues.

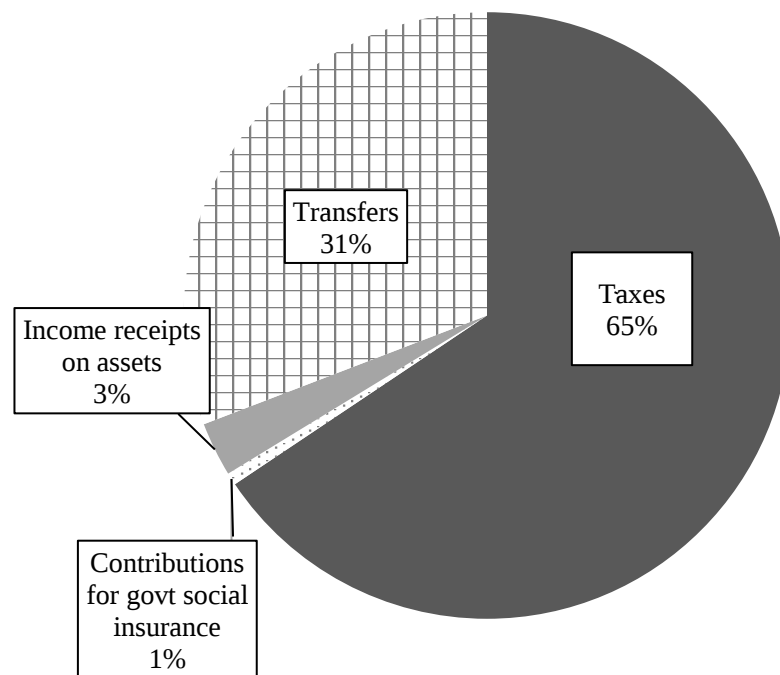


Figure 1.4 – Structure of revenue receipts to state and local budgets combined in the United States in 2021

Source: by the author based on data [7; 10].

Touching back on the subject of financial independence mentioned above, the state and local budgets are considered independent from federal assistance. Moreover, an overlook of the horizon of the last 10 years (Fig. 1.5) shows this independence has been a stable behavior pattern with an average own income of 68% of total revenues and 28% of transfers. Above-average transfers coverage is observed in the year 2015 supported by the need to partially cover almost \$300B of negative savings in accounts, and in the years 2020–2021 as the economic consequences of the global pandemic hit the most. This represents the importance of year-to-year stability in the budget structure to effectively sustain expenditures and address local issues.

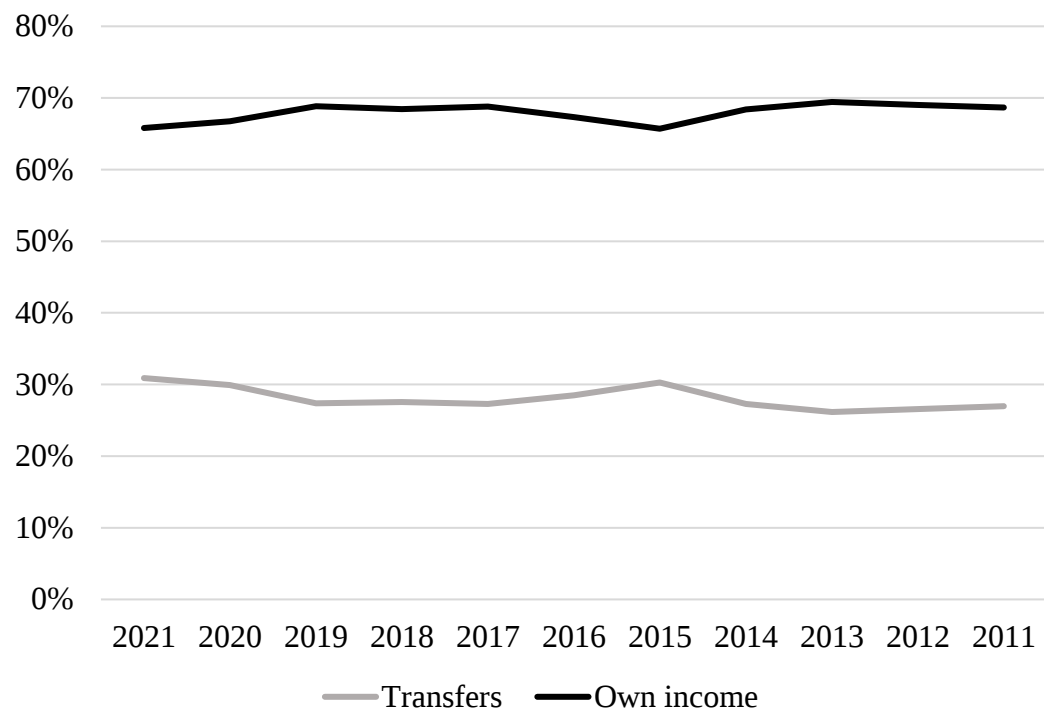


Figure 1.5 – Dynamics of transfers and own income of state and local budgets in the U.S. over the horizon of 2011–2021

Source: by the author based on data [16].

One of the key features worth discussing is the distribution of taxes. In the United States, there is no formal division of taxes into national and local like the Budget Code of Ukraine states for Ukrainian tax and budget systems. However, there is an obvious distribution of certain types of taxes to different levels of budgets. For instance, in 2021 federal budgets received almost \$5T in taxes, which

mostly consisted of personal taxes on income (56,39% in total tax revenue) and taxes on production and imports (34,79% of total tax revenue). State and local budgets in the same year were also supported by taxes on production and imports (67% of total tax revenues) and property tax (28,5% of total tax revenues) [16].

When analyzing mentioned three types of taxes – personal income tax, taxes on production and imports (including sales tax, excise tax, and others), and property tax, – in the last three fiscal years it is noticeable that most of the property tax is allocated to state and local budgets (about 72–80% in different years according to National Conference of State Legislatures [32]) as most of the property types in immovable and only located and registered on a certain territory, so, contributes in taxes to that particular territory. As for personal income tax, about 81% of it (2021) is allocated to the federal budget, and taxes on production and imports are split approximately in half (based on calculations using data [16]). There is definitely a logic behind this, and it is a great foundation for further comparison in later parts of the study.

The U.S. local budgets are financially stable due to the direct allocation of taxes and also through a system of financial equalization between territorial units (states). Federal tax districts do not coincide with state borders, and therefore there may be several states in one district. Thus, no state will be able to accumulate large tax revenues in its hands, which solves the problems of asymmetric development and internal migration due to better social standards.

The structure of public expenditures determines the vector and priority of public decisions and funding. The functional classification of expenditures differs in different countries, in particular, the structure of the U.S. state and local budgets by expenditures in 2020 is illustrated in Figure 1.6 below. The general fund amounted to \$3,207T, almost a third of which was spent on education, despite the fact the government fully covers only lower secondary level of education (up to high school); another quarter was spent on healthcare. The United States is generally not a socially-oriented country, and social spending on financial public support accounts for 7% of the budget.

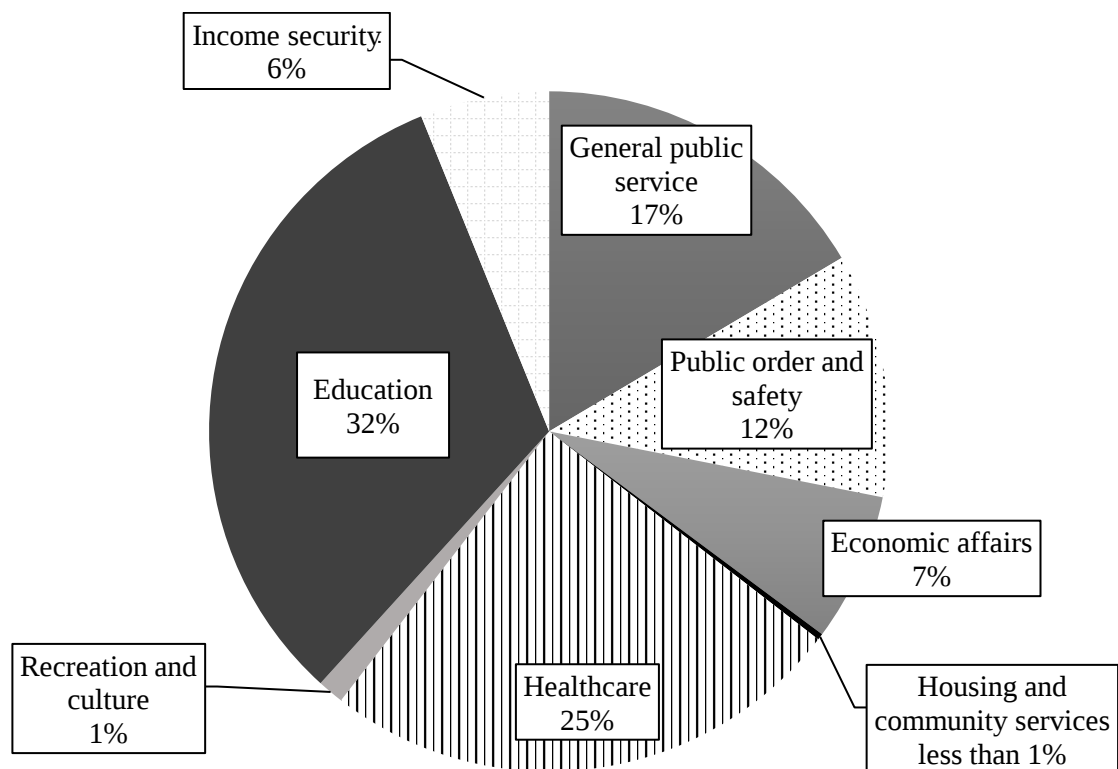


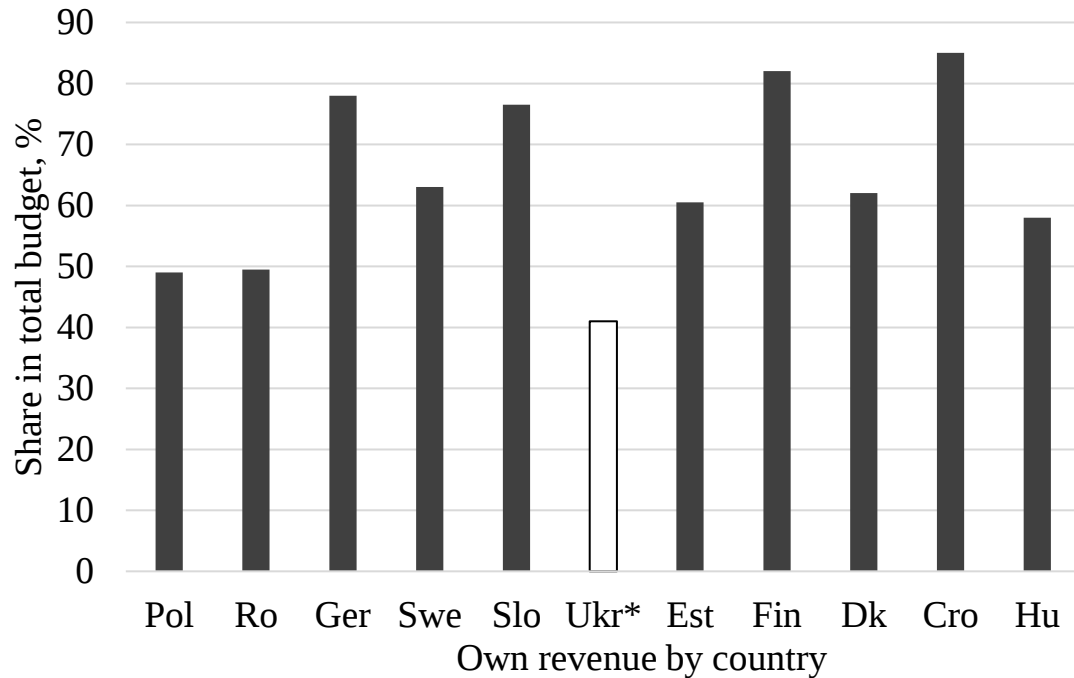
Figure 1.6 – Functional structure of current expenditures of the state and local budgets combined of the United States in 2021

Source: by the author based on data [7; 10; 55].

The federal budget structure shows spending more than 10% on veterans' maintenance, communal and regional development, and loans for their own business and housing, which has a positive impact on the living standards of the public. The U.S. also has one of the world's largest public expenditures on R&D [19], which also stimulates innovation and allows it to remain a world leader in country competitiveness for many years. Since the federal government delegated a lot of major functions to municipalities and gave them opportunities to financially cover those functions, it became easier to focus on broader and progressive goals for a country to thrive technologically and economically as well as increase the level of life for all citizens.

Among the unitary countries, the countries of the European Union and other European countries are a striking examples to briefly overview. Due to the conditions of the already mentioned European Charter, most of the taxes are

accumulated in local budgets, which were approved during the formation and development of the tax system and ensured high levels of own locally generated revenues (Fig. 1.7, below).



**– the calculation is based on the methodology of the European Union and, therefore, differs from that used by the author of the research*

Figure 1.7 – Aggregated own revenue of municipalities in chosen countries of European Union as a share of total local budgets in 2020 in comparison to Ukraine

Source: by the author based on data [13, p. 57–59].

As we see Ukraine appears to have the lowest indicators of financial independence of local budgets among shown countries above, while Scandinavian countries, Germany, and Slovakia present the highest ones. There is a visible trend of socially oriented countries like countries of the Scandinavian region to have a higher level of financial independence of their local budgets among other included countries. The higher level of own income could be explained by a higher need for social welfare expenditures, and, thus, higher tax collections in general. It is known that the public pays more than half of their income in taxes in mentioned countries. To measure how much business companies pay, for example, PwC uses in its reports the Total Tax and Contributions Rate (TTCR), the sum of all taxes and

mandatory contributions as a percentage of the company's pre-tax profit. In Ukraine, this rate is set at 45,2%. In socially oriented European countries, this figure ranges from 23,8% (Denmark) to 59,1% (Italy) [38]. However, even Poland, Romania, and Hungary which are close neighbors among presented and former soviet republics show higher values. Researching differences and financial independence of local finances in former soviet republics is yet another promising research topic.

France is one of the most decentralized countries in Europe in terms of financial resources, where decentralization began in 1982. The country does not have budgetary unity, each budget is separate and independent, but the national one is the main one. Tax revenues include property, business, and excise taxes, which form half of the local budget, and in Ukraine, a similar source is the personal income tax. Local governments in France mobilize taxes, which account for 5% of the country's gross domestic product.

The tax policy of this state is characterized by a wide range of local taxes, the most important of which are real estate tax, business tax, land tax, and transport tax (like the United States). The relationship between the state and local budgets is minimal and includes only funding for national government programs and targeted subventions. Such an organization provides a lot of freedom. The peculiarity of budget management is special trust funds, which are not included in the budgets, are subordinated to the state, and have specific goals. There is also a permanent High Council of Public Finance (HCPF), which ensures the financial stability of the local budgets [28, p.118]. The Council studies the accuracy and reliability of the macroeconomic forecasts and ensures the reliability of indicators, as well as conducts its own forecasts of income and expenditure with pessimistic and optimistic errors, based on which makes its recommendations in the annual reports. All types of budget planning are medium-term, which is what Ukraine is striving for.

Financial independence's key indicator is own income, which mostly depends on tax receipts, and that brings into question various aspects of collecting,

accounting, and processing taxes globally. The level of tax system development is crucial for local finances for its effective functioning. Ukraine has a fairly high value for time for the initiating and processing of tax payments – 328 hours per year and the 65th position out of 189 countries (according to the latest available data in 2018 [38]). Even though in the dynamics of this indicator there is a downward trend, it is still higher than the world average (233,9 hours).

On the other hand, in the top ten countries in this ranking (Hong Kong, Qatar, Ireland, Singapore, Denmark, Finland, etc.), the time for making and processing tax payments does not exceed 100 hours per year. Here are again Scandinavian countries that as mentioned above show a prominent level of financial independence of local budgets. This is facilitated by the state's involvement in new technologies and funding for re-equipment and retraining of staff to digitalize the tax process (electronic filing, electronic payments, use of pre-filled tax returns, electronic invoices, administrative web portals, transparency of tax collection, effective communication, etc.).

About 97% of the members of The Organization for Economic Co-operation and Development (OECD) use electronic payments to pay taxes and fees according to the annual “Paying Taxes” report presented by PwC [37, p. 27–28]. Electronic invoices have become popular in the European Union in many countries – including Denmark, the Netherlands, Spain, and Sweden – legislation to allow public administrations to accept electronic invoices in accordance with European standards.

Factors that hinder the introduction of technology for the tax administration and taxpayers include low literacy, unreliable information technologies, underdeveloped infrastructure and administration, low productivity and performance of workers in this field, and lack or poor quality of software for accounting, preparation, and payment of taxes.

Conclusions to Chapter 1

Thus, local finances are an essential element of the national budget system, decentralization reform, and social standards of living. They ensure the independent existence of the territorial unit if they are financially stable and perform such functions – distributive, stabilizing, controlling, and the function of financial support of local self-governing and its institutions. The functioning of local finances is influenced by many internal and external factors that are considered at all stages of the budget process, which include labor productivity, level of production and consumption, average wage and price, tax and fee rates, national policy on the distribution of national taxes between levels of budget system, time delays in the economy, etc. These and other factors lie as a basis for determining causal relationships and feedback loops, which explain the financial flows to and out of municipal deposits.

Global experience suggests that the principles underlying the structure of the budget system are directly determined by such factors as the form of government and the administrative-territorial division of the country as well as the history of the decentralization process. Overlooking the experience of the U.S. and European countries suggests that the process of adopting innovations increases the tax collection effectiveness and is worth exploring for further development and management of its own revenues. It is also crucial to note differences in national and local revenues and how they are managed.

The sources of own revenues of local budgets, which are collected according to territory of the budget and mostly consist of local taxes and fees, and their share in a total budget fund are key indicators for financial independence and stability of a municipality from national transfers and enables the opportunity to achieve the positive goals of decentralization reform, increase the level of life and bring even remote territories to thriving and prospering.

CHAPTER 2

ANALYSIS OF FINANCIAL STATE OF MUNICIPALITIES IN UKRAINE

2.1 Informational basis and methodological principles of the study of financial independence of municipalities in Ukraine

More basic statistical research methods were chosen to comprehend the overview of local finances in Ukraine in recent years as well as over the horizon for the reform functioning (since 2014). To characterize the current state of local revenues and financial independence, statistical methods and indicators were used, including relative indicators (structure, dynamics, intensity), averages, and indicators of variation (quadratic coefficient of variation). The indicator of variation is used for in-depth study and comparison of statistical data. It is possible to estimate the amplitude, the degree of deviation from the mean, and growth (decline) using a simple form of the quadratic deviation, as it reflects the value of the deviation in a percent:

$$\sigma = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n}}, \quad (2.1)$$

where x_i – an individual value of a parameter in a specific period (year);

$\bar{x}$ – mean;

n – quantity of periods (years).

This indicator is necessary for further calculation of the quadratic coefficient of variation, which is compared over several statistical series, which allows making comparative conclusions about the stability of the parameter and the homogeneity of the population (%):

$$V_\sigma = \frac{\sigma}{\bar{x}} \cdot 100\%, \quad (2.2)$$

To analyze a single series (the share of own income of local budgets in Ukraine), determine the trend described by the linear function, and make a mathematical forecast for future periods with the assumption of extrapolation, the statistical method of analytical alignment was used – replacing the actual series with theoretical. Given a stable absolute increase, the trend is determined by a linear function: $y = \alpha + bt$, (2.3). This is also used to observe the development of series in the case of neither positive nor negative changes happening in the economy that may influence the series values in the future. To solve the equations of analytical curves, the method of least squares (MLS) is used – to find the parameters α and b , – also use the method of simplified alignment, in which the sum of all values of t should be zero:

$$\begin{cases} \alpha = \frac{\sum y}{n}; \\ b = \frac{\sum yt}{\sum t^2}; \end{cases}, \quad (2.4)$$

де α – theoretical value of series when $t = 0$;

n – quantity of groups (years);

b – absolute increase.

However, one of the main research objectives is to create an explanatory system dynamics model and to find specific leverage points for a policy implementation in the future. System dynamics is a relatively new scientific approach that strives to explain the causes of complex, dynamic social problems (systems). This method was established by Jay Wright Forrester and his team at MIT in the USA, starting in 1956; the first textbook was published in 1961. Forrester while associating at MIT started out working with feedback control mechanisms (later – feedback loops) for military equipment for the Second World War. Over the years, he applied System Dynamics to social problems such as urban decay, economic growth in the case of population growth, pollution, and resource scarcity [52]. His book “World Dynamics” became the starting point for the groundbreaking book by Meadows et al. called “Limits to Growth” [26]. This book became one of the most important publications for the evolving

environmental movement. Therefore, this method was initially popular to tackle sustainability problems, however, later became accessible to many more fields of study. Modern system dynamicist, John Sterman, who picked up on Forrester's work at MIT, expanded the application of system dynamics in his book "Business Dynamics", which became a "Bible" of system dynamics [48].

Table 2.1, below, shows the stages of a problem-oriented analysis that is most often used in system dynamics-based research, including this one. It is a continuous process, where it is important to constantly refer to previous stages.

Table 2.1 – Stages of system dynamics-based research

Name of the stage	Representation in other methods	Brief description
Problem	Scientific method	Identification of a dynamic problem that holds significant importance to stakeholders, reference mode of behavior, boundary
Dynamic hypothesis		Explanation of causes for the problem and reference mode, causal loop diagram
Analysis		Testing hypothesis and model, identification of sensitive points of the model
Policy	Policy analysis and operations research	Policy testing
Implementation	Management and public administration	Presentation of 1 st and 2 nd best policies to decision-makers

Source: by the author based on data [29].

Proper problem identification is crucial for further advancing in the research stages. Before the reform in Ukraine, almost all taxes and other revenues were centralized in the national government's accounts and later on were allocated to the municipal needs, which means it should have gone through a long process of paperwork and complete dependency on whether it gets approved and processed. Moreover, most of the time it was ineffective since it is hard for the national government to comprehend all needs of people in, for example, small towns or

villages and give them sufficient resources promptly [31]. One of the causes of the process of financial decentralization that started in 2014 was the need for local budgets to become more independent and make changes effectively. This was ensured by the process of all local taxes and part of national taxes collected from a certain territory being allocated straight to the local budgets of that territory [8]. The reform aimed to push the interest of local governments in increasing revenues to local budgets, finding reserves to fill them, and improving the efficiency of tax and fee administrations, which will result in the availability of sufficient resources for new opportunities for communities, like already mentioned, – create an efficient local self-governing, implement social and infrastructural projects, create conditions for business development, attract investment capital, sponsor development programs, providing high-quality and affordable public services, establishing institutions of direct democracy, reconciling the interests of the state and local communities and what not [14]. For a lot of more secluded areas, these could be a serious change in their standards of living, as well as overall financial independence, which would mean an opportunity to sustain the municipality completely or mostly without the help of authorities. This leads to stakeholders who potentially have an interest in chosen problem:

1. The central government itself will benefit from financially independent local budgets as it will cut those transfers as an expenditure for the national budget.
2. The population will also benefit because of all the new opportunities their communities will have with the new resources they will oversee. Most communities can vote on what projects will be implemented and financed by the local budget. This problem is important for so many people, especially ones living in small towns and villages, as financial independence will give them more control and freedom as well as ensure development towards higher standards of living.

3. Municipal governments will have more power and resources as well to implement meaningful projects and invest in their communities and business.

Special software is used to create a causal loop diagram (CLD) and a simplified explanatory system dynamics model – Stella Architect (licensed 3.0 version), which has specific symbols to visualize a simulation (Fig. 2.1, below).

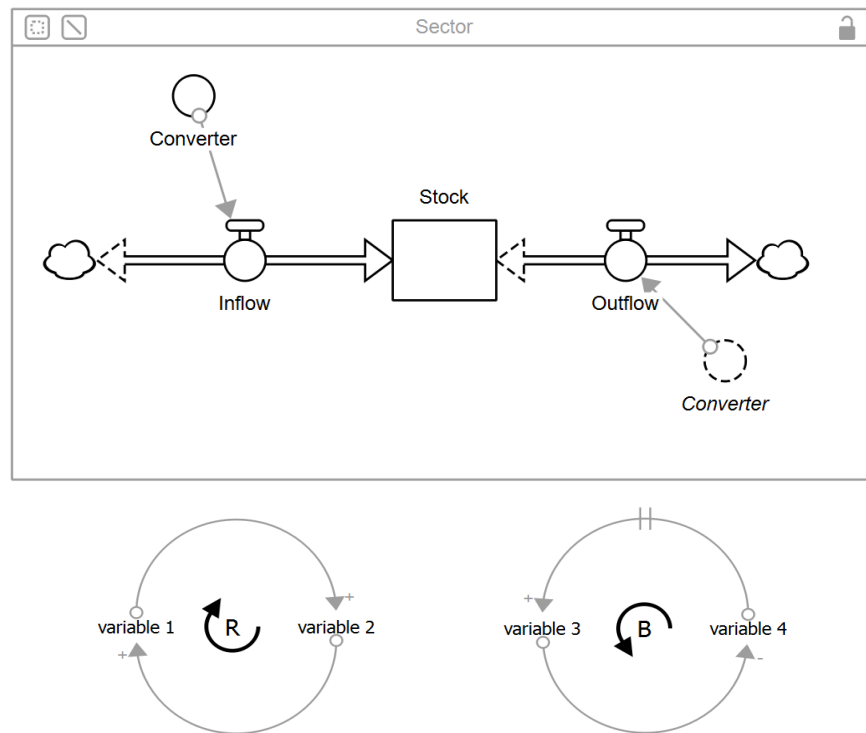


Figure 2.1 – Basic elements of system dynamic causal loop diagram and model using software of Stella Architect

Source: by the author based on data [21].

A brief overview of essential basic elements that form the model's structure to comprehend the research method:

- Stock – is a variable that is characterized by its ability to be accumulated relatively slowly over time (representation of an accumulative cause-and-effect relationship) and can only be effected through flows;
- Flow – a variable that flows in or out of an accumulated stock per unit of time, respectively inflow or an outflow. A difference between an inflow and an outflow is a net flow. The stock is increasing if the net flow is

positive, and respectively can be decreased or stay constant. A stock can also have only one of the mentioned flows;

- Converter – a variable that represents a single exogenous constant value or an equation of other converters that is characterized by an instantaneous cause-and-effect relationship, however, connected converters that influence each other cannot create a feedback loop – there has to be an accumulating and time delay present. A ghost converter is a complete copy of a converter is “ghosts” and changes with the change of an original converter;
- Sector – a special outline that locks all elements within its borders and is useful for organizing larger models;
- Feedback loop. Since cause and effect are central in the method, feedback loops are crucial for mental and simulation models, they drive the behavior over time of key variables and are used for analysis. Balancing feedback seek to bring the stock to equilibrium, while the reinforcing feedback loops do not have equilibrium – they may endlessly decrease and increase, since i.e. the growth in the cause leads to growth of effect which leads to even higher growth of the cause [51].

The sources of the information base of the research (exogenous and historical data and formulas for equations) include the data from the electronic reports of the Accounting Chamber, the State Statistics Service of Ukraine, the State Treasury Service, and the Ministry of Finance of Ukraine as well as OECD annual and special reports, the Tax Code of Ukraine, teaching materials, articles from the Ministry of Regional Development of Ukraine, the Pension Fund of Ukraine, Institute for Social and Economic Research, World Bank, research articles in scientific journals and conferences, etc. The latest available hard annual data is only 2020 on most national sources. The regulatory framework governing the state budget policy, as mentioned above, includes the Constitution of Ukraine, Budget and Tax Codes, the annual Law on the State Budget of Ukraine, the Concept of Reforming Local Self-Government and Territorial Organization of

Power in Ukraine, other laws governing budget relations, regulations of the Cabinet of Ministers of Ukraine, decisions on the local budget, target programs, decisions of regional, municipals and village councils, etc.

2.2 Overview of financial stability of municipalities in Ukraine during decentralization using statistical methods

A thorough study of the peculiarities of the functioning of local budgets at the present stage of the study requires determining which budgets fall into this category, their number, and their structure on a national scale. The year 2019 is considered the peak of the reform since 2014 as a learning curve was mostly successful and the process of uniting small communities into municipalities started to finish; it was also the peak year for the economy right before the “coronacrisis”.

Table 2.2 – Structure and dynamics of different types of local budgets in Ukraine

Type of budget	2019	2021	Absolute growth, number	Growth rate, %	Share in total amount of budgets (2019), %	Share in total amount of budgets (2021), %
Regional budgets, the budget of ARC	25	25	0	0%	0.274%	1.281%
Budgets of cities of republican/regional significance	185	13	-172	7.027%	2.024%	0.666%
District budgets	488	136	-352	27.869%	5.340%	6.967%
Budgets of territorial communities	782	1469	687	187.852%	8.557%	75.256%
District budgets in cities of regional significance	40	35	-5	87.500%	0.438%	1.793%
Budgets of cities of district significance	171	6	-165	3.509%	1.871%	0.307%
Budgets of urban-type settlements	521	39	-482	7.486%	5.701%	1.998%
Budgets of village councils	6927	229	-6698	3.306%	75.796%	11.732%
Total	9139	1952	X	X	100.000%	100.000%

Source: by the author based on data [27; 36].

As of January 1st, 2021, there are 1952 local budgets in Ukraine, while in 2019 there were more than 9 thousand, as tons of separate village councils remained ununited (Table 2.2, above). The predominant share of budgets – 1469 or 75,3% – are the budgets of village councils (villages). The next "leaders" are the budgets of village councils (229 or 11,7%) and the district budgets (136 or 7%). We can observe that in the mentioned 2 years the reform of decentralization advanced significantly as a large share of villages united in territorial communities (municipalities) – a new territorial unit that came with the reformation process and has proven its efficiency in budget management and the level of life for a lot of secluded villages and settlements. The share of the budgets of the territorial communities increased from 8,6% to 75,3% (almost 700 new ones added) in a total number of local budgets, while the number of budgets of village councils decreased from 75,8% to only 11,7% in the total number (more than 6000 villages united in new municipalities). Using relative intensity indicators, we conclude that in 2019 in Ukraine 1 regional budget averagely accounts for 288 budgets of the village councils, 32 budgets of the united territorial communities, and 21 budgets of the urban-type settlements, which indicates the incomplete state of formation of the united territorial communities, as the number of budgets of the individual villages is much predominant. In 2021 same indicators show that in 1 regional budget there were 58 budgets of territorial communities and only 9 budgets of village councils, which indicates that the process of municipalities' formation in Ukraine is currently heading towards a conclusion.

The revenue part of the city budget consists of four main components – tax and non-tax revenues, transfers from the government, and revenues from capital transactions. Municipalities' own income includes local taxes and fees, income from the sale and lease of communal property and communal property enterprises; administrative fines and sanctions, license, fees, and certificates. The most predominant share of these lies with local taxes, which are a part of tax receipts, while the rest of the sources of own income hold relatively small shares in the structure. Other receipts elements, such as special funds for certain goals and

transfers from the EU, other governments, international and charitable organizations, etc., account for less than 0,2% (in 2021 [36]) of total local budget revenues, so they can be neglected in further estimates and research. All the significant sources of receipts are shown in Figure 2.2, below.

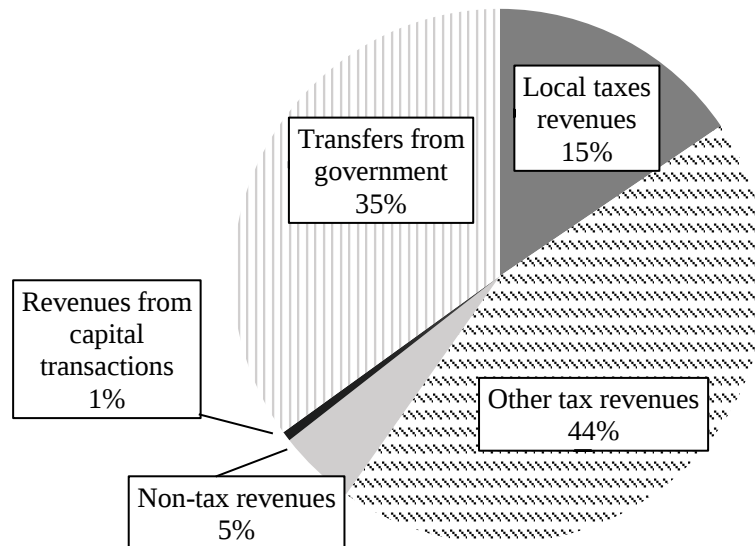


Figure 2.2 – The structure of revenues of local budgets in Ukraine in 2021

Source: by the author based on data [27; 36].

The figure shows that transfers from the state budget accounted for more than a third of Ukraine's local budgets revenues in 2021, while the share of national taxes allocated to local municipalities (mostly income taxes, rent, fees for natural resource usage, etc.) – for almost half, indicating their dependence on state aid and significant deficits. Local tax revenues (mostly property tax and “common” tax paid by locally registered entrepreneurs) account only for 15% of the budget demonstrating a weak level of independence as well. Non-tax revenues (income from property and business activities, administrative fees, receipt of funds for equity participation in the development of infrastructure of the settlement, etc.) contribute only 5% and, therefore, some of them also are considered as “own” income for municipalities, it is hard to include it as such for research purposes as the share of non-tax revenues to local budgets is so low as well as it holds limited opportunities for innovative policies and growth, in the long run, taking in the account current economic state of the country. Considering the dynamics of the last three fiscal years (Table 2.3, below), we can draw more detailed conclusions about

the development of the decentralization process and the financial state of municipalities.

Table 2.3 – Characteristics of the dynamics of the structural elements of local budgets revenues in Ukraine in the years 2018–2020

Component name	Year	Sum, billions of UAH	Absolute growth, billions of UAH	The rate of increase	Growth rate, %	The absolute value of 1% of the growth, billions of UAH
Local tax revenues	2018	61.03	X	X	X	X
	2019	73.58	12.55	1.206	20.56%	0.610
	2020	75.69	2.11	1.029	2.87%	0.736
	2021	89.9	14.21	1.188	18.77%	0.757
Other taxes revenues	2018	171.5	X	X	X	X
	2019	196.97	25.47	1.149	14.85%	1.715
	2020	395.79	198.82	2.009	100.94%	1.970
	2021	256.8	-138.99	0.649	-35.12%	3.958
Non-tax revenues	2018	28.03	X	X	X	X
	2019	26.11	-1.92	0.932	-6.85%	0.280
	2020	21.46	-4.65	0.822	-17.81%	0.261
	2021	27.78	6.32	1.295	29.45%	0.215
Transfers	2018	289.94	X	X	X	X
	2019	260.3	-29.64	0.898	-10.22%	2.899
	2020	160.18	-100.12	0.615	-38.46%	2.603
	2021	202.73	42.55	1.266	26.56%	1.602
Revenues from capital transactions	2018	2.14	X	X	X	X
	2019	2.93	0.79	1.369	36.92%	0.021
	2020	3.47	0.54	1.184	18.43%	0.029
	2021	3.46	-0.01	0.997	-0.29%	0.035
Total fund	2018	562.42	X	X	X	X
	2019	560.52	-1.9	0.997	-0.34%	5.62
	2020	471.5	-89.02	0.841	-15.88%	5.61
	2021	580.7	109.2	1.232	23.16%	4.72

Source: by the author based on data [27; 36].

In 2021, compared to 2018, there is a significant increase in the other taxes, which are the government's partial allocation of national taxes collected from an assigned territory – by 14,85% and more than 100% in 2019 and 2020 accordingly with a 35% drop in 2021, and a simultaneous reduction in state aid by 10,22% and 38,46, while it increased by almost 30% in 2021. However, the local taxes grew only 20,56%, 2,87%, and 18,77% in 2019, 2020, and 2021 accordingly, which means that financial independency development is yet not successful at first glance. The year 2021 was a major setback as transfers grew more than local taxes,

which increases less than the total fund. The total general fund declined by less than 1% in 2019 and by another 15,88% in 2020 and regained 23,16% in 2021, while real GDP growth was 3,2% in 2019 and decline of 4% in 2020 and +6,1% in 2021 [59]. Possible factors for the growth of total tax revenues in the mentioned time frame include the following:

- Some taxes, which were previously revenues of the state budget, in 2019 became revenues of local communities (for example, PIT from the lease of land to individuals to the local budget at the location of leased facilities);
- The amount of 5% of the rent for the use of subsoil for the extraction of minerals of national importance belongs from 2019 to the local budget at the place of their extraction;
- Introduction of land tax on forest lands;
- Abolition of the norm on the payment of land for land plots provided for railways within the allocation zones, in the amount of 25% of the land tax;
- Increasing the number of subsidies, which, unlike subventions, have no restrictions on the areas of use, and, consequently, give more freedom to local governments [8];
- The average growth rate of PIT revenues in Ukraine in 2019 was 19,8% and 7,1% in 2020 [46; 27].

The source of financial stability and autonomy of the local budget is its own income, as well as constant investment in future development. The larger the share of own funds in the revenue structure, the more stable the budget. In addition, by analyzing their own income, the community can infuse and increase it, and invest in development programs (for example, increase the tourist tax by updating historical monuments, recreational areas, etc.). Among Ukrainian local budgets, the percentage of own funds averages 23% from the beginning of the reform to 2020, while developed countries with longer and more thorough experience of financial decentralization keep the value at 69–80% [28].

Using the method of analytical equalization and hard pre-war data, it is possible to predict the share of own funds in the local budgets of Ukraine for the years 2022–2025, assuming extrapolation of no-war events. To do this, we calculate the share of local budgets' own funds for previous years as a relative indicator of the structure. Since the absolute increase in the calculated share is stable, the trend is determined by a linear trend: $\gamma = \alpha + bt$ (2.3). To solve the equations of analytical curves, the method of least squares is used (to find the parameters α and b), also use the method of simplified alignment, in which the sum of all values of t should be zero (Table 2.4, below).

Table 2.4 – Method of analytical equalization for forecasting the share of own income of local budgets of Ukraine

Year	Share of local taxes in local budgets (γ), %	t	$\gamma \cdot t$	t^2	γ_t
2014	9.20	-3.5	-32.20	12.25	22.8568
2015	27.50	-2.5	-68.75	6.25	22.62404
2016	28.80	-1.5	-43.20	2.25	22.39128
2017	26.20	-0.5	-13.10	0.25	22.15852
2018	26.20	0.5	13.10	0.25	21.92576
2019	27.20	1.5	40.80	2.25	21.693
2020	15.76	2.5	39.39	6.25	21.46024
2021	15.48	3.5	64.18	12.25	21.22748
Total	176.34	0.00	9.78	42.00	176.34

Source: by the author based on data [27; 36].

We find the parameters α and b to determine the equation of the trend curve using the system of equations. For a calculation we substitute the data from table 2.4 to formula 2.4 and calculate the required values:

$$1) \alpha = \frac{176,34}{8} \approx 22,04;$$

$$2) b = \frac{9,78}{42} \approx 0,23.$$

Hence, the equation of the linear trend of the share of own income of local budgets of Ukraine is: $\gamma_t = 22,04 + 0,23t$ (2.5). From it we can conclude that on average over the observed 8 years the share of own revenues in total of local budgets in Ukraine was only 22,04%, while it grew by an average of 0,23%

annually. With an assumption of extrapolation while using pre-war hard data, the forecasted value for the share of own revenue in local budgets in Ukraine will be following: $2022 - \gamma_{4,5} = 22,04 + 0,23 \cdot 4,5 = 23,09$ (%); $2023 - \gamma_{5,5} = 22,04 + 0,23 \cdot 5,5 = 23,32$ (%); $2024 - \gamma_{6,5} = 22,04 + 0,23 \cdot 6,5 = 23,56$ (%); $2025 - \gamma_{7,5} = 22,04 + 0,23 \cdot 7,5 = 23,79$ (%). Graphical representation of data including the forecasted values shown in Figure 2.3, below, is not perfect for a real-life circumstance where the hard data 2021 and 2022 may show no changes or a decrease due an additional assistance needed for most of local budgets, however, it demonstrates average development of a key value for research.

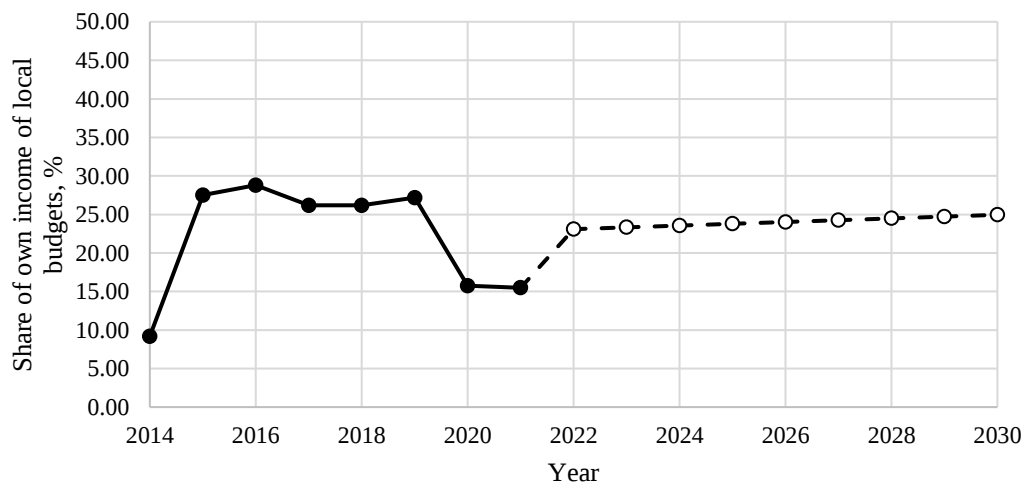


Figure 2.3 – Trend line of the share of own revenues in total local budgets in Ukraine with a forecast

Source: by the author based on data [27; 36], Table 2.4.

From the above calculations, it follows that on average over the observed 7 years the share of own funds of local budgets of Ukraine is about 22%, while at the same time experts recommend a figure of at least 60–80% [13, p. 59]. If the same growth rate is maintained (on average 0,23% per year), despite the war in Ukraine in 2022, the percentage of own revenues will reach the lower end of the desired range level no earlier than in 60 or more years, which shows that some extreme measures are needed to be taken, considering that war crimes in Ukraine may only worsen these conditions and time frames. The general trend from 2014 until 2021 is almost constant in the share of own revenues with an increase by an average of

0,23%, firstly, due to the major decentralization reform and, secondly, further annual amendments and changes to the Budget and Tax Codes.

Quadratic deviation on historical time series based on formula 2.1 is $\sigma_{UA} = 0,0697$ or 6,97%, that is, the average share of own revenues in local budgets revenues for Ukraine deviated from the average by 6,97%. Figure 2.4, below, shows the same statistical series for the United States over the same horizon, which graphically has a value of 65% to 70% for a given period, which is a goal range for Ukraine. According to an indicator of quadratic deviation for the U.S. is $\sigma_{US} = 0,011$ or 1,1%, that is, the average value deviated from the mean (68%) by 0,11%. To compare the stability of these series, the corresponding quadratic coefficients of variation according to formula 2.2 are calculated:

- 1) $V_{\sigma(UA)} = \frac{0,0697}{0,23} \cdot 100\% = 30,3\%$;
- 2) $V_{\sigma(US)} = \frac{0,01108}{0,68} \cdot 100\% = 1,63\%$.

Hence, $V_{\sigma(US)} < V_{\sigma(UA)}$, then the dynamics of the share of own revenues in total revenues of local budgets in the States was more stable (fewer deviations) than in Ukraine.

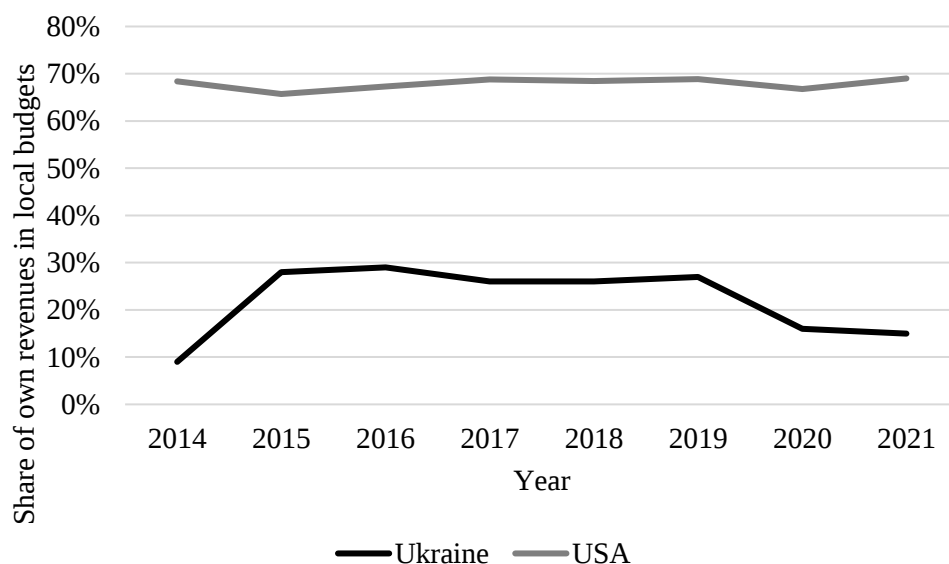


Figure 2.4 – The dynamics of the share of own revenues in total revenues of local budgets in Ukraine and the U.S. over the years 2013–2021

Source: by the author based on data [36; 16].

Since the local taxes account on average only for 22% of total local budgets while about 70% are held in national taxes allocated by the government and transfers, the budgets are not independent of the government, and this is a major step back for the financial system and autonomy and, furthermore, lots of meaningful changes in local communities cannot be implemented. This leads to scenario analysis, where there is a forecasted scenario from Fig. 2.3 based on pre-war hard data and estimated scenarios. The «feared» scenario is a further decrease to the beginning-of-the-reform values due to war and inability to recover in medium-term time, and a «desired» increase to the European benchmark of around 60-80% in local tax in total income in the next 5-10 years (Figure 2.5, below). The desired scenario is a goal of an upcoming simulation. Hence, the graph below is a reference mode of behavior for further system dynamics-based research which the simulation will try to replicate. The reference mode of behavior for a model is a historical behavior over time that identifies the problem and determines the time horizon for a simulation model as well as the boundary for what system parts to include [21].

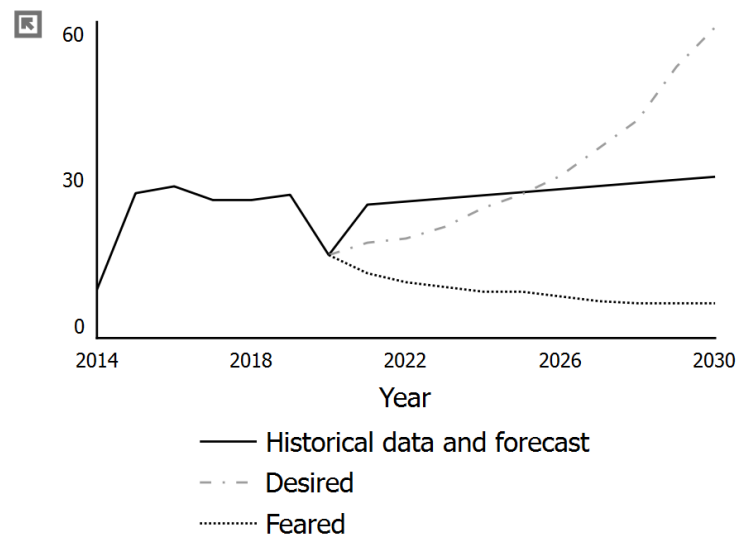


Figure 2.5 – Scenarios of prognosis for a share of own revenues on local budgets in Ukraine until 2030 as a key indicator of financial autonomy (using software Stella Architect) – reference mode of behavior for a model

Source: by the author based on data [27; 36], Table 2.4, and author's estimations.

The expenditure part of local budgets is essential for analysis as the efficiency of expenditures management can positively contribute to gaining more financial autonomy as well as helps to observe the current priorities of municipalities. Expenditures are divided into functional categories, similar to the functional classification of expenditures and the state budget. Figure 2.6, below, shows that some of the largest accounts of expenditures are education (44%), where more than 60% are spent on secondary education, and health care (16%), both of which are mostly financed by government subsidies. Significant expenditures to be provided by local budgets are financing of economic activities (20%) – more than half are expenditures on transport, and construction (24,5%), – and the expenses on government functions (8%), where the largest share is occupied by financing the local self-governing (89%). At the same time, general economic, trading and labor activity, agriculture, and the fuel-and-energy complex together account for less than 2% of expenditures on economic activity [36].

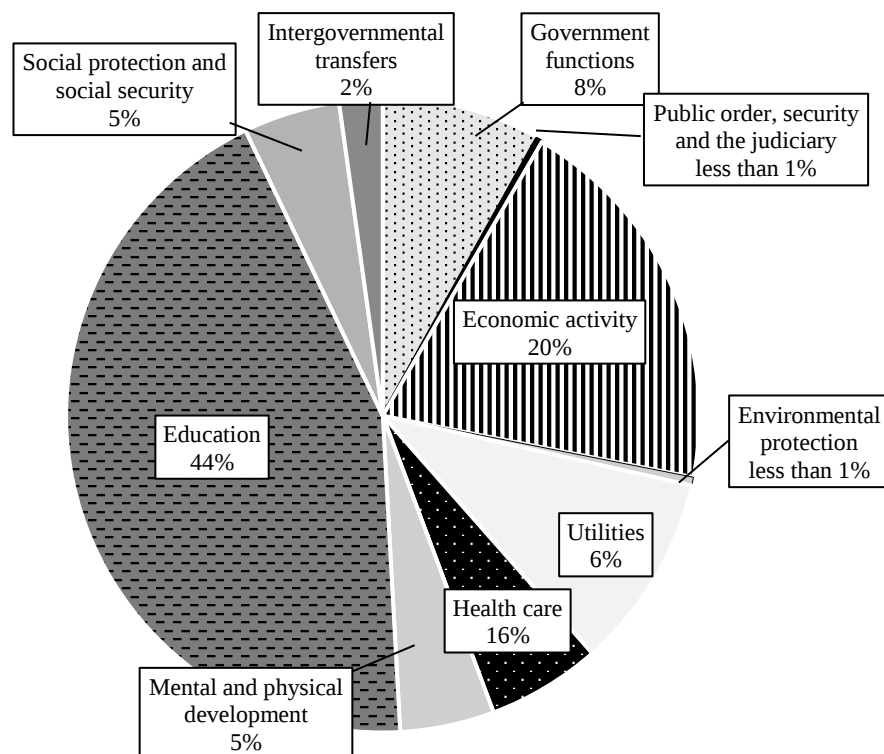


Figure 2.6 – The structure of expenditures of local budgets in Ukraine in 2021

Source: by the author based on data [27; 36].

The smallest share of expenditures goes to the protection of the environment and public order. We observe that a lot of crucial for higher standards of life accounts (utilities, mental and physical development, environmental protection, public order, security, and judiciary) are very low, which means that the budget struggles to cover critical expenses before it has an opportunity to develop to quality of secondary aspects. Low financial autonomy also contributes to the inability to provide for new initiatives.

The important account of social protection and social security contributes only 5% to the total expenditures, however, this was not the case in the previous years. The dynamics of the expenditure components in 2018–2021 are shown in appendix A. Generally, most expenditures grew about 15% with higher inflation and wage growth, however, some not prioritized categories like environmental protection and public order, security, and the judiciary declined in 2020 to cover other expenses in economic activity, government functions, and education. The decline in social protection and social security expenditures (2018–2020) was affected by the revision of the volume and a significant reduction in government subsidies for housing and communal services, reduction of lifetime government scholarships, and protection of the most vulnerable as well as delegating more weight of social security to national authorities other than local municipalities. The increase in expenditure on education was provoked mainly by reforms in the educational process and an increase in salaries for workers in this field.

2.3 Dynamic hypothesis and validation testing of the research using system dynamics approach

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 [9, p. 57]. The formulation is based on the fact that local tax revenue

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” [11] and adapted for this model. The assumption is that the total production is labor-intensive, which is mostly true for Ukrainian production [44, p. 688]; hence, the only wage is taken into consideration and other costs like capital or land are outside of the model boundary. As the biggest cost for each business, wage lies in the cost of units produced, which determines the desirable price at which goods should be sold – indicated price that includes cost per unit of production and the markup of business, and then actual price adjusts to it with a delay. 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. [53].

National tax revenue (*R4*). As has been mentioned, 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. A share of it is allocated to the municipalities and then adds to their total revenues and accumulates in municipal deposits. 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 [25]. Therefore, the average wage also determines the amount of consumption as individuals spend a certain share of their wage on it (it is assumed that individuals do not have any other sources of income, which is true for most Ukrainians, or their wage has the largest share of total household income). 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.

What if surplus? (*R2*). If local municipalities find themselves in surplus, 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. Since this situation rarely happens to municipal deposits, it is hard to find consistent data for the usage of surplus resources, however, the chosen assumption is the most reasonable – a lot of municipalities have a so-called development budget, which accumulates extra resources and is spent on meaningful initiatives.

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. Fixed costs are not included in total costs for business as they do not contribute to dynamics. There is a delay because individual entrepreneurs pay “common” taxes after the end of a fiscal quarter or year.

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. The shortage of funds could be covered in other ways, but most municipalities approach banks and/or foreign governments for transfers or loans. This brings up the ineffectiveness of the situation as loans are simply covering primary needs and are not invested to generate additional profit later. There is also

an assumption here that 100% of loan requests get approved by the according institutions.

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 (based on total population) 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.

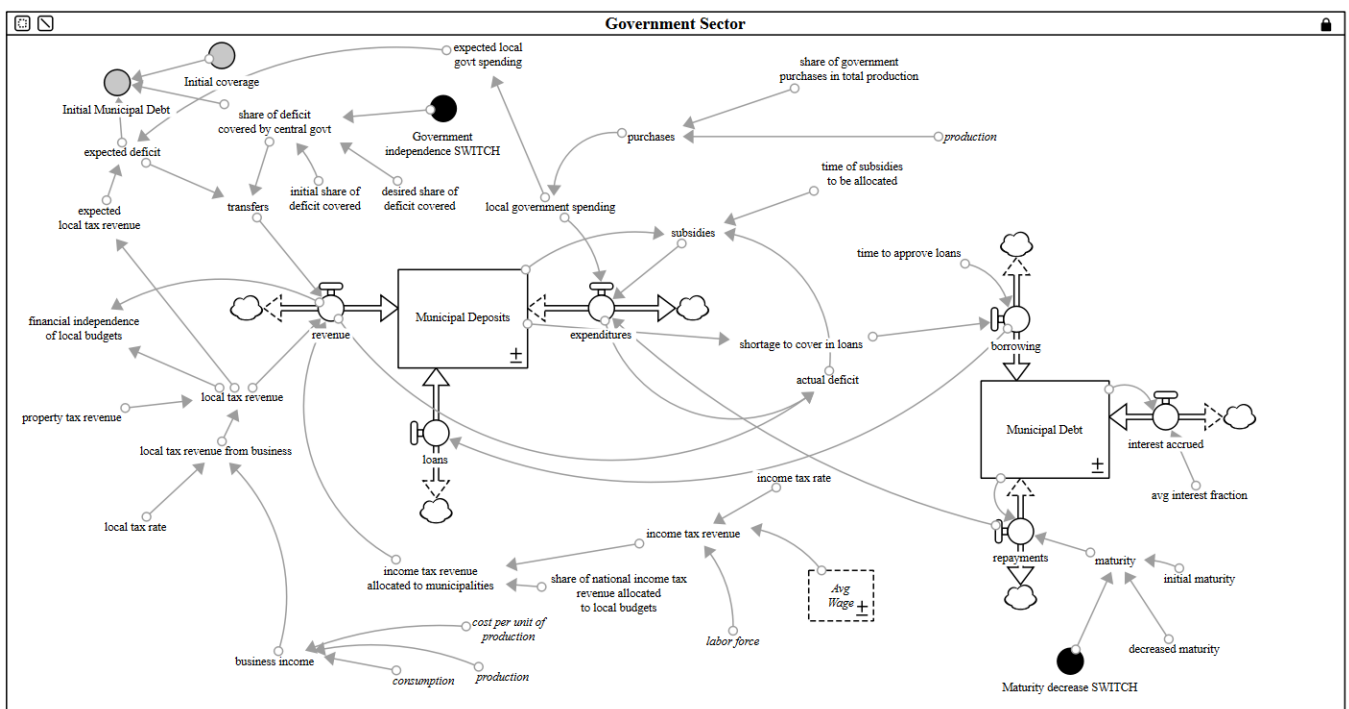


Figure 2.8 – Government sector of the system dynamics model

Source: by the author in Stella Architect.

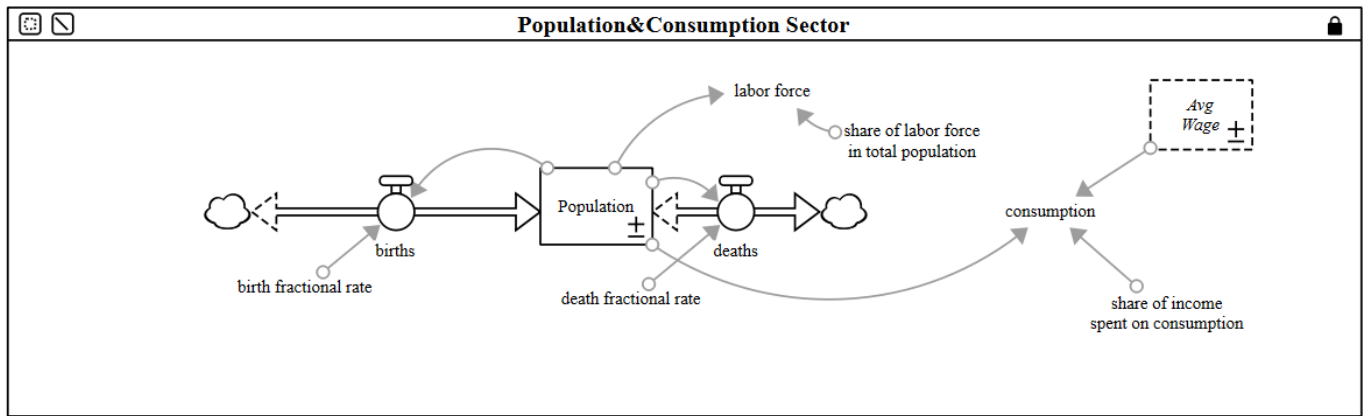


Figure 2.9 – Population and consumption sector of system dynamics model

Source: by the author in Stella Architect.

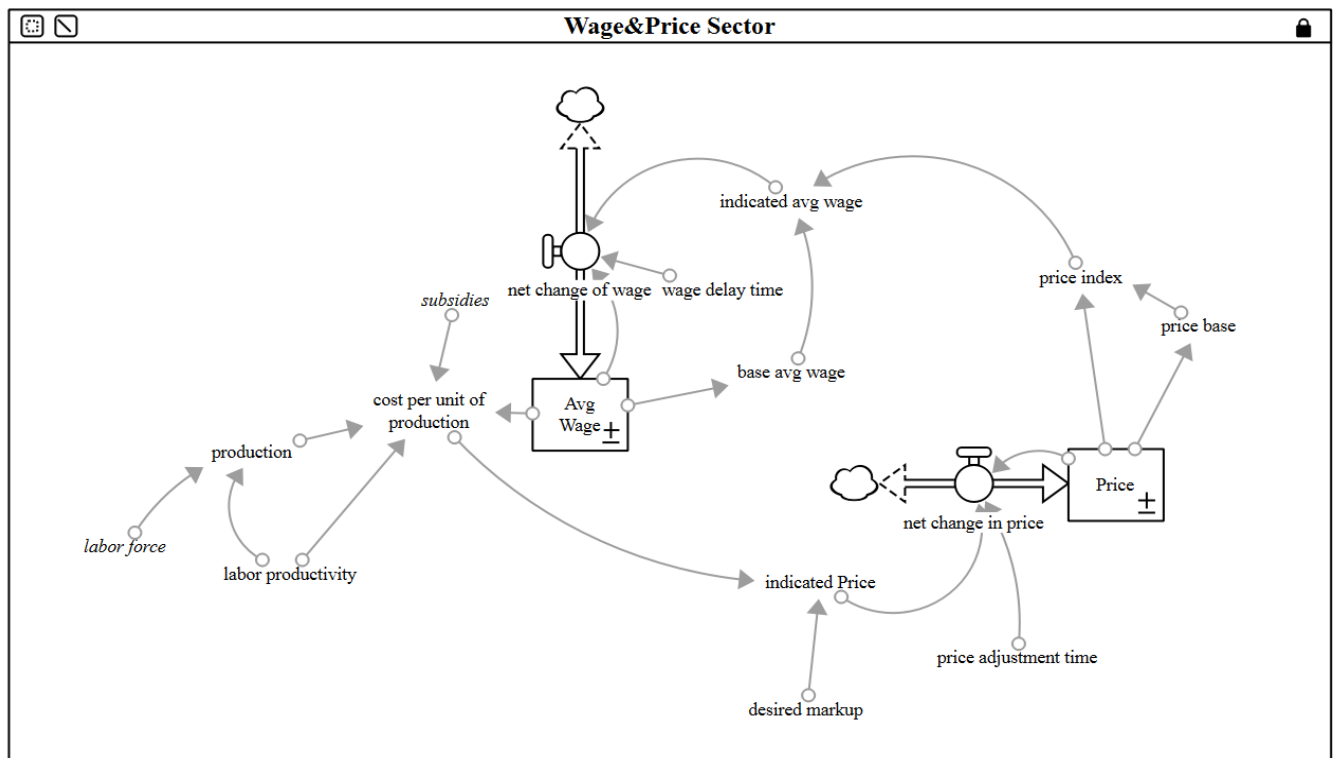


Figure 2.10 – Wage and price sector of the system dynamics model

Source: by the author in Stella Architect.

The separate three main sectors of the model are presented in Figures 2.8–2.10 and the full model is shown in appendix B. To build confidence in the model and its simulation results, a series of validation tests were performed (including ones by Barlas [4]). Some specific results of sensitivity analysis are presented in Chapter 3. 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 Worldbank. Model documentation was created according to guidelines [41]. Model validation details in terms of tests conducted include:

- 1) Structure confirmation test. The model structure was built following the descriptions of the reference mode of behavior, knowledge about the real system, and scientific literature. Some specific aspects of processes were excluded from the model boundary as the purpose of the model is to have a broad understanding of why local municipalities are still dependent on the central government, despite financial decentralization reform. Details on the foundation for equations are found in model documentation (appendix C).
- 2) Parameter confirmation test. All parameters have real-life meaning and there are no “dummy” variables. Some parameters, however, are averaged into constant values from time-series data as they do not show much of a dynamic change. Some others are personal manual calculations yet based on hard data. More on these – in model documentation (appendix C).
- 3) Dimensional consistency. There are no dimensional inconsistencies reported by the modeling software (i.e., unit warnings in Stella Architect).
- 4) Partial model testing and extreme conditions. This testing was conducted within each sector and even smaller structures, which produced behavior that was reasonable with no unexpected modes.
- 5) Integration error test. All available methods of integration in Stella yielded about the same result without any extreme changes noticeable. Reducing DT to a smaller value also did not show changes in behavior.
- 6) Sensitivity analysis. The sensitivity analysis was conducted on all parameters. Some of them showed highly sensitive results on key variables, which started the discussion for limitations as well as possible places to intervene in the system (both touched further on in Chapter 3).

The graph in Figure 2.11 (below) shows the simulation results of the baseline scenario meant to reproduce the reference mode of financial independence.

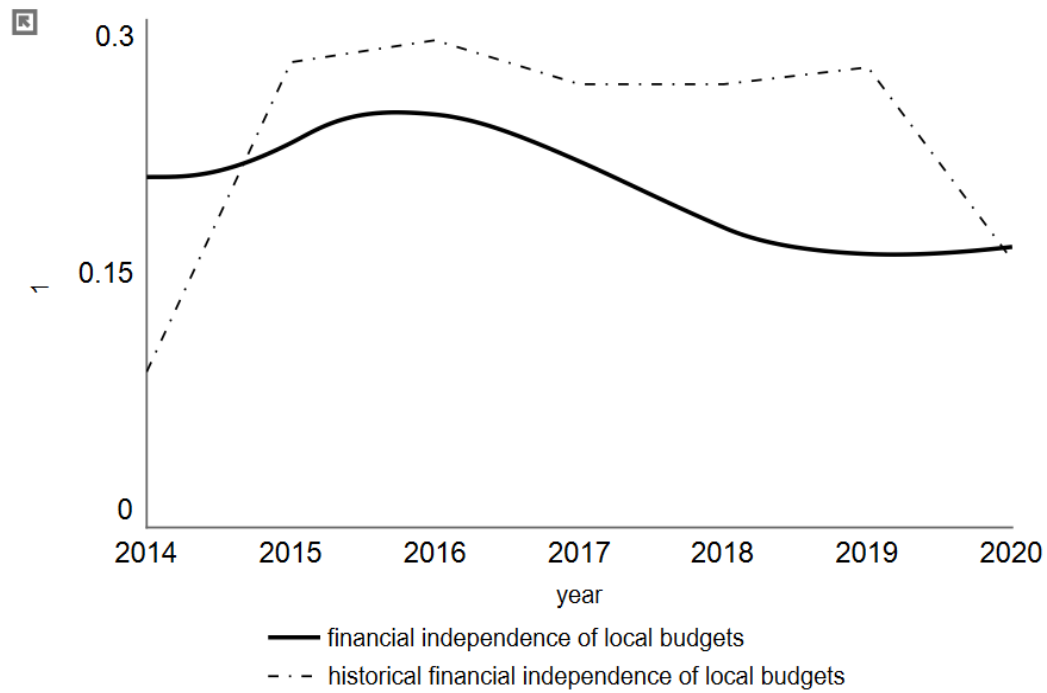


Figure 2.11 – Reference mode replication results in the baseline simulation

Source: by the author in Stella Architect.

The graphs below in Figure 2.12 show some other variables replication, which there was reliable historical data available for.

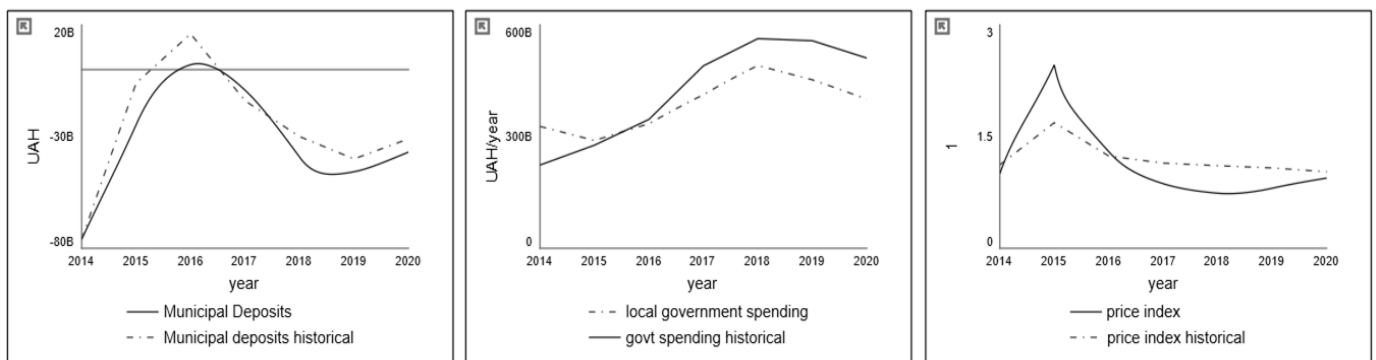


Figure 2.12 – Historical data replication results in the baseline simulation

Source: by the author in Stella Architect.

All fits are not perfect, however, show similar behavior modes. The reference mode simulated is the same in terms of increase at first as decentralization policies in the real system “kicked in” and decrease towards the end of the time horizon. This helps to build confidence that future policy interaction will show reliable enough results. The overall behavior of the simulation (Fig. 2.13) can be split into three time periods for further analysis.

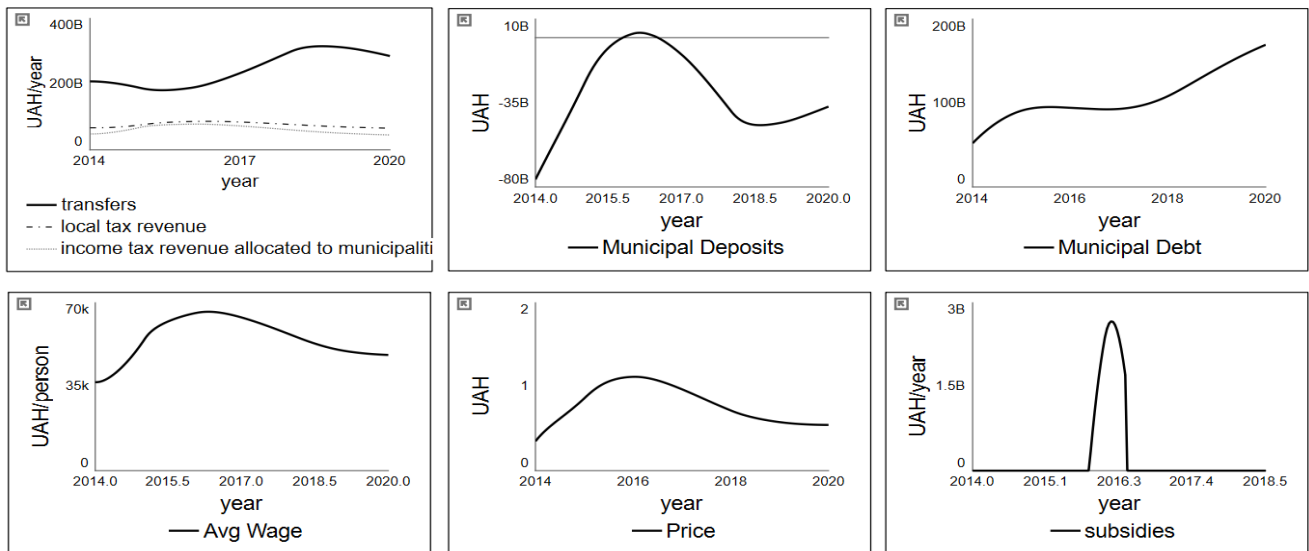


Figure 2.13 – Key variables' behavior in the baseline simulation

Source: by the author in Stella Architect.

During this period of years 2014–2016 two major loops dominate in the system and are responsible for most of the behavior – R1 and B1. In the beginning, the R1 kickstarts everything – the average wage and the cost of unit per production are growing throughout this period. As these two parameters are part of other loops, those also become active with a small delay. Started by R1, both R3 and B2 ensure the growth of local tax revenues, which are added to municipal deposits. Despite the growth of deposits, they are still negative, which starts the B1, since the actual deposit is always covered with loans, which add to the municipal debt and the deposits.

This mechanism also involves a co-flow structure – loans as an inflow to deposits equals the amount of borrowing, which is an inflow to debt. Since the behavior of the deposits reaches zero, the shortage each year to cover with decreases, and municipal debt is exponential decay, which still adds repayments, Revenues show almost linear growth (due to loops R3, B2, and R4) exceeding the spending and eventually deposits reach their peak. Once the loops responsible for revenue growth max out, it brings the deposits in surplus, which kickstarts subsidies (What if surplus? (R2)) and stops borrowing since there is no shortage to cover. In the first 2 years of simulation, the financial independence is growing as local tax revenue is growing while transfers decline.

On the horizon of 2016–mid-2018, as labor productivity and production starts to rise in prosperity of municipalities it increases their spending along with repayments of accumulated debt. An exogenous input of labor productivity decreases cost per unit of production. As the cost of production fall, so do prices and wages, which are caught up in the reinforcing mechanism of R1 that ensured a vicious cycle. The average wage, which is a part of multiple feedback loops, starts to decline. This lowers tax revenue both from business and individuals through R3 and R4 and drives the deposits back in deficit because revenue exceeds spending over time. There is more and more debt accumulated through B1, which is represented by the exponential growth of debt. With revenues lower than spending, the expected deficit increases so transfers have to increase to sustain the level of spending that is growing. The revenues are growing, however, local tax started to collapse, which brings financial independence to a lower level.

The last year and a half of simulation (mid-2018–2020) represent different behavior mode. Exogenous data-driven labor productivity starts collapsing, presumably because of an ongoing pandemic. This drives lower production and spending. Cost per unit of production increases because of lower productivity, which triggers and changes the direction of reinforcing loop R1. With delays, wages and price stop decreasing. Lower production also drives lower spending and expected deficit declines. Therefore, transfers are reduced towards the end. At the same time, both local and national tax revenue remains almost constant due to R3 and R4 activity, where the average wage almost is not changing. Loop B1 remains in action since deposits are yet negative. The changes in transfers and total revenue over this time horizon stop financial independence from decreasing. It may seem puzzling that wage is decreasing at different stages of the model, which is hardly realistic. However, wage in the model is averaged wage and there is a realistic expectation that higher wages do not change as much while lower wages are usually sensitive to different conditions. This means that on average, wages could decrease as the simulation shows. The main driver of the behavior is R1 as it triggers other loops it is connected to.

Conclusion to Chapter 2

We observe that the process of villages uniting in territorial communities is finishing, however, the state of local budgets in Ukraine is alarming. In 2021 most of the local budgets in Ukraine are the budgets of territorial communities (75%), of which about 58 per 1 regional budget. The revenue structure shows that the largest sources of income are other (all taxes excluding local) taxes and transfers (44% and 35% of the general fund in 2021), while local taxes accounted for only 15%, which is one of the lowest values since the reform. The level of financial autonomy is on average equals 22%, while the goal is at least 60%. The analytical equalization shows that annual growth is less than a quarter of 1%, which is insufficient to ensure financial stability and will take decades to reach desired levels if the trend continues.

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.

The general reason for low financial autonomy lies in massive dependency on government aid and income-based taxes, while taxes that are classified as local lay on businesses, which need more support. The research revealed the need for additions to the model in the future – property markets and municipal borrowing. The model has been validated and built confidence in through various tests, but yet has serious assumptions, limitations, and aspects outside of the model boundary, which can be improved and added as new data and research appear.

CHAPTER 3

POLICY DESIGN AND IMPLEMENTATION AS A DEVELOPMENT PERSPECTIVE OF LOCAL BUDGETS IN UKRAINE

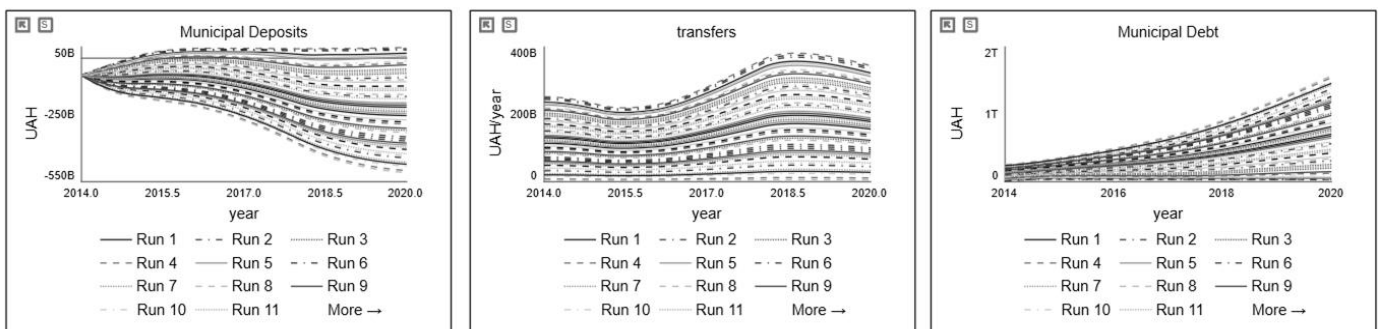
3.1 Sensitivity analysis of parameters and limitations overlook

The ultimate goal of this simulation was to bring financial independence to the lower end of the desired range of values – 60% of own revenues (mostly local taxes) in total revenues of local budgets in Ukraine [9, p. 58], while a running model for a longer period, until 2030, for instance. Sensitivity analysis was performed on all parameters to find points for intervention in the system, as well as opening model limitations, which are discussed later. The process of sensitivity analysis is to force a model to simulate as many runs as desired (for this research 50 runs are chosen), where each run has a different value of a chosen parameter within a set range and sensible distribution, and to see whether the key parameters of the system change their behavior or numerical values throughout the runs of the simulation. The bigger the difference in behavior and values of key parameters, the more sensitive is the system to changes in a certain parameter.

There are rather easier choices for policies in terms of sensitive parameters like increasing tax rates or canceling transfers at all, however, it is economically irrelevant and bears hard consequences. And while it possibly increases the level of financial autonomy, it also drives the deficit up, brings poverty level, bankrupts business, and decreases the standards of life, which are the opposite goals of the model – to have financially independent budgets that have sufficient resources to cover essential expenditures and implement new initiatives for the area and members of a municipality. For a better possible policy, two data-backed parameters were chosen, on change in which the model reacts in a highly sensitive

way. These parameters are the share of the expected deficit covered by the central government in transfers and loan maturity.

Acknowledging the sensitivity analysis results of the share of deficit covered by transfers, there is an observation of both numerical and behavioral sensitivity in various graphs below (Figure 3.1). Some of the key variables (municipal deposits, transfers, and municipal debt) show numerically different results for runs with the value of the chosen variable within the range. Behavior sensitivity is also obvious within deposits and debt graphs, where they show almost constant behavior within certain runs, but higher slopes within others. Since the parameter is backed by data and calculations based on data (refer to model documentation, appendix C), it can be used as a leverage point for a policy. The initial value is set to 80%, however, the benchmark set by European countries, where local budgets are functioning more effectively, is about 20% of the expected deficit. This value is used for a possible policy in another simulation with a specific “switch” on.



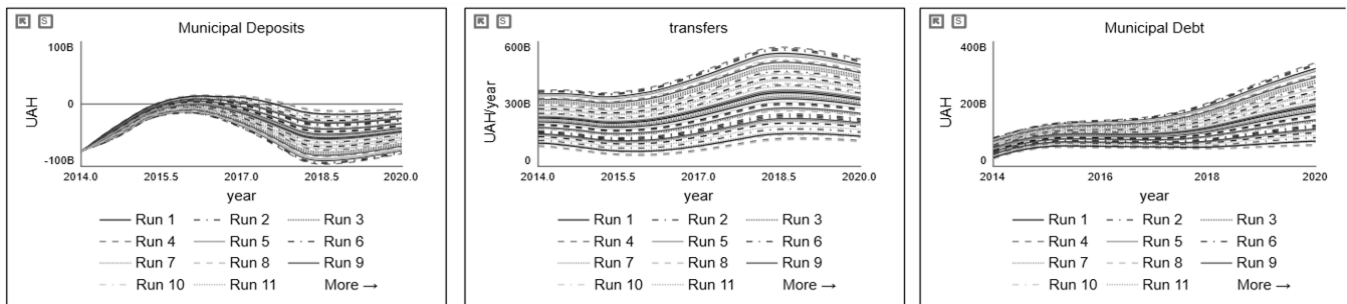
Number of runs: 50
Parameter: the share of deficit covered by the central govt
Distribution: Uniform
Range: 0.1-0.9 (dimensionless)

Figure 3.1 – Sensitivity analysis results for a share of the deficit covered by the central government

Source: by the author in Stella Architect.

Another good point for intervention is loan maturity – in how many years the loan has to be repaid including interest, which applies to both bank loans and municipal bonds. While potentially decreasing transfers may help the autonomy, it increases the shortage of funds in the community, which is assumed to be covered

by loans in a form of traditional loan or municipal bonds. Increasing loan maturity may ease the consequences of decreasing government aid and help to not fall into a debt trap with efficient management. In Figure 3.2, there is an observation of both numerical and behavioral sensitivity (in municipal debt). Since this parameter is backed by data and calculated as an average based on data (refer to model documentation, appendix C), it can be used as a point for policy. The initial value used in the baseline simulation is 11 years, which is an approximate average from data for Ukrainian municipal loans in recent years [27]. The run with a lower share of expected deficit covered with transfers will put pressure on municipalities in terms of debt. Longer maturity can ease that; therefore, the “policy” value is set at 20 years.



Number of runs: 50
Parameter: maturity
Distribution: Incremental
Range: 7-25 (years) – as a historical range for different municipal loans [27]

Figure 3.2 – Sensitivity analysis results for municipal loan maturity

Source: by the author in Stella Architect.

Appendix D provides more sensitivity analysis results for other parameters that seem important in system structure (and mental models) as well as reachable to change by central government – income tax rate and share of the labor force in population. While increasing tax rates to fill the budgets and creating new jobs to have more taxable income in the population may seem a positive policy option, the sensitivity analysis shows that the created system structure is not highly sensitive to changes in these parameters. Neither of them causes behavioral changes, which is most important, and changing the income tax rate does not influence the number of transfers at all, both numerically and behaviorally. Thus, it is important to only

consider highly sensitive parameters for a policy, which are backed by data. It is also crucial to consider the challenges and timelines of implementation, which are also discussed later.

While the model reached its main goal, there are some limitations to consider in using it now and in the future for a potential expansion or further research. The model is built and calibrated as an aggregation of all municipalities in Ukraine, which means some specific ones of them would be outliers, and model results and policies might not be relevant to them. This aggregation is one of the biggest assumptions in the model; some others could be found throughout the text and in model documentation. There are also other assumptions as well as a number of potentially important things that were left outside of the model boundary or not mentioned:

- Businesses' only cost is wages, however, there are some capital-intensive productions that will need capital costs consideration. Since the majority of cases in Ukraine do not fall in this category, it was overlooked.
- Individuals' only income is also wage. However, we as individuals can receive many different types of income like interest on our deposits, dividends, etc. Again, in Ukraine, it is a rare enough case to leave it behind considering the underdeveloped stock market and generally low savings among the population to receive significant interest payments.
- The demographic part of the model does not include immigration and emigration processes in the country, as well as imports and exports.
- Desired markup was set to 40% on top of production cost, while it is suggested that the average markup is higher. Businesses and entrepreneurs that pay local taxes are usually local small to medium companies that exist in high competition and, therefore, cannot have higher desired markup.
- The only endogenous taxes included in the structure are income tax from individuals (national) and entrepreneurs (local), however, those are not the only ones. National income tax from individuals (PIT) collects the highest amount of money that is shared with municipalities and that is the way it

was the only one used. The biggest contributors to local tax revenues are income tax from entrepreneurs (“common” tax) and property tax exogenously added. Real estate market modeling will also be a great extension of the model in the future, however, challenging in terms of recent war crimes.

- Lack of data. There is a lack of data in the field of alternative borrowing and its usage in Ukraine, some delay and adjustment times were calibrated in the model (refer to documentation, appendix C). Most of the financial historical data including the execution of revenues of local budgets and taxes collected is available for the full year of 2021 and the beginning of 2022. However, some other indicators in the model like labor productivity, birth and death rates, etc. are not available on reliable sources for 2021 and later. Hence, the simulation cannot run fully for 2021 while some data is not available. Simulating only with a limited number of indicators or assuming no change in 2021 from 2020 would compromise the validity and reliability of the model due to the inability to compare simulated behavior to a historical one. Therefore, the simulation stops in 2020.

Hence, the model, unfortunately, does not include the impact of war in Ukraine, and its simulated prognosis is also based on the latest data for 2020. However, the model can be modified later to include recent data as well as recalibrated to certain municipalities and groups of municipalities rather than their aggregated number. Its uniqueness allows improvements and future development.

3.2 Policy design and possibilities of improving results and forecast

To “implement” chosen policy decisions in simulation and view their action in the longer run, a new policy structure must be added to the model. One of the approaches for that action, while having an ability to have access to both baseline simulation and after-policy-implementation simulation, is to add converters that serve as “switches” of policy, which means they could “switch on” a policy when

needed and “switch off” returning the model to a baseline. These converters are marked in solid black in Fig. 2.8. This will also change equations for parameters that are affected by policies (formulas 3.1 and 3.2, below).

$$\begin{aligned} \text{Maturity} = & \text{initial_maturity} \cdot (1 - \text{Maturity_increase_SWITCH}) + \\ & + \text{desired_maturity} \cdot \text{Maturity_increase_SWITCH}, \end{aligned} \quad (3.1)$$

$$\begin{aligned} \text{Share_of_deficit_covered_by_central_govt} = & \text{initial_share_of_deficit_covered} \times \\ & \times (1 - \text{Government_independence_SWITCH}) + \text{desired_share_of_deficit_covered} \\ & \times \text{Government_independence_SWITCH}, \end{aligned} \quad (3.2)$$

where the share of deficit covered by the central government – ultimately a share of the expected difference between expected local taxes and partial allocation of national taxes collection and expected local government spending, about 80% of which is usually covered in transfers that add to total revenues and accumulate in municipal deposits.

The “switch” can only be equal to either 0 or 1. Hence, if the “switch” is on, it equals 1, and the value of the parameter will equal the desired one by policy as the other part of the equation will be multiplied by 0 and not active. When the “switch” is off (equals 0), initial values are assumed in the simulation (baseline). The simulated behavior with active policies is presented below (Figures 3.3–3.4).

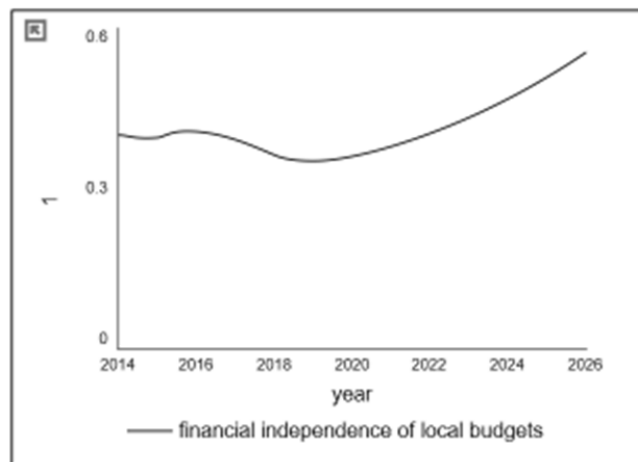


Figure 3.3 – Simulation results for fin. independence of local budgets as a share of local tax revenues in total revenues 2014-2026 with policies implemented

Source: by the author in Stella Architect.

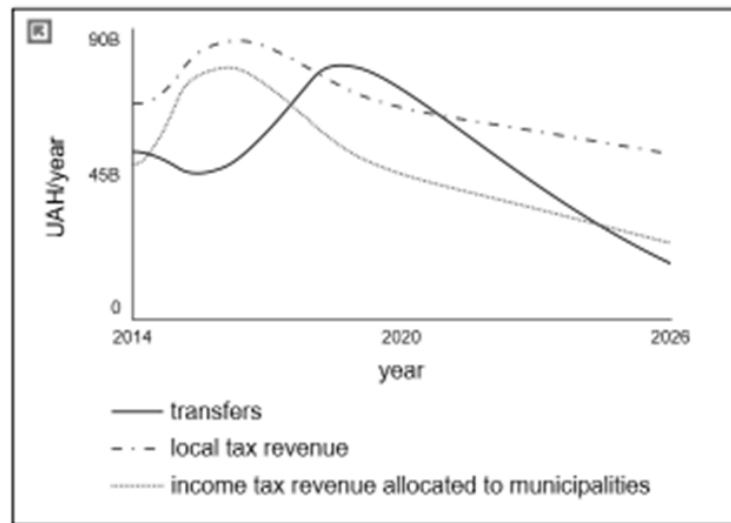


Figure 3.4 – Simulation results for key revenue sources of local budgets over 2014-2026 with possible policies implemented

Source: by the author in Stella Architect.

There are some similarities in the behavior, however, the initial growth with a peak as the reform is introduced is happening faster than in the baseline run of the simulation. This happens mainly because the total amount of transfers supplied is very limited, which increases the shortage of funds municipalities need to cover. It results in almost linearly increasing debt, which drives deposits into a bigger deficit (B1 balancing feedback loop – dominates the system). By the end of 2020, a couple of mechanisms keep driving the behavior same direction the second half does not change its behavior mode. The R1 feedback loop drives wages and prices up, while reinforcing loops R3 and R4 push both taxes from individuals and business revenues down.

An important insight is that total revenues of local budgets and all components of it decrease by the end of the longer simulation, which seems abnormal. However, it should be born in the mind that the population of Ukraine is constantly declining over the time horizon of the simulation due to the negative demographic net growth of the population [46], and this structure is included in the model, and also due to large immigration processes, which is outside of the model boundary. Unless the government drastically changes its policies and improves the demographic situation, or increases labor force share in the total aging population,

this mode of behavior like the one above is very expected. All important factors depend on population and labor force, which is obvious from the system's structure and equations, – for example, consumption, production (GDP), government spending, income tax revenues as only working people pay it, etc. With constantly decreasing population and labor force simulated, such behavior becomes expected. On the other hand, both tax revenues exceed transfers, which is a desirable state for local budgets' receipts.

There are other parameters, in which changes produce highly sensitive behavior, from the conducted sensitivity analysis. Some of them lie in strongly driving loop R1 (for example, wage delay time). Another aspect has been pointed out above as changes in population or labor force would have great policy implementation results. However, demographic changes or interventions in the labor market (like changing wage delays or share of the labor force in population) are far more complicated for central or local government to implement. The dynamics of these parameters influence a lot of other systems in Ukraine, and the financial independence of local budgets seems as not a highly prioritized goal as, for example, social welfare or solving consequences of the aging population. Moreover, these types of policies require a lot of time and resources as well as higher proficiency in these mechanisms, which the author does not currently possess. It is also hard to change wage delays as a lot of internal public infrastructure reorganization is required to increase, for example, the number of times to adjust wages per year.

Chosen policies for the alternative scenario are easier to implement than others, which seem more effective. Cutting expenses is more familiar and faster for the central government than looking for funds to increase them – regarding cutting transfers. Even though the government tries to support non-performing local deposits, it is more harmful than good for their independence. In case of very low financial aid from the government, there will be higher borrowing and debt (discussed more in the next sub-section). To ease that pressure loan maturity increase seems to be a reasonable step. Another alternative could have been a

decrease in the interest rate; however, it is not beneficial for banks and other lending institutions involved and it is highly unlikely to negotiate something like this. Increasing maturity, on the other hand, has positive side effects for both those institutions and municipalities and, therefore, is a better way for policy implementation and trust-building.

3.3 Problems and perspectives of policy implementation for municipalities in Ukraine

The methods and results of the research reveal some notable problems in the object of the research. From the calculations above, conducted during the statistical overview, it is possible to identify certain conclusions about the state of local budgets in Ukraine during decentralization. We observe that the process of separate villages uniting into territorial communities (municipalities) is almost finished as the share of budgets of territorial communities grew by 66,7% in 2021 compared to 2019 (Table 2.2), however, the efficiency of their functioning is yet to question. The analysis of the revenue structure showed that in 2021 local budgets mostly consisted of transfers (35%) and national taxes allocations (44%), while the source of financial independence, local taxes or their own revenues, accounted for only 15% (Figure 2.2). Over the horizon of 2018–2021 local tax revenues increased by 20,56%, 2,87%, and 18,77% in 2019, 2020, and 2021 respectively, and transfers decreased by 10,22% and 38,46% accordingly and stroke back up 26,56% in 2021 (Table 2.3), however, these improvements are not sufficient enough as own revenues have to gain about 40% in revenue structure to meet the set benchmark of the research [9, p. 58].

While the mentioned growth rate is a positive value, the analytical equalization shows that despite the chronic deficit, the share of local budgets' own funds is growing every year, but this growth rate is less than 1% (equation 2.5), while the average value 2014 to 2021 is 22%. This means that ensuring at least this trend does not guarantee local budgets' financial stability in the next few years. In

the 5 years since the beginning of the reform and its constant supplementation, local budgets have become, on average, only half dependent on state subventions and subsidies, but they still have a long way to go. The basis for growth, although insufficient, remains changes in the tax distribution between state and local budgets and the completion of the process of creating united territorial communities. According to the level of development of the tax system, Ukraine rose from 165th place among 181 countries in 2014 to 65th place out of 190 countries in 2019 [37]. The largest source of income remains the personal income tax, while in European countries – local taxes and corporate income taxes. Also, the existence of restrictions of allocation on tax revenues to the budget (national and local) slows down development, because, for example, in EU countries, the main priority is local budget revenues, which can be full or partial. Legislative independence is also successfully practiced, as the state sets only the minimum and (or) maximum tax rates, and local governments have the right to adjust within these limits [20, p. 63-64] and establish their own tax collections. Most developed countries and countries with independent local budgets have progressive tax rates (increase rates with increasing tax base) instead of a fixed rate that does not change. In addition, some EU countries have tax insurance benefits (Denmark, Spain), unemployment benefits (UK, Finland, Luxembourg,) and sickness benefits (Belgium, the Netherlands, France, Sweden) [20, p. 67]. Quadratic deviation on historical time series based on formula 2.1 of the same indicator for Ukraine equals 6,97%, that is, the average share of own revenues in local budgets revenues for Ukraine deviated from the average by 6,97%, which is larger than developed countries as well.

The system dynamics model confirmed a chronic deficit (negative municipal deposits) and growing municipal debt, which is discussed more in the perspectives of policy implementation. Some general processes in the economy also play in the insufficient collection of taxes – negative growth of population, which results in a lower labor force, consumption, labor productivity, and other indicators. Followed that the share of transfers increased in 2021, while the share of local taxes

decreased, which is confirmed by historical data and shows a decrease in the financial autonomy of local budgets in Ukraine. Despite the growth of transfers, the shortage of funds also remains a problem that drives borrowing up, which by the structure of the expenditure (Figure 2.6) does not increase capital-intensive expenses and investments in the economy or bring the level of life up. The general suspected and revealed issue is a shortage of local taxes collected in municipalities, reasons for which inside model boundary include decreasing of the labor force and labor productivity, which lowers production and businesses' income, as well as lower consumption by decreasing population who consuming goods and services offered by entrepreneurs, who are local taxpayers. The theoretical overview of the problem revealed several problems, including inefficiency of the legislature as most taxes are classified as national and rarely distributed in municipalities' favor.

Some problems are either only slightly mentioned or are outside of the model boundary and are slowing the development of financial autonomy:

- War crimes happening in Ukraine in 2022, which have a large impact on national finances as well as local as a lot of businesses are unable to pay taxes, individuals lose their taxable incomes, the taxable property is destroyed and other challenges for local economies. For instance, some taxes became optional or temporarily canceled;
- Inefficiency of budget equalization. More often than not, the state covers local expenditures (deficit) with targeted state subventions, while the basic subsidy accounts for less than 5% of intergovernmental transfers, and budgets that can pay the reverse subsidy are extremely small [27];
- Low level of development of communal enterprises, municipal services, and other sources of own revenues that have a very insignificant share;
- Tax evasion and a significant level of the shadow economy [54];
- Low level of development of municipal borrowing, as well as low demand for it as population, has very limited savings capacity [23];
- Disproportions in the development of different regions of Ukraine [40];

- Real estate and other property markets do not reach their full potential as for contributing to local revenues;
- High level of the average time for tax payments (328 hours per year in 2019 [37]), which slows down many financial processes and planning;
- Constant updating of legislation, to which the general system does not have time to adapt;
- Limited freedom of local governments to create their own principles of budget enrichment;
- Differences in the interests of public authorities, local communities, and the private sector.

This list is not limited, or full, and further research will bring public attention to even more critical issues that urge new solutions. The possible recommendations include revealed problems, policies designed in the model, and international experience of prospering local communities. All recommendations could be grouped into categories shown in Table 3.1, below.

Table 3.1 – Types of policies recommended

Type	Recommendations
Administrative	Enabling changes to Budget and Tax Codes less often for the sake of faster adaptability, increasing efficiency of tax administrations, educating small communities, prioritizing local budgets in tax distribution, allocation of more legislative freedom, and fighting shadow economy.
Financial	Cutting the share of the revenues covered by transfers, encouraging a balancing distribution of income to consumption, developing other sources of own revenues, reforming equalization policies, supporting and investing in local business, promote “tomorrow” spending of communities.
Demographic	Providing a better environment for family planning, active employment policies, and battling immigration.
Other markets development	Municipal borrowing market and property market.

Source: by the author based on research results.

Even though, the process of uniting separate villages into communities has ended, the efficiency of their finances and budget management is still low. They are more dependable on transfers, do not possess a lot of local taxpayers in a form

of businesses, and do not have much access to those available forms of municipal borrowing, which are also very limited (discussed more later). That is why a lot of investments have to be forwarded to rural areas for them to become capable to contribute to their own communities. Introducing a smart village concept will help villages become more independent. Educating about budget management is also crucial. The tax administration also must be upgraded and reformed as Ukraine remains an outsider for a high average time to process tax payments [38] as well as further developing the tax system. This could be implemented by the state's involvement in new technologies and funding for re-equipment and retraining of staff to digitalize the tax process (electronic filing and payments, use of pre-filled tax returns, electronic invoices, administrative web portals, transparency of tax collection, effective communication, etc.). About 97% of OECD countries use electronic payments to pay taxes [37, p. 27–28]. Electronic invoices have become popular in the European Union in many countries – including Denmark, the Netherlands, Spain, and Sweden – legislation to allow public administrations to accept electronic invoices.

Cutting transfers and developing municipal loans are the main ways for recommendations, which result in a higher share of own revenues and a higher growth rate decreasing the time needed to reach the goal of 60% of own revenues in budgets. The system dynamics model revealed a great need to support the demographic situation, active employment policies, and encourage a supporting balance of consumption and savings. It would be great to re-focus the policy of territorial equalization from PIT to business-based and sales-based taxes as those determine fairer indicators of area's welfare (based on the U.S. experience).

Thus, the model shows that cuttings in transfers result in higher deficit and potential debt. As a result of observed policy and many other possible policies, when transfers decrease, the deposits are in excessive deficit and debt is increasing. This is a double-ended stick. Solving one problem pushes another to its more negative boundaries. This is something that seems very logical now, however, was not anticipating prior modeling, which is why the system dynamics approach is a

suitable tool. Thus goes, intense debt is not always the worst situation as the market of municipal borrowing develops. Developing new ways to cover the deficit could be another highly effective policy, however, taking that action also requires a lot of resources. Solving both finance dependence and deficit position is not likely using this version of the model, which, of course, could be extended to tackle more problems in the system of public finance in Ukraine. Moreover, cutting transfers will drive alternative financing to develop and give municipalities more freedom in suitably managing their debt and repayments, given some borrowing restrictions are lifted.

Even though the model does not include different types of municipal borrowing, this aspect is still underdeveloped in Ukraine. For example, there were only six separate emissions of internal municipal bonds over the years 2014–2018 in Ukraine by three unique municipalities, all of which were city councils [23, p. 102]. This shows that this instrument is mostly available to larger communities and is not popular. Domestic and international loans have been used, however, their total value has not exceeded 40,000 euros per year in the same period [23, p. 103]. This is caused both by the underdeveloped market and multiple restriction mechanisms in the legislature. Actions that would help improve the demand and access to cooperation with the international market and domestic institutions like insurance companies for municipal borrowing include – a high share of own and fixed revenues of local budgets, possession of the highly liquid communal property, the presence of governmental or other securities owned by local authorities, obtaining state guarantees and guarantee of financial and credit institutions, etc. [23, p. 106]. Appendix E includes different instruments of municipal borrowing available in the U.S. that are an example of a policy.

The model is unique in the way that newly available data can be added and new markets and sectors. It can also be recalibrated to represent only certain areas of Ukraine or even a separate municipality, or even other countries, that share the same assumptions and have a similar financial system, which makes the method suitable for assessments.

Conclusions to Chapter 3

The sensitivity analysis, which was performed on all factors of the model, revealed the best places to intervene in a simulated system for a future policy that showed both behavioral and numerical sensitivity. This type of analysis presented that cutting government transfers and increasing maturity for municipal loans ease the financial state of municipalities.

Therefore, the built model is neither perfect nor full as there are factors that rely on heavy assumptions or exist outside of the model boundary. These include assumptions about costs of enterprises, individuals' income, exogenous taxes, and other factors, etc., and limitations about war crimes, shadow economy, aggregating and averaging. The model also does not represent the data for 2021 as not all data for needed exogenous parameters are currently available, and hence, running the model of a longer period is less reliable.

The system dynamic research confirmed a chronic deficit (negative municipal deposits) and growing municipal debt. Some general processes in the economy also contribute to the insufficient collection of taxes and own revenues – negative growth of population, which results in a lower labor force, consumption, labor productivity, and other indicators. An excessive list of problems is discussed regarding the financial autonomy of municipalities including legislative, political, economic, and social areas.

Recommendations for policies, aside from those already mentioned, also include various actions in administrative, financial, and demographic directions, as well as the need for the development of other markets like property and municipal borrowing. Comprehensive application of recommended measures along with foreign experience will contribute to financial stability, enrich local budgets, and accelerate the stable establishment of their independence from public funds. This will give a chance to establish wealthier communities that enjoy a higher level of life.

CONCLUSIONS

The essence and current characteristics of financial independence of local budgets of Ukraine in the context of decentralization reform are defined in this study. Chapter 1 summarizes the different approaches to the concepts of “decentralization” and “financial independence of the budget”. Thus, the local budget is the sum of financial resources of the local government, formed from various sources of income, which the local council body has the right to dispose of under current law to perform its functions and meet the needs of the community. One of the revenue sources is the own revenues of a municipality that are collected on their territory exclusively and are fully allocated to an according local budget (e.g. local taxes). The level of financial independence means having enough its of own revenues to sustain most of the local expenditures (the used benchmark is 60%). The reform and financial autonomy give opportunities to increase the level of life in smaller communities, implement meaningful initiatives, develop their social and economic life, and prosper. Severe dependency on governmental aid takes a lot of opportunities away. Chapter 1 also highlights the factors that affect financial independence grouped in those affecting the revenue flow and the expenditures. In addition, the foreign experience of decentralization and financial autonomy management is presented, which is used for further recommendations.

Chapter 2 assesses the local budgets using statistical methods and includes several stages of system dynamics research with a simplified explanatory model of aggregated municipal deposits. After using various statistical indicators, the following results were revealed: in 2021 most of the budgets are the budgets of territorial communities (75%), of which about 58 per 1 regional budget; the largest sources of income are other (all but local) taxes and transfers (44% and 35% of the general fund), while local taxes accounted for only 15%, which is one of the lowest values since the reform. Using the method of analytical equalization, the share of local budgets' own funds was calculated, as they are a source of financial stability

and independence. The equation of the trend $22,04 + 0,23t$ shows an increase in the share of own funds, and the average value over the research horizon is as low as 22%. the coefficient of variation showed that the level of financial independence of local budgets in Ukraine is less stable than in developed countries (e.g., the U.S.). Unfortunately, the growth rate of this indicator ($\approx 0,2\%$ per year) is too low to ensure financial stability and will take decades to reach desired levels if the trend continues. Furthermore, the lack of data for 2022 excludes geopolitical crisis and war-zone impacts, which is assumed to only worsen the trend achieved in results.

A system dynamics hypothesis and model revealed important feedback mechanisms that play role in 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. The general reason for low financial autonomy lies in high dependency on transfers and income-based taxes, while taxes that are classified as local lay on businesses, which need more support. Some aspects revealed the need for deeper research and addition to the model – municipal borrowing and property markets. The model has been validated and built confidence through various tests, but yet has serious assumptions, limitations, and aspects outside of the model boundary. Through sensitivity testing (Chapter 3), two best policies are recommended – cutting down the share of expected deficit covered in transfers and increasing maturity on municipal loans to ease the challenge of lower aid.

Other important policies include the development of new instruments of municipal borrowing, legislative changes, and active demographic actions to resolve the main problem of the research and other ones identified concerning municipalities' welfare. The model has a big potential for expansion and solving mode issues regarding this system or to be recalibrated for specific reasons and areas. After completing its tasks, this research opens new doors to the municipalities in Ukraine and needs to be updated with new data and expanded.

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Appendix A

Table A.1 – Characteristics of the dynamics of the structural elements of local budgets expenditures in Ukraine in the years 2018–2021

Component name	Year	Sum, B of UAH	Absolute growth, B of UAH	The rate of incr.	Growth rate, %	The absolute value of 1% growth, B of UAH
Government functions	2018	28.6	X	X	X	X
	2019	34.9	6.3	1.220	22.028%	0.286
	2020	40.9	6	1.172	17.192%	0.349
	2021	45.9	5	1.122	12.225%	0.409
Public order, security, and the judiciary	2018	1.1	X	X	X	X
	2019	1.3	0.2	1.182	18.182%	0.011
	2020	1.83	0.53	1.408	40.769%	0.013
	2021	1.74	-0.09	0.951	-4.918%	0.018
Economic activity	2018	77.2	X	X	X	X
	2019	81.9	4.7	1.061	6.088%	0.772
	2020	93.9	12	1.147	14.652%	0.819
	2021	112.4	18.5	1.197	19.702%	0.939
Environmental protection	2018	3	X	X	X	X
	2019	3.4	0.4	1.133	13.333%	0.030
	2020	2.4	-1	0.706	-29.412%	0.034
	2021	2.4	0	1.000	0.000%	0.024
Utilities	2018	30.1	X	X	X	X
	2019	34.5	4.4	1.146	14.618%	0.301
	2020	32.1	-2.4	0.930	-6.957%	0.345
	2021	56.7	24.6	1.766	76.636%	0.321
Health care	2018	93.2	X	X	X	X
	2019	89.8	-3.4	0.964	-3.648%	0.932
	2020	50.9	-38.9	0.567	-43.318%	0.898
	2021	33.1	-17.8	0.650	-34.971%	0.509
Spiritual and physical development	2018	18.9	X	X	X	X
	2019	21.6	2.7	1.143	14.286%	0.189
	2020	21.9	0.3	1.014	1.389%	0.216
	2021	27.4	5.5	1.251	25.114%	0.219
Education	2018	165.7	X	X	X	X
	2019	187.1	21.4	1.129	12.915%	1.657
	2020	199.4	12.3	1.066	6.574%	1.871
	2021	249.1	49.7	1.249	24.925%	1.994
Social protection and social security	2018	145.5	X	X	X	X
	2019	103.2	-42.3	0.709	-29.072%	1.455
	2020	23.9	-79.3	0.232	-76.841%	1.032
	2021	28.1	4.2	1.176	17.573%	0.239
Intergovernmental transfers	2018	7.3	X	X	X	X
	2019	8.7	1.4	1.192	19.178%	0.073
	2020	10.7	2	1.230	22.989%	0.087
	2021	12.6	1.9	1.178	17.757%	0.107

Source: by the author based on data [27; 36].

Appendix B

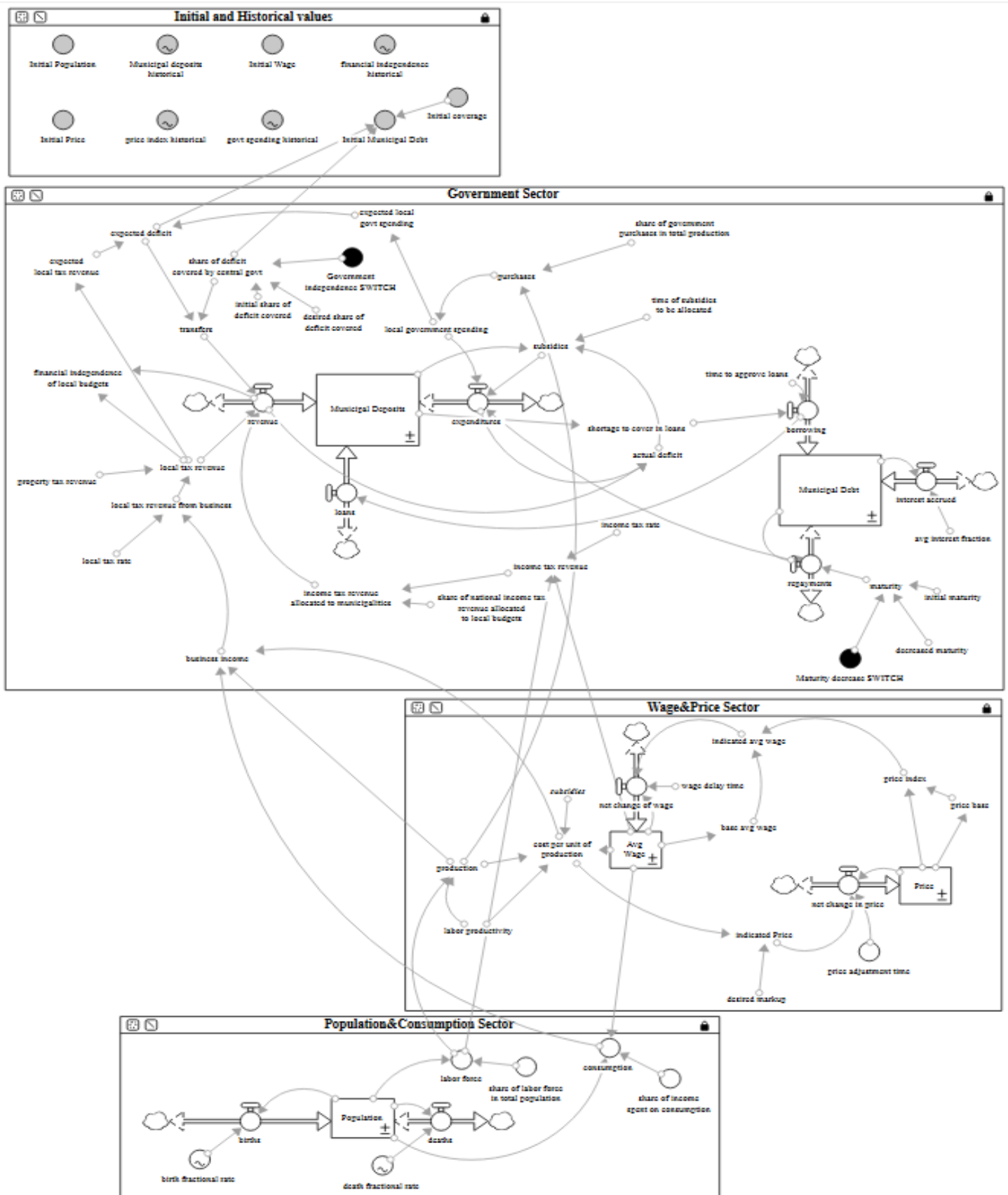


Figure B.1 – Explanatory system dynamics model of financial autonomy

Source: by the author in Stella Architect.

Appendix C

Model documentation

Government Sector:	
$\text{actual_deficit} = \text{SMTH1}(-(\text{revenue} - \text{expenditures}), 0.25, 76\text{e}9) \{\text{DELAY CONVERTER}\}$ UNITS: UAH/year DOCUMENT: This delay converter represents the actual deficit per year as a difference of revenue and spending smoothed as communities report financial data quarterly. There is a minus before the equation to have deficit value as positive. The initial actual deficit is based on hard data for deficit in 2013, one year prior simulation, by Ministry of Finance [27].	
$\text{avg_interest_fraction} = 0.06$ UNITS: 1/year DOCUMENT: This converter represents average annual interest rate for municipal loans calculated from an average from a range of interest rates' hard data available by Ministry of Finance in Ukraine about Municipal debt [27].	
$\text{borrowing} = \text{shortage_to_cover_in_loans} / \text{time_to_approve_loans}$ UNITS: UAH/year DOCUMENT: This flow represents the gain of borrowed money per year that adds to debt. The inflow is shortage of funds that needs to be covered with loans over the time to approve loans. There is an assumption here that absolutely all loans are approved without rejections from banks or other lending institutions.	
$\text{business_income} = \text{SMTH1}((\text{consumption} - (\text{cost_per_unit_of_production} * \text{production})), 0.25, 580\text{e}9) \{\text{DELAY CONVERTER}\}$ UNITS: UAH/year DOCUMENT: This delay converter represents total annual business profit collected over some time and it generally calculated as revenue with costs subtracted. The business revenue equals to consumption as population spends money to buy goods and services provided by firms. Costs are represented as cost per unit of production multiplied by total production (GDP). Business also updates calculations of their profit quarterly. Initial value was calculated as local tax revenue from business in 2013 divided by local tax rate as that was the available historical data.	
$\text{decreased_maturity} = 20$ UNITS: year DOCUMENT: This converter represents longer maturity for municipal loans for policy implementation to ease debt pressure on communities. Based on value OECD research of European countries, France in particular [28].	
$\text{desired_share_of_deficit_covered} = 0.2$ UNITS: 1 DOCUMENT: This converter represents how much of expected reported deficit will be covered with transfers from central government after possible policy is implemented and policy switch is on.	

$\text{expected_deficit} = -(\text{expected_local_tax_revenue} - \text{expected_local_govt_spending})$ UNITS: UAH/year DOCUMENT: This converter represents financial information about expected deficit per year as a difference of expected revenue and spending. Expected deficit is based on actual simulated revenue and spending from previous periods of time. There is a minus before the equation to have deficit value as positive. This is needed because before each spending year municipalities plan their budget and can estimate their tax revenue and spending based on previous data. It is done so they can receive transfers depending on how big is their expected deficit. In this case they have all available revenue planned ahead and only the actual deficit that appears during the fiscal year is covered with loans.
$\text{expected_local_govt_spending} = \text{SMTH1}(\text{local_government_spending}, 0.5) \{\text{DELAY CONVERTER}\}$ UNITS: UAH/year DOCUMENT: This delay converter represents expected local government spending from local spending per year as information stock updating, assumed, every half a year. This expectation is needed to report to government to request transfer and plan their budget for the next fiscal year.
$\text{expected_local_tax_revenue} = \text{SMTH1}(\text{local_tax_revenue}, 0.5) \{\text{DELAY CONVERTER}\}$ UNITS: UAH/year DOCUMENT: This delay converter represents expected revenue from local tax per year as information stock updating, assumed, every half a year based on local tax revenue. This expectation is needed to report to government to request transfer and plan their budget for the next fiscal year.
$\text{expenditures} = \text{local_government_spending} + \text{repayments} + \text{subsidies}$ UNITS: UAH/year DOCUMENT: This flow represents a sum of all expenditures for local communities per year: local government spending, repayments of debt and subsidies if they are more than 0.
$\text{financial_independence_of_local_budgets} = \text{MIN}(1, \text{MAX}(0, \text{local_tax_revenue}/\text{revenue}))$ UNITS: 1 DOCUMENT: This converter calculates the financial independence of local budgets as a share of local tax revenue in total revenue. Lower financial independence means that other sources of total revenue are increasing and taking up higher share while the share of local tax dropping.
$\text{Government_independence_SWITCH} = 0$ UNITS: 1 DOCUMENT: This a policy switch for decreasing share of expected deficit covered by central government in transfers from initial data-based value to desired one for policy implementation. When it is 1, the parameter changes to desired for policy.
$\text{income_tax_rate} = 0.18$ UNITS: 1 DOCUMENT: This converter represents income tax rate, which determines what share of taxable income will be paid in taxes. The value is based on data from Tax Code of Ukraine [53].

$\text{income_tax_revenue} = \text{Avg_Wage} * \text{income_tax_rate} * \text{labor_force}$ UNITS: UAH/year DOCUMENT: Income tax revenue is a share of taxable income per year paid in tax. Total taxable income is average wage of workers multiplied by total labor force.
$\text{income_tax_revenue_allocated_to_municipalities} = \text{share_of_national_income_tax_revenue_allocated_to_local_budgets} * \text{income_tax_revenue}$ UNITS: UAH/year DOCUMENT: This converter represents income tax revenue per year allocated to municipalities as another source of their total revenue and is calculated as total income tax revenue and share of it that is allocated to local budgets of the territory where it was collected from.
$\text{initial_maturity} = 11$ UNITS: year DOCUMENT: This converter represents average maturity for municipal loans calculated from as an average from a range of hard data available by Ministry of Finance in Ukraine about Municipal debt [27].
$\text{initial_share_of_deficit_covered} = 0.8$ UNITS: 1 DOCUMENT: This converter represents how much of expected reported deficit will be covered with transfers from central government. Based on value from teaching materials "Local budgets" from Ukrainian National Academy of Management [56].
$\text{interest_accrued} = \text{Municipal_Debt} * \text{avg_interest_fraction}$ UNITS: UAH/year DOCUMENT: This flow represents money added to accumulated debt in a form of interest. It is formulated as amount of debt at a certain point in time divider over average interest fraction.
$\text{loans} = \text{borrowing}$ UNITS: UAH/year DOCUMENT: This is a co-flow, which represents loans flow to deposits and equals to borrowing per year.
$\text{local_government_spending} = \text{purchases}$ UNITS: UAH/year DOCUMENT: Local government spending equals to government purchases per year, which expenditures on healthcare, education, public goods, etc.
$\text{local_tax_rate} = 0.055$ UNITS: 1 DOCUMENT: This converter represent average local tax rate calculated based on the range possible local tax rate which depend on the type of business (for example, agricultural business pays by lower tax rate. This is based on data from Tax Code of Ukraine [53].
$\text{local_tax_revenue} = \text{local_tax_revenue_from_business} + \text{property_tax_revenue}$ UNITS: UAH/year DOCUMENT: This converter represents total local tax revenue as a sum of property tax and local tax revenue from business.

$\text{local_tax_revenue_from_business} = \text{local_tax_rate} * \text{business_income}$ UNITS: UAH/year DOCUMENT: This converter calculates total local tax revenue per year from business by multiplying business income by local tax rate. Business pays a fixed share of their profit that does not change with changing of taxable income.
$\text{maturity} = \text{initial_maturity} * (1 - \text{Maturity_increase_SWITCH}) + \text{desired_maturity} * \text{Maturity_increase_SWITCH}$ UNITS: year DOCUMENT: Maturity is in how many years the loan has to be repaid including interest. The value for baseline simulation equals to initial maturity. When the policy switch is 1, the parameter changes to desired maturity.
$\text{Maturity_increase_SWITCH} = 0$ UNITS: 1 DOCUMENT: This a policy switch for increasing maturity on municipal loans. When it is 1, the parameter changes to desired for policy.
$\text{Municipal_Debt}(t) = \text{Municipal_Debt}(t - dt) + (\text{borrowing} + \text{interest_accrued} - \text{repayments}) * dt$ INIT Municipal_Debt = Initial_Municipal_Debt UNITS: UAH DOCUMENT: This stock represents the accumulated amount of debt in UAH of municipalities at a certain point in time. It accumulates with additional borrowing and interest accrued each year and depletes with repayments.
$\text{Municipal_Deposits}(t) = \text{Municipal_Deposits}(t - dt) + (\text{revenue} + \text{loans} - \text{expenditures}) * dt$ INIT Municipal_Deposits = -76e9 UNITS: UAH DOCUMENT: This stock represents the balance of deposits in UAH per year at a certain point in time. It accumulates by revenue from different sources and loans and drained by expenditures.
$\text{property_tax_revenue} = 35114565000$ UNITS: UAH/year DOCUMENT: This converter represents exogenous property tax revenue per year which adds to total local tax revenue. This tax and taxes paid from business are main contributors to local tax revenues, however, property tax revenue do not fluctuate as much since property market is not changing a lot over the simulation time. The value was taken as an average value of available historical data by Ministry of Finance in Ukraine for researched period of time [27].
$\text{purchases} = \text{production} * \text{share_of_government_purchases_in_total_production}$ UNITS: UAH/year DOCUMENT: Government purchases is determined by production per year and the share of purchases in it.
$\text{repayments} = \text{Municipal_Debt} / \text{maturity}$ UNITS: UAH/year DOCUMENT: This flow represents the money drained from accumulated debt as it gets repaid over time. The outflow formulated as dent itself as a certain point in time over maturity that varies according to policy implemented in model.

revenue = (local_tax_revenue+transfers+income_tax_revenue_allocated_to_municipalities) UNITS: UAH/year DOCUMENT: This flow represents a sum of all sources of revenue per year available to municipal communities: local tax revenue, income tax revenue allocated to municipalities and transfers from central government.
share_of_deficit_covered_by_central_govt = initial_share_of_deficit_covered*(1-Government_independence_SWITCH)+desired_share_of_deficit_covered*Government_independence_SWITCH UNITS: 1 DOCUMENT: This converter represents how much of expected reported deficit will be covered with transfers from central government. The value for baseline simulation equals to initial share. When the policy switch is 1, the parameter changes to desired share.
share_of_government_purchases_in_total_production = 0.18 UNITS: 1 DOCUMENT: This converter represents the share of government purchases in production (GDP). GDP is calculated as a sum of consumption, investments, net export and government purchases. The share of purchases in GDP in Ukraine is based on Analytical strategic article from Ministry of Regional Development of Ukraine [2].
share_of_national_income_tax_revenue_allocated_to_local_budgets = 0.29 UNITS: 1 DOCUMENT: This converter represents what share of total income tax revenue is allocated to local budgets. The rest goes to national budget. The value was taken as an average value of available historical data about local budgets structure by Ministry of Finance in Ukraine for researched period of time [36].
shortage_to_cover_in_loans = IF Municipal_Deposits<0 THEN -Municipal_Deposits ELSE 0 UNITS: UAH DOCUMENT: This converter represents the actual shortage of funds the municipality faces based on their current deposits. If deposits are in surplus there will be no shortage (0) and no borrowing. If the deposits are negative, then shortage will equal the amount the deposits need to reach balance (equal zero).
subsidies = MAX(0, ((IF actual_deficit>0 THEN 0 ELSE Municipal_Deposits)/time_of_subsidies_to_be_allocated)) UNITS: UAH/year DOCUMENT: Once communities prosper and have surplus that can make meaningful changes like subsidizing business, which can help them to develop local business and increase tax revenue. This means they can only happen during surplus and cannot be negative.
time_of_subsidies_to_be_allocated = 1 UNITS: year DOCUMENT: This converter represents time for subsidies to allocated and processed from local budget to business, which is assumed to be 1 year.

time_to_approve_loans = 1.25 UNITS: year DOCUMENT: This converter represents the time needed for requested loans to approved and processed by banks or other lending institutions. Calibrated manually to get a close fit of variables that have historical data available and to a reasonable value for Ukraine.
transfers = expected_deficit*share_of_deficit_covered_by_central_govt UNITS: UAH/year DOCUMENT: This converter calculates the amount of transfers per year as multiplication of expected deficit by the share of it covered by transfers.
Initial and Historical values Sector:
financial_independence_historical = GRAPH(TIME) Points: (2014.000, 0.092), (2015.000, 0.275), (2016.000, 0.288), (2017.000, 0.262), (2018.000, 0.262), (2019.000, 0.272), (2020.000, 0.158) UNITS: 1 DOCUMENT: This converter represents the historical values for the financial independence of local budgets (share of local tax revenue in total revenue) calculated manually based on historical hard data from Ministry of Finance in Ukraine [27].
govt_spending_historical = GRAPH(TIME) Points: (2014.000, 223509000000), (2015.000, 276940000000), (2016.000, 346242000000), (2017.000, 490119000000), (2018.000, 563271000000), (2019.000, 557524000000), (2020.000, 510979000000) UNITS: UAH/year DOCUMENT: This converter represents the historical values for the government spending retrieved from data from Ministry of Finance in Ukraine [36]
Initial_coverage = 1 UNITS: year DOCUMENT: Initial coverage is the number of years in debt that is expected to be covered.
Initial_Municipal_Debt = (1-share_of_deficit_covered_by_central_govt)*expected_deficit*Initial_coverage UNITS: UAH DOCUMENT: This converter represents the initial value for the stock of municipal debt and is not available data of in 2013, therefore, it was calculated as part of expected deficit that is not covered by central government and by initial coverage.
Initial_Population = 45553047 UNITS: person DOCUMENT: This converter represents the initial value for the stock population based on population data from 2013 (as previous year of simulation run) from State Statistics Service of Ukraine [46].
Initial_Price = 0.35 UNITS: UAH DOCUMENT: This converter represents the initial value for the stock of Price, which was manually calculated to get a close fit to available price index data.

Initial_Wage = 36900 UNITS: UAH/person DOCUMENT: This converter represents the initial value (2013) for the stock of average wage retrieved from data of Pension Fund of Ukraine [39].
Municipal_deposits_historical = GRAPH(TIME) Points: (2014.000, -7.6e+10), (2015.000, -6022300000), (2016.000, 1.6e+10), (2017.000, -1.4e+10), (2018.000, -3e+10), (2019.000, -4e+10), (2020.000, -3.1e+10) UNITS: UAH DOCUMENT: This converter represents the historical values for the stock of municipal deposits retrieved from data of Institute for Social and Economic Research and Ministry of Finance in Ukraine.
price_index_historical = GRAPH(TIME) Points: (2014.000, 1.121), (2015.000, 1.687), (2016.000, 1.239), (2017.000, 1.144), (2018.000, 1.109), (2019.000, 1.079), (2020.000, 1.027) UNITS: 1 DOCUMENT: This converter represents the historical values for the price index retrieved from data from Worldbank [59].
Population&Consumption_Sector:
birth_fractional_rate = GRAPH(TIME) Points: (2014.000, 0.108), (2015.000, 0.107), (2016.000, 0.103), (2017.000, 0.094), (2018.000, 0.087), (2019.000, 0.081), (2020.000, 0.078) {GF EXTRAPOLATED} UNITS: 1/year DOCUMENT: This converter represents crude birth rate in Ukraine over the period of 2014 to 2020 as graphical function of time. It indicates the number of live births occurring during the year, per 1,000 population estimated at midyear. Based on data from Worldbank [59].
births = Population*birth_fractional_rate UNITS: person/year DOCUMENT: This flow represents births countrywide per year calculated as total population at a certain point of time multiplied by birth fractional rate.
consumption = (Avg_Wage*share_of_income_spent_on_consumption)*Population UNITS: UAH/year DOCUMENT: This converter represents the sum of money each person in Ukraine spends each year on buying goods and services, which is called consumption. It is calculated as average wage divided by share of income spent on consumption.
death_fractional_rate = GRAPH(TIME) Points: (2014.000, 0.147), (2015.000, 0.159), (2016.000, 0.147), (2017.000, 0.145), (2018.000, 0.148), (2019.000, 0.147), (2020.000, 0.163) {GF EXTRAPOLATED} UNITS: 1/year DOCUMENT: This converter represents crude death rate in Ukraine over the period of 2014 to 2020 as graphical function of time. It indicates the number of deaths occurring during the year, per 1,000 population estimated at midyear. Based on data from Worldbank [59].

deaths = Population*death_fractional_rate UNITS: person/year DOCUMENT: This flow represents deaths countrywide per year calculated as total population at a certain point of time multiplied by death fractional rate.
labor_force = share_of_labor_force_in_total_population*Population UNITS: person/year DOCUMENT: The total amount of labor force per year is calculated as population of Ukraine divided by the share of labor force in it.
Population(t) = Population(t - dt) + (births - deaths) * dt INIT Population = Initial_Population UNITS: person DOCUMENT: This stock represents the accumulated total population of Ukraine in persons at a certain point in time. It accumulates with births and depletes with deaths.
share_of_income_spent_on_consumption = 0.895 UNITS: 1/year DOCUMENT: This converter represents what share of wages is spent on goods and services provided by businesses each year by population. Based on article in news about recent estimations of this value [33].
share_of_labor_force_in_total_population = 0.55 UNITS: 1/year DOCUMENT: This converter represents what share of total population corresponds to labor force. Based on yearly data from State Statistics Service of Ukraine and calculated as average [46]. This may seem as comparatively low value because of the problem of ageing population in Ukraine.
Wage&Price_Sector:
Avg_Wage(t) = Avg_Wage(t - dt) + (net_change_of_wage) * dt INIT Avg_Wage = Initial_Wage UNITS: UAH/person DOCUMENT: This stock represents the adjusted average wage in UAH per person at a certain point in time. It accumulates with net change of wage.
base_avg_wage = HISTORY(Avg_Wage, TIME-1) UNITS: UAH/person DOCUMENT: This converter retrieves the value of average wage from the previous year.
cost_per_unit_of_production = (Avg_Wage/labor_productivity)-(subsidies/production) UNITS: 1 DOCUMENT: This converter calculates the cost per unit of production as money that are paid for labor (wage) divided by what part of total production gets produced by each worker. This value is decreased is subsidies per unit are above zero since with subsidies firms spend less of production.

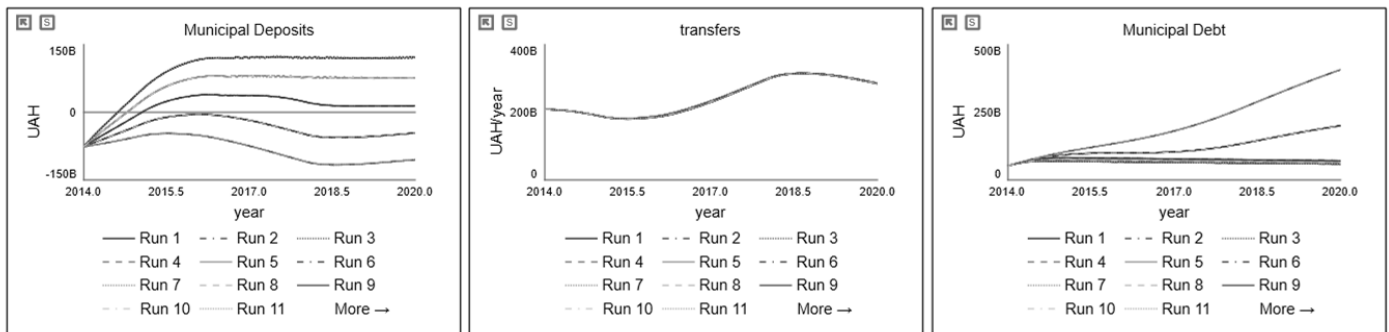
$\text{desired_markup} = 0.4$ UNITS: UAH DOCUMENT: This converter represents the markup of business - how much they add to cost of production at set a price for their services, which 0.4 on top of production cost, while it is suggested that the average markup is higher by article in link. Businesses that pay local taxes are usually local small to medium companies that exist in high competition and, therefore, cannot have higher desired markup [24].
$\text{indicated_avg_wage} = \text{price_index} * \text{base_avg_wage}$ UNITS: UAH/person DOCUMENT: This converter calculates indicated average wage as base wage multiplied by price index as I am assuming that wages adjust proportionally to price index.
$\text{indicated_Price} = (1 + \text{desired_markup}) * \text{cost_per_unit_of_production}$ UNITS: UAH DOCUMENT: Indicated price for price update in this converter is calculated as cost per unit of production multiplied by 1 plus desired markup from businesses.
$\text{labor_productivity} = \text{GRAPH}(\text{TIME})$ Points: (2014.000, 72590), (2015.000, 67162), (2016.000, 81465), (2017.000, 105310), (2018.000, 132534), (2019.000, 130182), (2020.000, 124230) {GF EXTRAPOLATED} UNITS: UAH/person DOCUMENT: This graphical function represents historical yearly data for labor productivity in Ukraine - how much of GDP is produced per person in labor force. This is different from GDP per capita, which is GDP per person of total population. Based on data in annual Labor reports of State Statistics Service of Ukraine [46].
$\text{net_change_in_price} = (\text{indicated_Price} - \text{Price}) / \text{price_adjustment_time}$ UNITS: UAH/year DOCUMENT: This flow represents price update based on indicated wage and wage delay time.
$\text{net_change_of_wage} = (\text{indicated_avg_wage} - \text{Avg_Wage}) / \text{wage_delay_time}$ UNITS: UAH/person/year DOCUMENT: This flow represents average wage update based on indicated wage and wage delay time.
$\text{Price}(t) = \text{Price}(t - dt) + (\text{net_change_in_price}) * dt$ INIT Price = Initial_Price UNITS: UAH DOCUMENT: This stock represents the updated price in UAH of products at a certain point in time. It accumulates with net change of price.
$\text{price_adjustment_time} = 0.5$ UNITS: year DOCUMENT: This converter represents how long it takes for prices in Ukraine to adjust to indicated based on relevant article on price-setting by National Bank of Ukraine [3].
$\text{price_base} = \text{HISTORY}(\text{Price}, \text{TIME} - 1)$ UNITS: UAH DOCUMENT: This converter retrieves the value of price from the previous year.

price_index = Price/price_base UNITS: 1 DOCUMENT: This converter calculates price index as current price divided by the price of previous year.
production = labor_productivity*labor_force UNITS: UAH/year DOCUMENT: Since labor productivity is basically GDP per person in labor force, it is multiplied by total labor force to get total production.
wage_delay_time = 1.2 UNITS: year DOCUMENT: This converter represents how long it takes for average wages in Ukraine to adjust to indicated wage based on manual calibration based on lack of data.
The model has 88 (88) variables (array expansion in parens).
In root model with 4 sectors.
Stocks: 5 (5) Flows: 10 (10) Converters: 73 (73)
Constants: 39 (39) Equations: 44 (44) Graphicals: 7 (7)
There are also 20 expanded macro variables.

Start Time	2014
Stop Time	2020
DT	1/32
Fractional DT	True
Time Units	year
Pause Interval	0
Integration Method	Euler
Keep all variable results	True
Run By	Run
Calculate loop dominance information	True
Exhaustive Search Threshold	1000

Modelling Software: Stella Architect

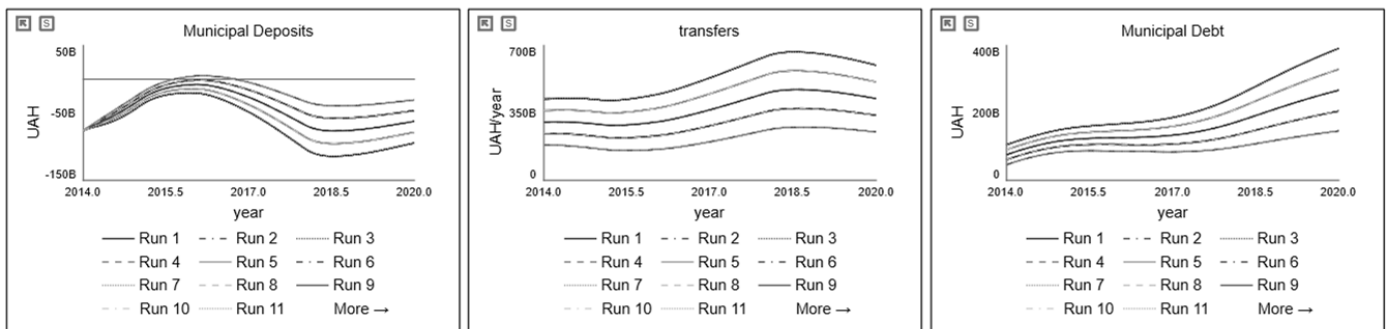
Appendix D



Number of runs: 50
Parameter: income tax rate
Distribution: Incremental
Range: 0,05-0.5 (5-50%)

Figure D.1 – Sensitivity analysis results for income tax rate

Source: by the author in Stella Architect.



Number of runs: 50
Parameter: share of the labor force in the population
Distribution: Incremental
Range: 0,5-1 (50-100%)

Figure D.2 – Sensitivity analysis results for a share of labor force in the population

Source: by the author in Stella Architect.

Appendix E

Table E.1 – Municipal borrowing instruments available in the U. S.

Type of debt	Instrument	Details
Long-term debt	General obligation bonds	Limited tax general obligation (LTGO) bonds are issued by a vote of the legislative body. Because the voters have not been asked to approve a tax increase to pay for the principal and interest, general fund revenues must be pledged to pay the debt service on LTGO. It does not provide any additional revenue to fund debt service payments. Unlimited tax general obligation bonds (also called voted debt) must be approved by 60% of the voters and can be used only for capital purposes.
	Revenue bonds	Revenue bonds are used to finance water and wastewater projects, airports, and stormwater systems. Payment for debt service on revenue bonds comes from user fees generated by the capital facility that is being built. They are not backed by the full faith and credit of the city, and investors consider them somewhat less secure than general obligation bonds.
	Improvement district bonds	Local improvement district bonds are commonly used for projects such as street improvements, street lights, sidewalks, water and sewer systems, and underground power lines.
	Lease-purchase agreements, conditional sales contracts, and certificates of participation (COPs)	Lease-purchase agreement – the local government makes installment payments to a vendor or a third party over time, acquiring the property at the end of the lease for a nominal payment. Conditional sales contract – reserving the right to repossess the property if local government defaults. Certificates of participation (COPs) transform a lease or conditional sales contract into a marketable security.
	Federal and state loans	Provided by government agencies.
	Refunding and advance refunding bonds	Refunding bonds is a procedure whereby an issuer refinances an outstanding bond issue by issuing new bonds. Advance refunding refers to the practice of issuing refunding bonds more than 90 days before the date on which the refunded bonds may be called and redeemed.
	Private activity bonds	Private activity bonds are tax-exempt revenue bonds often issued by public development corporations to finance non-governmental activities. The purpose of these bonds is to finance activities or projects that satisfy a substantial public purpose.
Short-term debt	Interest-bearing warrants	A warrant is an order that directs the treasurer to pay a specified amount to the named person or the bearer of the warrant. If the city lacks the money to pay the warrant, the treasurer registers the warrant for future payment and is authorized to set an interest rate.
	TANs, BANs, RANs, and GANs	TANs (tax anticipation notes), BANs (bond anticipation notes), RANs (revenue anticipation notes), and GANs (grant anticipation notes) are four short-term borrowing alternatives that are repaid out of money derived from the source or sources in anticipation of which they were issued or from any money otherwise legally available for this purpose.
	Lines of credit	Lines of credit provide an alternative to anticipation notes. A bank and a city agree on the maximum amount that will be available under the line of credit. The local government provides a note to the bank that is backed by the full faith and credit of the jurisdiction. The amount of outstanding principal drawn against a line of credit counts against the debt limits.

Source: by the author based on data [30].