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COMPLEMENTARY CURRENCY LOCALIZATION IN CLOSED CONTOURS OF ECONOMIC EXCHANGE: THEORETICAL BACKGROUND AND EXPERIMENTAL VERIFICATION

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ABSTRACT

The issue of basics for successful functioning of a complementary currency has gained utmost importance in the recent years because of the crisis phenomenon in the world economic domain. In the discussed research, the focus has been put on the structural aspect of the problem with the network approach having been used as a theoretical background. During the initial stage of the research, a mathematical model of a local municipal economy has been engineered. Using this this economic model and a number of other economic local system models, it has been revealed that closed exchange contours could be found in every modelled system. It has been found that the number of closed exchange contours in an economic system is greater than in the similar random or social system, and exactly these contours form a structural basis for system's sustainability. To evaluate the effect of complementary currency introduction, an agent-based computer model has been coded. This computer model has proved the efficiency of complementary currency introduction. Complementary money supports functioning of the economy, and, in case of the lack of real money, can improve and speed up economic processes flowing in the system. The described results have been received while computer simulation with implementation of the agent-based computer model and have been verified through the experiments in the real local economic system.

KEYWORDS

Complementary currency, agent-based computer model, closed contour, network approach, sustainability.

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1. INTRODUCTION

Intense development of communication means, rapid growth of data volumes which could be processed and analyzed due to increasing computer power are the main features of the today world. All these processes have built a solid basis for instant decision making and have eased capital movement over boundaries and territories.

Information technology development, and emergence of the Internet have become the technical foundation for a new economic reality, and all these factors have given a rise to continuous growth of electronic commerce with introduction of various type virtual money. Our world is rapidly turning into a global information space with practically unlimited possibilities of economic communication.

Not only real individuals have become the subjects of these communications, but also economic structures generated by them through economic communications. Today, we have communications of entities which are based on communications, i.e. we have a type of "squared" communications. All this poses new challenges for economics as a science.

Communications form a complicated network. If to follow the foregoing logic, we observe a network of networks, and the network approach has been gaining its popularity and has proved its usability and validity in most cases.

2. NETWORK APPROACH

Due to the dynamics of communication development during recent 30 years, Castells has postulated that "under the condition of information era, the historic tendency results in the fact that dominated functions and process are mainly organized in accordance to the network concept" (Castells, 1999). This does not mean that network structures did not exist before. It means that this phenomenon has come to the foreground and has changed the well-known concept that social and economic systems should have been organized according to their geographical characteristics in order to succeed.

Skills and knowledge received by means of networks has proved to be the basis of effectiveness and competitiveness of economic agents. Moreover, by means of networks, these skills and knowledge are transformed into goods and services which are being propagated over vast territories. It is necessary to mention that knowledge under discussion is not of technological type, but the marketing one, being received as the result of processing big data consisted of information about communication acts between economic agents.

Theoretical models and empirical experiments developed on the basis of the network tensor analysis and system techniques implementation have shown that communications between manufacturing subjects in an economic system (a region, or a municipal entity) could be comprehended as a set of economic subnetworks of two different types:

- the first type, locally closed subnetworks (contours), meet the demands in locally manufactured products;
- the second type, open, or transit, subnetworks are oriented towards exchanges with other local systems and are to meet both part of internal demands (import), and a part of external demands (export).

This division might be considered as a trivial one. The mainstream in the modern economic theory pays a great deal of attention to subnetworks of the second type, but the focus of today research should be put on closed subnetworks, as exactly this type networks might be considered as a structural pattern for a sustainable and self-organizing economic system.

Closed networks, which main goal, de facto, is to meet reciprocal demands of network participants through the equivalent exchange of goods and services, are the most interesting type of self-organization, as it provides the ability of individually open microsystems to be collected into macro systems, and to evolve progressively. Ignoring this type of self-organization in a regional macro system study makes it incomplete, and, thus, not valid.

It is important to note, that locally closed economic networks (internal market) functionality is based on medium and small businesses which create the substantial share of workplaces, deliver great volume of essential products and services, and, as a result, determine social-and-economic "climate" in the region.

Any network of economic exchanges could be represented by a commodity and financial components. In a commodity network, raw materials, half-stuff products, goods and services are circulating in accordance with the Leontief's "input-output" model (Leontief, 1990). Geographical position of economic agents, volumes of exchange, dates of product delivery are significant factors for this network functioning.

In a financial network, every communication act of product exchange is reflected, but this type network deals with non-material objects, such as property rights, money, and etc. The rate of their exchange does not depend on product volumes, or geographical distance between economic agents. Furthermore, communications in the financial network have the opposite directions in comparison to product movements in the commodity network.

Both commodity and financial networks could be described in terms of money in the theory and practice of economy. At the same time, the fact that money is means of communications with a discrete code (yes or no, buy or do not buy), while records in financial reports being reflection of material flows have a continual nature, is not under serious attention. Money in a cash or in a company's account, as materials and goods on their ways, are signed in corresponding columns from accounting balances in terms of rubles (or euros, or dollars, or etc.). But this is only an accounting technique which has been existing for more than several hundred years. Representation of material flows in the money form strongly obscures the fundamental difference between money and goods. Not only this fundamental difference is ignored, but the algorithm of their circulation as well.

Not paying attention to the essential difference between the natures of objects under communications in commodity and financial networks means to be in a risk position while decision making, for example, in case of decision to start a product manufacturing or do not. As a rule, all decisions are based on the analysis of different ideal financial indices in accordance to the Fridman's monetarist approach (Fridman, 2002) which is in the mainstream of economics today. Thus, many material characteristics of manufacturing, as well as local region peculiarities, specificity of the national economy, and many other factors could be omitted.

Without comprehending material and ideal flows conjugating mechanisms in the economy, it is impossible to have a success in investigation of the observed phenomenon of the "network society".

3. CLOSED AND TRANSIT NETWORKS

Representation of an economic system as a network helps anyone to take a fresh look at the so-called hierarchical levels of the economy (municipal, regional, national). Since any economic system at any hierarchical level could be represented as a network, it becomes possible to consider any economy as a network in which a separate system as a node interacts with the other similar systems (nodes). Every node in this network is a "viable" system: being visually enlarged, it will turn out to be a network. Researchers, as a rule, try to integrate "small" systems into a larger one according to the hierarchical principle, placing a large system over the smaller ones in the style of a pyramid. However, this is only a construct in a human mind. In the world of economic networks, there is no "above" and "below", there are no hierarchies. There are only networks nested over other networks. The properties of network parts are not intrinsic properties: they can be understood only in the context of a larger whole.

Structurally, every economic system could be perceived as a network where a node is a single enterprise, and an edge is an existing economic link between two enterprises.

Let's discuss any arbitrary open contour comprised of enterprises. In this case, every enterprise could be considered as a black box, a linear operator, converting one set of products (resources) into another is set in accordance with specific coefficients. This enterprise appears to be a classic component of any balance model. All these enterprises compete with each other for access to limited resources trying to minimize inputs, maximize outputs, and as a result, come to equilibrium prices in the market. The only stimulus for such "transit" production processes is to receive an added value, which is equal to the difference between the input and output (node) prices. This concept, which can be called the "input-output-paradigm," has firmly entered the minds of economists along with the linear balance models. As a result, chains of enterprises and production programs are lined up, giving the maximum effect in the scope of the "input-output" system with the stated restrictions on the initial resources. Resources, products, goods, acts of exchanges of goods, markets, prices, value added, profits – that is where attention of market economy subjects and, consequently, the mainstream economic theory was concentrated.

Currently, this narrow view is more and more eroded by the efforts of institutional theory, which postulates that the act of goods exchange is, of course, the "moment of truth", but it is influenced by many important factors, relations between enterprises, thus, should not be reduced to a single fair act of buying and selling. Moreover, lasting relationships and supporting them contracts play in the economic life more important role than targeted commodity exchanges.

This becomes clear from the glance at the developed microeconomics cores where contractual relations, and services are not only the most promising, but already has become the basic sector of the economy. For example, in 2018, total services in the UK GDP were estimated as 74.5%, while production sector was only 24.2 % (Proza,ru, 2019).

When a chain of enterprises forms a closed loop, balanced in all its nodes, then a closed structure is formed, this structure is independent from the external price landscape. In a closed contour (loop) of the network, production largely acquires the character of a contract, service, and this factor is mostly preferred by consumers, and can help to compete with the "production monsters". In this way, all internal markets are reproduced.

In closed contours, internal, or complementary, type of currency could be successfully used, because of the discussed properties of these contours. This concept is postulated in (Popkov, 2015). In transit contours, only external, or real, currency can act. Without doubt, this kind of currency can be used in contours of both types, and this fact blurs the distinction between external and complementary money. The same idea was expressed by F. A. Khayek in (Khayek, 1996), where he wrote that "we learn that there is no clear distinction between money and non-money". In experiments discussed later in these materials, we try to prove the fact that complementary money (non-money, in terms of Hayek) can play the role of external money in case of the lack of the external money.

Taking into account experience of the non-payment crisis, this complementary money, apparently, can have the nature of debt securities, by means of which all internal needs are measured, their significance and weight can be evaluated. Outside the closed contours, they are included into the general financial flow.

4. MUNICIPAL ECONOMY MODEL

Economic system of the municipal level was chosen to be investigated through implementation of the network approach. Open statistical data has become the data foundation for the Municipal economy model. This model represents economy of a municipal entity with 10,000 population. The population distribution by age groups is as follows:

- 55% (5500 people) – working age (over 18 years),
- 27% (2700 people) – above working age (retirement age),
- 18% (1800 people) – below working age (up to 18 years).

The Municipal economy model was engineered based on the following concepts:

- it was necessary to support diversification of the economy in order to provide different goods and services in condition of a single leading enterprise absence, as this enterprise existence could convert a municipal system into a mono town economy,
- it was necessary to provide production-and-market relations between different manufacturing entities in the municipal system; those entities which did not have such relations were excluded from the model.

Types of products and services and volumes of their consumption were identified based on the analysis of the consumer basket and according to the modelled population distribution. As the "raw" data for calculation of the commodity flows between enterprises in the municipal entity, annual reports of similar enterprises from similar economic sectors were used. Such indices as product volumes, average wages, average number of employees were taken into consideration. Population was allocated as a separate sector that consumes products of local enterprises and provides them with the most important resource – the labour resource.

To determine the significance of the internal communication (production-consumption) relationships between the enterprises, their needs in the each other's product were taken into consideration in accordance with the structure of the production costs. In estimation of the financial flows, the average costs in the Ural region were used.

The sectoral composition of the Municipal economy model was determined as follows:

1. agricultural farm (cereal and industrial crops cultivating),
2. meat and dairy farm (meat and dairy production),
3. poultry farm (poultry breeding and egg production),
4. meat processing plant (production of semi-finished goods from meat and poultry),
5. dairy plant (production of dairy goods),
6. bakery (bakery product manufacturing),
7. flour mill (flour production),
8. feed mill (feed production),
9. furniture factory (home and office furniture production),
10. car care centre (car maintenance and repair),
11. trucking company (shipping operations),
12. population.

As it was already mentioned. based on statistical data and actual economic indicators of similar enterprises, a consumption matrix was compiled. It represents commodity/financial flows aggregated over the year. It contains volumes of product/service exchange (in the money form) between municipal sectors: a row matches to a sector–seller, and a column – to a sector – consumer. In the other words, the matrix rows reflect the "output" flows which municipal sectors deliver to the other municipal sectors, while the matrix columns reflect the "input" flows which contain data about product/services they consume from the other municipal sectors.

The primary matrix was balanced, all imbalancing flows were restricted as they reflect relations between municipal enterprises and external companies. It means that the modelled system became to be a sustainable one (the dynamic system model has proved this fact, it will be discussed further in this paper), thus, providing conditions for a simple reproduction. In a reproduction cycle, every economic agent sells its product, and, due to the received money, can buy all the necessary materials and goods from the other system agents in order to manufacture its own product in the same volume, and, once more, to sell it, to receive money, and etc. The resulting consumption matrix is depicted as Table 1.

This matrix demonstrates that domestic production meets the needs of population: they obtain the ability to buy local bread, meat and dairy products, furniture, as well as to use services of the car care centre and transport (transportation). In the municipal economy model, 28 main internal ties between municipal sectors were identified (non-zero cells in Table 1).

This matrix could be visualized as a graph, and this graph is shown in Fig. 1. This graph is built in Pajek64 version 5.07 and is presented in the Kamada-Kawai layout.

Table 1: Consumption Matrix of the Municipal Economy Model.

	Product consumption (w_{ij}),.											
Sector	1	2	3	4	5	6	7	8	9	10	11	12
1	–	0	0	0	0	0	496000	1340680	0	0	0	0
2	405	–	0	53993	590322	0	0	0	0	0	0	0
3	0	0	–	79100	0	0	0	0	0	0	0	8227
4	0	0	0	–	0	0	0	0	0	0	0	109460
5	0	0	0	0	–	0	0	0	0	0	0	79389
6	0	0	0	0	0	–	0	0	0	0	0	27514
7	0	0	0	0	0	4081	–	0	0	0	0	0
8	0	8726	419318	0	0	0	0	–	0	0	0	0
9	0	0	0	0	0	0	0	0	–	0	0	2352
10	0	0	0	0	0	0	0	0	0	–	33	9000
11	0	0	0	0	0	0	0	0	0	0	–	16280
12	14000	17000	40450	59000	170300	48000	16000	30000	19200	7000	7730	–

5. SOFTWARE SUPPORT FOR CLOSED CONTOURS DETECTION

To investigate structural features of the Municipal economy network, especially, to find out all closed contours in it, a computer program named "TechNetwork" was coded. This program also proposes additional functionality, in accordance with SNA-methodology (SNA-Social Network Analysis) (Faust, 2006), but this functionality will not be under discussion here. A screenshot with the Municipal economy network, being investigated in this program, is shown in Fig.2. One of the closed contours, which were revealed, is highlighted in this figure.

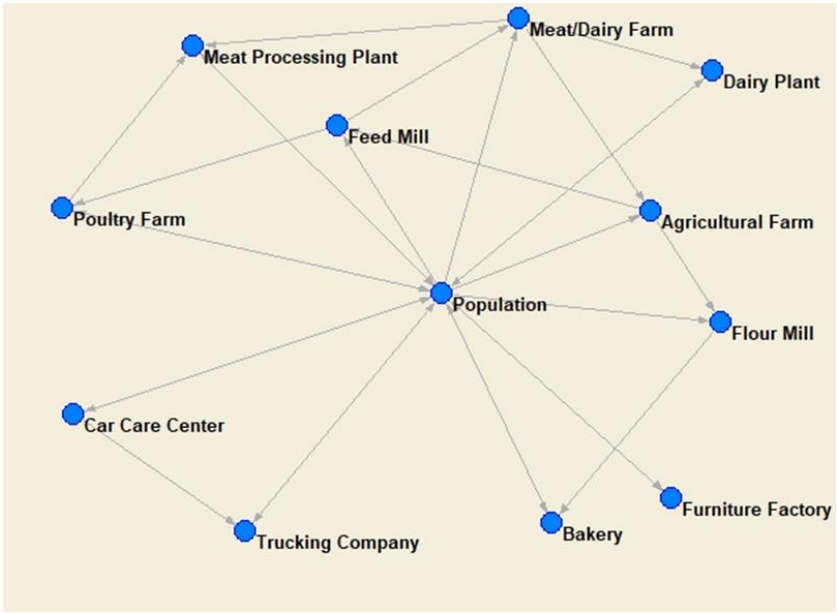

Figure 1: Municipal Economy Model Graph.

In this network, in total, 19 closed contours were detected: 7 comprised of 3 network nodes, 5 – of 4 nodes, 5 – of 5 nodes, and 2 – of 6 nodes.

These results have showed that even a simplified model of municipality includes a significant number of closed contours of commodity exchange, which serve as a natural basis for the further development of cooperation. Many entities simultaneously participate in several exchange chains, so financial flows related to different exchange contours often pass through the links between the same enterprises. For the formation of cooperative ties, the role of population, which often acts as a closing element of a product chain, is important, since products are produced for a final consumer, moreover, it is impossible to imagine an enterprise without labour resources.

To prove the fact, that a closed contour (or a cycle) is really a prevalent structure in a sustainable economic system, one more study was carried out. In the first stage of this study, several economic networks were built. The Municipal economy network was also included in the economic network set together with the four other economic networks which became the results of business games held in different local business communities.

Three business games were organized in different regions of Russian Federation: Ufa city (Bashkortostan Republic), Ekaterinburg (one of the Russian industrial centres), and Moscow (the capital of the Russian Federation).

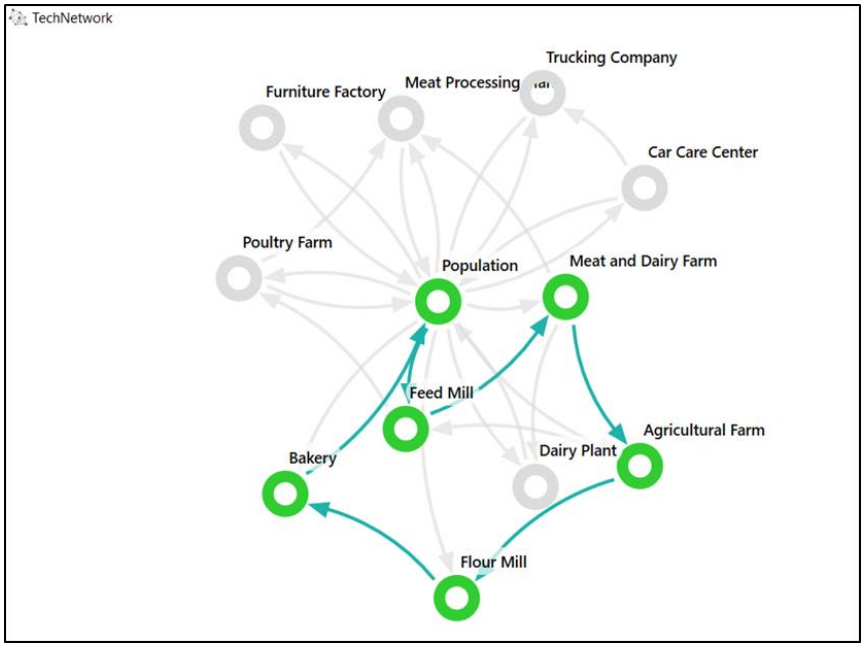

Figure 2: Screenshot of "TechNetwork" with the Municipal economy network.

All of the business game participants had been collected from the local business communities, where the games were organised. Each game was lasting for two hours: during the first hour participants were acquainted with the rules and regulations, the second hour was spent for a communication/exchange process and a network formation activity. In the game, participants were simulating the process of business activity: they were buying and selling (exchanging) different goods. One of the main requirements of the experiment was that these goods for exchange were the same as the participants were producing in the real life. Virtual money was used in the game to support these exchanges, every participant had received definite sum of money before the game started. Intensification of the exchange and network formation was obtained by introducing the negative interest rate (Lietar, 2007) for the money fund available in the game.

One more economic network (the fifth in the set under exploration) was received as a result of business game, which main goal was to engineer a model of camp provision with all the necessary goods.

Closed contours were revealed in every economic network of the set. For the aim of comparison, for every economic network, a set of the similar (with the similar properties – the same size and density) random networks was engi-

neered. This technique of the network comparison with the similar random networks in order to find the peculiarities of the networks under research is very popular in SNA-methodology. These similar random networks were produced in Pajek environment. Closed contours distributions for two of the economic networks and corresponding random networks are shown in Fig. 3

The horizontal axis corresponds to the number of nodes comprising closed contours (cycle size), and the vertical axis shows the number of this size closed contours (cycles) found in a network. In a red, one can find the results of the business games, in blue – the average numbers calculated for random networks (of the same sizes and densities). It is evident, that for economic networks formed in business games, closed structures are really intrinsic, as if they are more frequent for every dimension in distribution than for the random networks. The same effect was denoted for all other investigated economic networks.

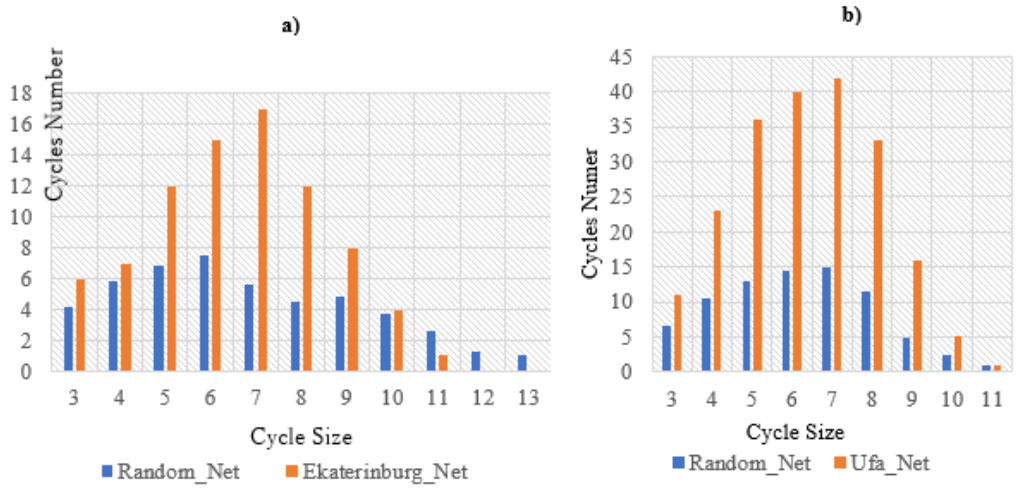

Figure 3: Distribution of closed contours in economic and random networks: a) Business game in Ekaterinburg; b) Business game in Ufa.

Similar experiments were held to find closed contours in various social networks of small groups. This research has delivered the opposite results. Closed contours in social networks are even more rare structures than in similar random networks (Zvereva, et al., 2017).

6. DYNAMIC AGENT-BASED MODELS

In the previous sections, we have discussed static economic models. In relation to the Municipal economy model, it was postulated that it was a sustainable one, it means that it can operate in a long time, repeating cycles of simple reproduction. To prove this fact and to have a chance to investigate the model's behaviour, dynamic computer model has been developed. One more question was of a great interest to evaluate the possibility and estimate the effect of complementary currency introduction. To achieve the goals, the set of agent-based models was built in Netlogo (Wilensky, 1999) environment. This environment supports the process of engineering agent-based models. It is a common knowledge that the agent-based technology is geared towards social and economic sciences area, and, in this case, was considered to be the most suitable simulation technology (Macal, 2010).

In Fig.4, a screenshot of one of the models from the coded set is presented. This model might be considered as a dynamic version of the Municipal economy model. In this model, 12 agents corresponding to the 12 sectors of the municipal economy are acting. They make exchanges in accordance with the consumption matrix inputted into the model. Money is introduced into the model to support these exchanges. One can observe money turnover in every moment of the modelling time.

This computer model was used in simulation experiments to investigate the system behaviour in conditions of money lack, and when money amount is enough. The main goal was to prove or reject the fact of the system's sustainability. This model has proved the fact that the system under research is a sustainable one, because all the exchanges in every experiment ended successfully, but when the money amount was insufficient, it was necessary to

spend longer time to finish all the exchanges. For investigating how complementary currency could work, this model was almost useless because of its small size and non-intense exchange process flowing in it.

Some other models realizing similar algorithms but based on the other data sets were engineered. Let's discuss the basic algorithm of all models from the set.

In every model from the set, there are N agents, every (i-th) agent produces a unique product in the volume of (xi), and, at the same time, consumes the other agent's products. The consumption volumes are determined by the corresponding (i-th) column from the consumption matrix, and the volumes of production (xi) are estimated based on the mathematical concepts of the Leontief's "input-output" model (Leontief V.V., 1990). Based on these data, exchange processes between the agents are simulated.

Money is introduced into the Model to support exchanges in the system, its volume is determined by the Money supplement coefficient (K) and the total product volume in the system. Every agent receives a sum of money on its account, initial value of the agent's money (mi) is estimated in direct proportion to its initial product volume (mi=K·xi). The coefficient (K) can be set to the necessary level before the modelling process starts. In simulations, money volumes on the agent's accounts are changing permanently, and one can observe these changes in the model's window (these changes also are stored in the output file for subsequent analysis).

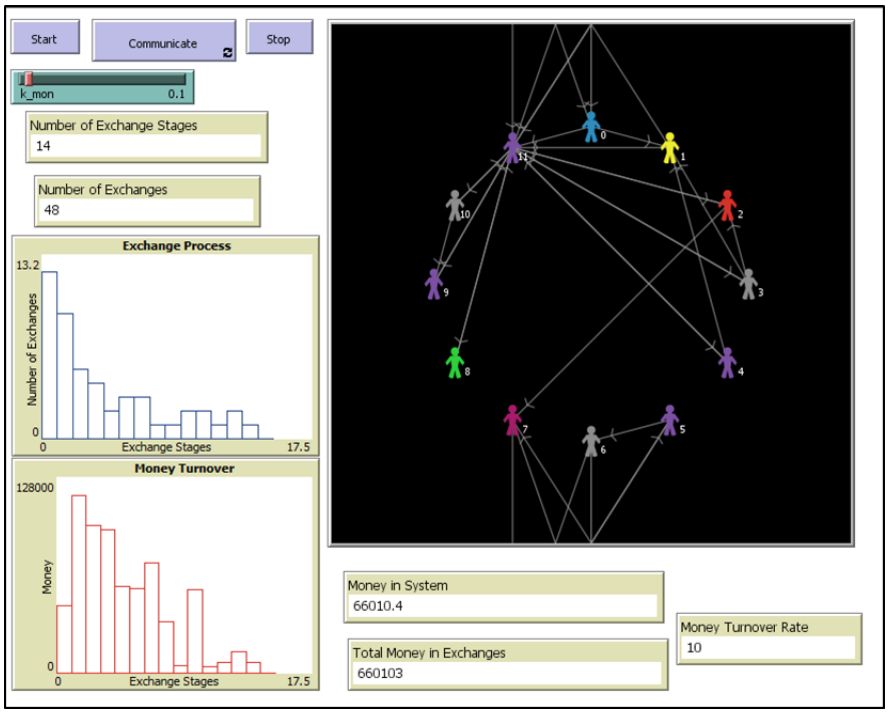

Figure 4: Screenshot of the Municipal Economy dynamic model.

One model from the set delivers the opportunity to model agents of two different types: the Environmental agent, which represents external business environment, and internal agents, which model local enterprises. Exchanges of internal agents with the Environmental agent can be understood as import and export operations.

In this model, two types of money circulated are modelled: external (real) money and internal (complementary) money. For each type of money, there is its own coefficient, which can be controlled from the model window (Fig. 5). External money is the money in its common sense. It can be used in all exchange operations simulated in the model, and the complementary money is used only for internal exchanges between all but the Environmental agent.

It was discovered that complementary money introduction is a very useful idea for exchange process optimization. The following conclusions have been made:

- complementary money introduction into the system greatly decreases the time necessary for exchanges completion, the complementary money can work and works as the real money;
- complementary money weakens, and when it is enough, suppress the crisis which arises if the money volume is insufficient in the system;
- the less volume of real money is in the system, the greater positive effect is made by the complementary money being introduced into the system.

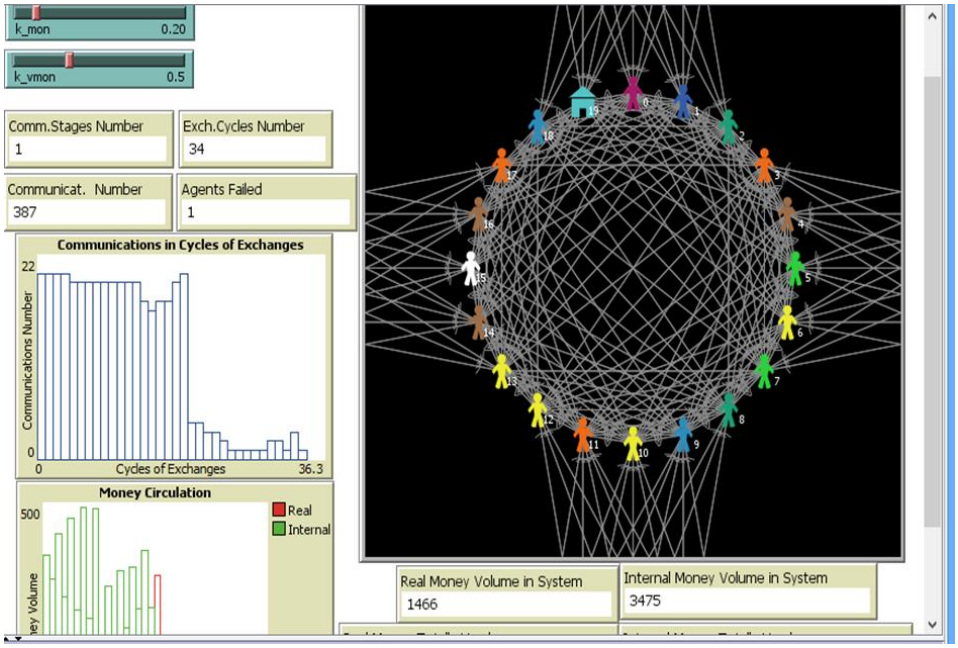

Figure 5: Screenshot of the model version with complementary money.

Once again, it was shown that there were internal exchange chains, in which complementary money was circulating, they closed and balanced themselves. Internal chains were invisible for the Environmental agent. Exactly these internal closed chains made the basis for economic system sustainability. More experiments and result details one can find in (Zvereva, Berg, 2017)

7. ECONOMIC EXPERIMENTS IN THE LOCAL BUSINESS COMMUNITY

Real economic experiments were carried out in the agricultural region of Bashkortostan. This region is about 40 km far from Ufa, there are several small manufacturing companies and service sector enterprises. Agricultural output and products manufactured from agricultural products comprise the economic basis of the community. The aggregated indicators of the local community are as follows:

- number of employees is under 200 persons;
- business activity types are as follows: crop farming, cattle breeding, trading, agricultural machinery services, and etc.;
- area of cultivated land is about 8000 hectares, the area of arable land is about 6000 hectares;
- cattle number is 1200;
- level of capitalization is 330 million rubles.

At the beginning of the experiment, the community was in a depressive state, bank loan debts had been growing. There were almost no cash for the salary payment, and the salary debt exceeded three months' salary, thus, all the foregoing facts resulted in the social tension increase.

In the period of 2010–2013, three economic experiments on commodity exchange were carried out in the territory of the community based on the complementary currency usage. The complementary currency was fully supported by the locally manufactured products and trade residues in the local shops.

The largest local enterprise, "Shaymuratovo Ltd." became an emission centre of the complementary currency. It issued this currency (hot bones) in the cash form, it was called "shaimuratics". Every year, the previous issue complementary currency was withdrawn from the turnover and replaced by the new one. The annual issue of the complementary currency was in the ranks of 100 thousand to 400 thousand rubles.

There were no restrictions on the usage of this currency, it was used for salary payments as well as for mutual payments between entrepreneurs. The complementary currency usage was a freewill case: any day, every community member had a possibility to receive the necessary currency volume (not more than their salary amount). That is why, "shaimuratics" were in demand in the case when there was a lack of ruble cash for supporting the turnover. The ruble and complementary currency turnover control was executed when they were paid (in the enterprises cash-desks) and when they were received as payments for products and services (in the shops cash-desks, and etc.). All data about the complementary currency and ruble turnover were aggregated for a week. It gave a possibility to estimate how many rubles and hot bones were involved in the turnover for a week. The turnover diagram is presented in Fig. 6. The turnover scales were made comparable (look at the left and right range) for better visual illustration of revealed synergetic effect which arose due to the currencies joint use.

It is evident from Fig. 6 that it took at about 5 weeks "to launch" the turnover, during this period the community members were studying to use the new type currency. Later, the turnover of "shaimuratics" demonstrated the tendency towards the growth, while, at the same time, in the neighbour communities, which used only rubles, the turnover was continuously decreasing. The week level of turnover has the strongly marked season characteristics: the 29th – 32nd week peak became the result of the New Year eve, then we can see the drop (the 33rd week) because of activity decrease while the winter vacations.

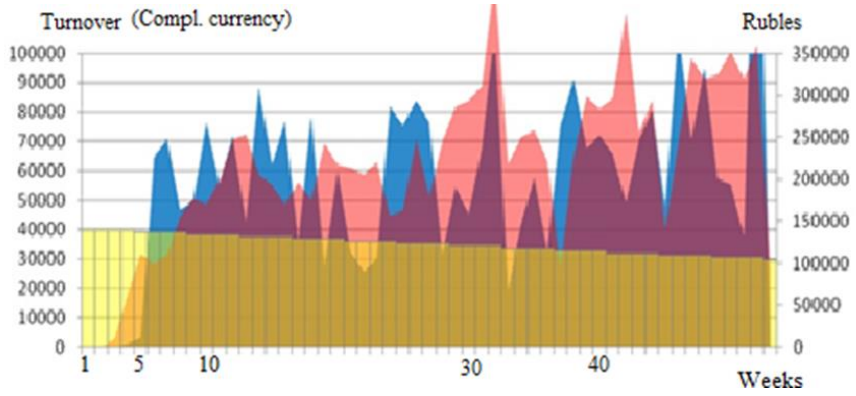

Figure 6: Comparable dynamics of the local community commodity turnover of the complementary currency (is shown in blue colour, left range) and Russian rubles (is shown in red colour, right range) in terms of week specification.

From the diagram one can guess that in the periods when there was the lack of rubles in the community, it was compensated by the complementary currency, and vice versa, when the rubles volume was large enough, the necessity in the complementary currency became less (the same results were received during the computer experiments). Thus, complementary currency in a local business community acts as a complement and in compliance with the national (real) currency.

In the discussed economic experiments, the complementary currency usage provided sustainable development of the local business community according to the following parameters:

- commodity turnover has been increased twelve times;
- productivity has been increased by 20 percent;

- all salary debts were repaid;
- average salary level has been increased by 26 per cents.

As to consider the structural aspect of the problem, it became evident that closed contours of exchange comprised of various type participants had been formed. As examples, we could propose 2 different versions of these structures:

- Enterprise (paying salary) – an enterprise employee (paying for a taxi service) – a taxi driver (buying wooden products) – a local entrepreneur (paying warehouse rent) – Enterprise;
- Enterprise (paying salary) – an enterprise employee (paying debt to a neighbour) – a neighbour (paying for food) – the enterprise's store/Enterprise.

Thus, each closed contour of exchange began with the enterprise and ended with it. Currency circulation along some contours could be repeated periodically, and along others – could be done only once. It was impossible to track the movement of each currency unit, because all of them were in a cash form (all complementary currency was in a cash form), one could observe only their turnover over a week, but several traces were recorded by means of observation and questionnaires.

8. CONCLUSIONS

Closed production contours might be considered as a structural basis of any economic system; strong economy is based on mutually supporting and reinforcing each other domestic production cycles. These structural elements always can be found in sustainable economic networks, as exactly these contours form the structural template of economic system sustainability and self-producing. These closed contours operate as generators of non-inflationary money, since they are provided with goods and services. Internal complementary currency supports economic system functioning, and, in case of real money lack, can improve and speed up economic processes. The described results have been received while the computer simulations with implementing the agent-based computer model and have been proved through the experiments in the real local economic system.

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