

The new form of mixed economy with rationing: agent - based approach.

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Rationing

- ❖ A number of mixed economy' types.
- ❖ The most famous mechanisms are market, rationing, planning, direct distribution, gifts,
- ❖ Mixture of Market & Rationing:
 - ❑ Tobin James (1952): "A Survey of the Theory of Rationing". *Econometrica*, 20 (1952), 521-553.
 - ❑ Howard David H. (1977). "Rationing, Quantity Constraints, and Consumption Theory." *Econometrica* 45, 399-412.
 - ❑ Makarov V. L., Vasil'ev V. A. (1989) "Equilibrium, Rationing an Stability". *Matecon*, #25 (4), 4-95.
- ❖ Quotas are given

Social Norms & Agent Based Models

- ❑ Huge variety of social norms: taboo, traditions, rules, standards. rates, quotas, etc.
- ❑ Emergence of norms in a society:
 - Bastin Tony Roy Savarimuthu, Stephen Cranefield, Maryam A. Purvis and Martin K. Purvis (2010): Obligation Norm Identification in Agent Societies / *Journal of Artificial Societies and Social Simulation*, 13 (4).
 - Epstein Joshua M. (2000): Learning to Be Thoughtless: Social Norms and Individual Computation / The Brookings Institution and Santa Fe Institute, Center on Social and Economic Dynamics, *Working Paper No. 6, January 2000*.
 - Fent, Thomas (2006): Collective Social Dynamics and Social Norms / *MPRA Paper No. 2841*.
 - Neumann Martin (2010): Norm internalization in Human and Artificial Intelligence *Journal of Artificial Societies and Social Simulation*. – Vol. 13. – № 1, 2010.
 - Hollander Christopher D. and Wu Annie S. (2011) The Current State of Normative Agent - Based Systems. *Journal of Artificial Societies and Social Simulation*. – Vol. 14. – № 2, 2011.
- ❑ Quantities' norms in a market & rationing mixed economy – mechanism of changing?

Agent based model of the mixed economy

Agents (individuals) are divided onto 6 social groups (clusters).

- business oriented people
- military people
- state bureaucrats
- doctors, scientists, teachers
- culture, art workers,
- servants of a religion, priests, etc

Motivation of agents:

agents in the clusters are divided to the three ranks; *high*, *middle* and *low* ones with exclusion of the first social cluster. The first cluster (business oriented people) has objective to achieve maximal profit. The other people destinations are to get high rank.

Norms in consumption

The quantities' norms associated with the clusters and the ranks in. An agent consume goods from two sources: from market and rationing spheres. In a simple case we consider that an agent used only one source: market, if he/she belongs to the first cluster, or rationing, otherwise.

Model

Now we describe the first version of the agent - based model, where each social cluster produces one "good", and the norms relate to the first good only. Other "goods" we interpret as development's levels of the clusters. So the production function of the first cluster looks as

$$a_1(t) = n_1(t)^{\alpha_1(t)} \cdot k_1(t-1)^{\beta_1(t)} \cdot a_2(t)^{\gamma_2} \cdot a_3(t)^{\gamma_3} \cdot a_4(t)^{\gamma_4} \cdot a_5(t)^{\gamma_5} \cdot a_6(t)^{\gamma_6} \cdot$$

where

$a_1(t)$ is a production of the first cluster in the period t ;

$a_j(t)$ is the level of the cluster' j development in the period t ;

$n_1(t)$ is the quantity of agents, populated cluster 1;

$k_1(t-1)$ is accumulated capital (production funds) to the beginning of the period t ;

Other clusters' production functions are about the same type. So there is a strong dependence of all clusters on each other. It is impossible to develop one cluster with no development of others.

Model

- ❑ The consumption of an agent c_i is defined by his/her budget, if he belongs to the first cluster and is equal to the existing at the given period norm of a rank & cluster for others.
- ❑ So a marco-path $\{a(t), c(t)\}$ of the agent-based model, which is the outcome of simulations, depends on the norms, generated by the mechanism, we try to design.
- ❑ The comparison of the simulated trajectories can be done by standard way, using well know criteria.

Model

The simple way to generate the norms we used is the following. The initial norms for all clusters and ranks are given. Further agents make influence on the norms according to the formula.

$$c_{sr}(t) = \begin{cases} c_{sr}(t-1) \cdot e_{x(n)} \cdot f_{x(n)}(r) \cdot o_{x(n)}(t-1) & ; s = x \\ c_{sr}(t-1) / (e_{x(n)} \cdot f_{x(n)}(r) \cdot o_{x(n)}(t-1)) & ; s \neq x \end{cases}$$

where $e_{x(n)}$ – the level of n -th agent's influence on the total level of consumption of social cluster x – is calculated as:

$$e_{x(n)} = 1 + \mu \cdot (1/n),$$

with n – the number of agents in the society and μ – a coefficient, which determines the power of the agent. By default μ equals 10 for agents of the first (high) rank, 3 for the second and 1 for the third rank. This implies that the influence is an order higher for the agents of the first (high) rank if compared to the third rank.

The results of computational simulations (X coordinates is years, Y coordinates is the volume of production).

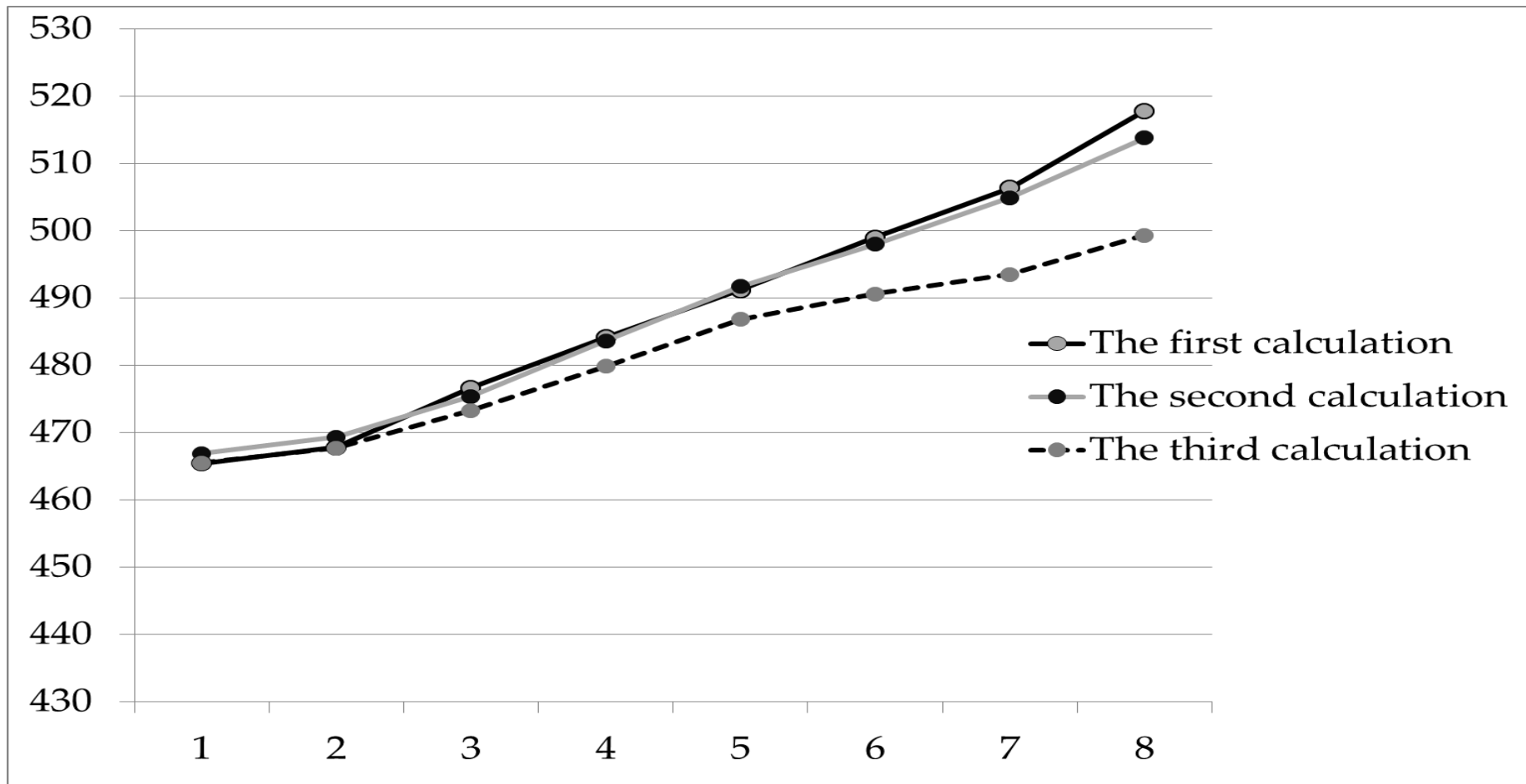


Figure demonstrates the results of calculations with respect to the estimated values of production in all the three scenarios.

The impact of the initial number of agents in clusters

Social cluster	Experiment 1.1 (each agent can change quota)	Experiment 1.2 (quotas are changed only by representatives of a special cluster)	Experiment 2.1 (each agent can change quota)	Experiment 2.2 (quotas are changed only by representatives of a special cluster)
First	1,053	1,042	1,001	0,996
Second	0,962	0,944	1,011	1,002
Third	0,930	0,981	0,983	1,010
Fourth	0,954	0,956	1,035	0,987
Fifth	0,936	0,948	0,996	1,003
Sixth	0,933	0,967	1,022	0,989
Standard deviation (for all clusters)	0,03060	0,02568	0,01479	0,00713

The results demonstrate that in the first case (when the first social cluster initially includes 50% of the society), quotas of the first social cluster increased more than quotas of other clusters. Note that the standard deviation of the values for all clusters is larger than in case of change only by the representatives of a special cluster.

The some results of calculations

- (1) successful development of a society with social clusters requires *equal rights* of social clusters;
- (2) democratic principle of change in quotas (when each individual has a direct influence on the values of quotas) is a more efficient economic mechanism;
- (3) social quotas change faster for the dominant social cluster than for other clusters;
- (4) even trying to make a society more balanced (i.e, with equal number of individuals in social clusters) at the end we inevitably face differentiation in production and consumption;
- (5) a society with differentiation is more inclined to additional stratification in the level of consumption.

Coming closer to reality

- Introduction of spatial and regional feature of the model.
- More specification of the agents.
- Comparison of mechanisms for changing norms related the different decision making, going from a political system.