ANALYTIC NETWORK PROCESS AS QUALITATIVE SIMULATING TOOL: RESEARCHING OF FINANCIAL CRISIS

Olga Andreichicova*
Moscow Institute of Physics and Technology
Moscow, Russia
E-mail: olga_andr@hotmail.com

Alexander Andreichicov
Russian State University of Innovation Technology and Business
Moscow, Russia
E-mail: alexandrol@mail.ru

ABSTRACT

Analytic Network Process is the convenient tool for simulating of complex problems under uncertainty. Network model describes the problem by the qualitative attributes such as clusters, nodes and relations between them. These attributes can present essential factors, criteria, properties, functions, actors and other aspects of the considered problem. The researcher also can use quantitative data in the form of expert judgments for experimental evaluating of mutual influences of the attributes. Thus we have an opportunity to explore complex problem and to obtain unobvious results by experimenting with model and to achieve the better understanding of the problem for decision making. We show the example, which demonstrates some capabilities of ANP for the researching of the efficiency of the measures for the surmounting of financial crisis.

Keywords: ANP, simulating, priorities, financial crisis

1. Introduction

Analytic Network Process (ANP) developed by Thomas Saaty (Saaty, 2001) is a powerful tool for system analysis and qualitative simulating. One of its main advantages is that it can be applied under uncertainty, when other techniques do not work. Network model describes the problem by the qualitative attributes such as clusters, nodes and relations between them. These attributes can present essential factors, criteria, properties, functions, actors and other aspects of the considered problem. We also can use quantitative data in the form of expert judgments for experimental evaluating of mutual influences of the attributes. Thus we have an opportunity to explore complex problem and to obtain unobvious results by experimenting with model and to achieve the better understanding of the problem for decision making.

In this paper we are researching the problem of financial crisis with use of ANP. We would like to find out, what measures should take the governments to cope with recession, unemployment and other consequences of the crisis. How these measures will influence main economic indicators and what of them have the greater effect. We don't purport any specific country in this example and take into consideration economic aspects and relations, which are universal for every state.

* Corresponding author

2. Network model

At first, we shall build the network model to learn, how the set of measures, which many governments are taking now, will influence main economic indicators. We take into consideration the set of attributes, joint into following clusters:

2.1. Government

This cluster contains 6 elements (nodes) that present the measures, which government can take for surmounting of the crisis. They are:

- ***Export Incentive***. For example, the government can devaluate exchange course of national currency to stimulate export or furnish a financial assistance exporters or use political tools in foreign-economic activity.
- ***Financial Support***. So we name direct financial assistance of the government to banks, producers and population.
- ***Interest Rate***. Many states have lowered the refinancing rate to support crediting, but some countries have marked up it.
- ***Poor Assets' Purchase***. The governments purchase the poor assets of the banks and producers to avoid chain reaction and to keep population from poverty.
- ***Protectionism***. This is meant the imposing of custom duties for import goods to raise demand for national production.
- ***Tax Cut***. The government can reduce taxes for population and producers for hard time.

2.2. Banks

Banks were the sources of financial crisis. They are main actors in economics, which supplies with money the producers and population. We include 4 following nodes into this cluster:

- ***Assets***. The assets of many banks strongly change during the crisis. Undoubtedly, banks' assets influence all kinds of their activity.
- ***Credits***. This is main function of a bank, which need not comments.
- ***Deposits***. Financial difficulties have influence on bank deposits, so this node is important for our research.
- ***Mortgage***. World financial crisis has begun with mortgage crisis in USA, therefore this factor should be taken into account.

2.3. Producers

Main goal for world economics is to overcome the recession. In view of this goal we consider the following attributes of producers:

- ***Capitalization***. The drop of stock market and companies' value influence production volume, employment and other important economic parameters, so it is included in our model.
- ***Innovation***. Along with difficulties the crisis creates incentives for innovation, because producers have to find more effective technologies and to make more procurable and more attractive goods for consumers. Innovation can save some producers and create new markets.
- ***Output***. So we name production volume, which is one of the most important characteristics of any producer.
- ***Profit***. This attribute does not need comments.

2.4. Science and Technologies

Science is the base of new technologies and innovations. Recession compels producers to find help in science researches. The governments usually do not reduce investments into scientific researches in hard time. We consider 2 main nodes in this cluster:

- ***Costs***. Governments or producers can change the costs for scientific researches during the crisis, what in turn can influence new technologies, innovation and other important factors.
- ***New Technologies*** are main outcomes of scientific researches.

2.5. Population

Population is undergone the negative impact of financial crisis such as loss of jobs, reduction in incomes and others. In turn, people forms demand for goods and credits, their trust influences bank deposits. We include the following obvious elements in this cluster:

- ***Demand.***
- ***Incomes.***
- ***Trust.***

2.6. Macrofactors

This cluster contains main economic indicators that should be improved in result of government's measures:

- ***Capital Investments.***
- ***Employment.***
- ***Inflation.***
- ***Market Shares.***
- ***Production Level.***

We think these indicators don't need a comment, except that someone could consider another set, but every researcher has a right to form own network model and to substantiate it at that. Network model is shown in Figure 1, where arrows between the clusters denominate the influence directions. We have used the SuperDecisions software (SuperDecisions, 2009) for the ANP in our research.

Note this model is assigned for evaluating positive consequences of the measures, being taken by the government. It is important, as many influences can have both positive and negative direction. Here we are researching only positive influences. If someone would like to take into consideration negative influence of these or other factors, he should build a model (its structure may stay the same) for the revealing their impact. It should not to mix positive and negative influences in one example, because this can bring to false outcomes. We can research in one example positive influences and in other example negative ones. After that we can obtain integrated estimation of influence with use *Benefit – Cost* (*BO*) approach, implying positive influences as benefits and negative as costs.

When we were evaluating the positive influence of clusters and elements (nodes), we wanted to learn, how crisis management measures, have been taken by the government, would influence banks, producers, population, science and macrofactors. Comparing the clusters and nodes, we asked "What of two compared elements (clusters) the analyzed element (cluster) influence more and how much more?" At that experts filled pair comparison matrixes, like the following:

Comparing by the cluster ***Banks***	*Banks*	*Producers*	*Population*	*Sc&Tech*	*Macrofactors*	***w***
Banks	1	2	3	9	5	0,4574
Producers		1	2	5	3	0,087
Population			1	3	2	0,1497
Sc&Tech				1	1/2	0,2572
Macrofactors					1	0,0487

Priorities of influence for all clusters are brought in Table1 in Appendix.

Comparing nodes of cluster ***Macrofactors*** by the node ***Innovation***	*Capital Investments*	*Employment*	*Market Shares*	*Production Level*	***w***
Capital Investments	1	1	1/2	¼	0,125
Employment		1	1/2	¼	0,125
Market Shares			1	½	0,25
Production Level				1	0,5

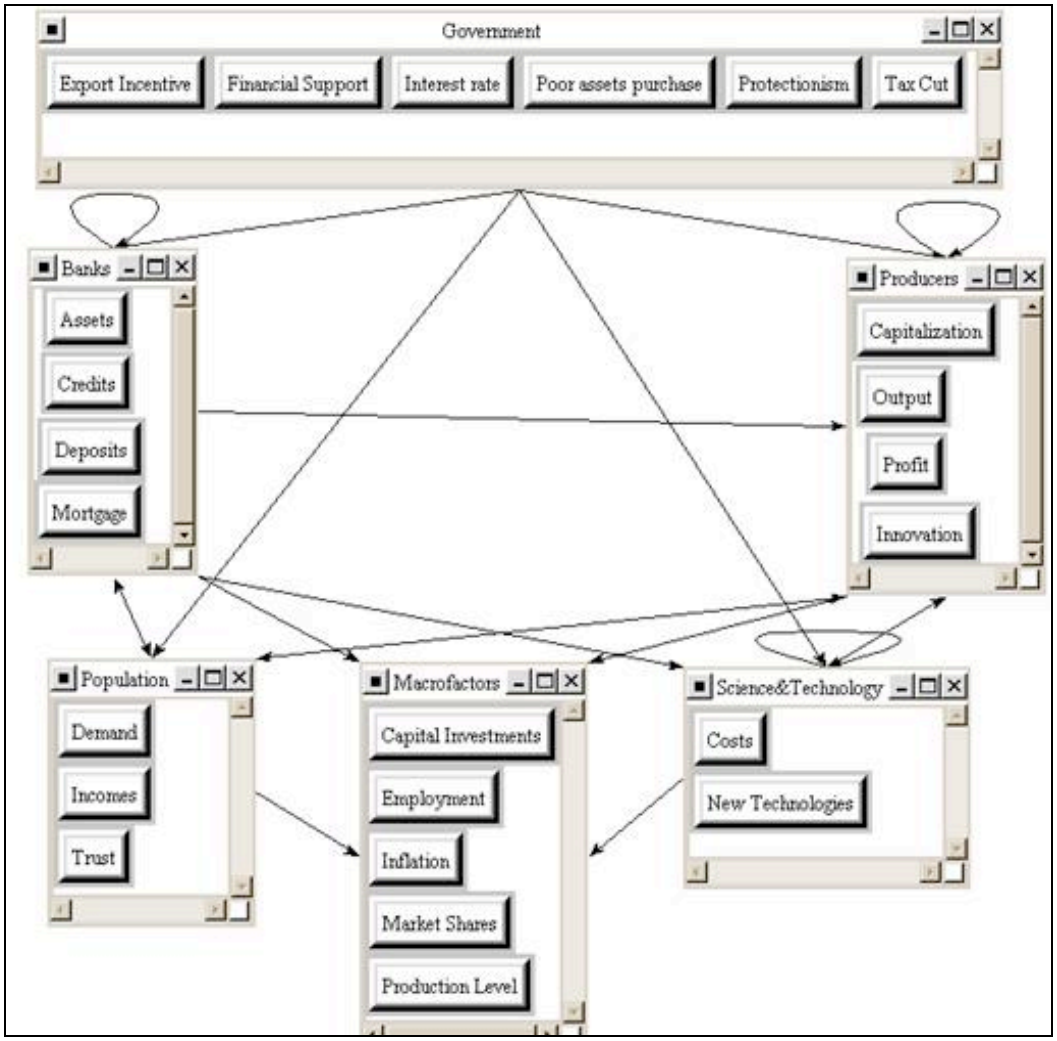

Figure 1. Network model for evaluating of positive influence.

Priorities of influence for all nodes of the network model are brought in unweighted supermatrix in Table 2 in Appendix. In Table 3 the weighted supermatrix is shown, and limiting priorities are brought in Figure 2 and Figure 3. We can see that cluster *Producers* is the most influenced by other clusters in the model, then cluster *Macrofactors* follows.

In Table 4 are brought limiting priorities of clusters and nodes, normalized by cluster. Influences, which our model describes, have produced the greatest impact upon the nodes of the cluster *Producers*, and this testifies that government's measures are correct, if they will be properly put into practice. We are interested in limiting priorities of *Macrofactor*'s nodes at existing influences. We see that the greatest positive

effect will have *Production Level*, *Employment* will be improved too. Other indicators will become better in a less degree. The mutual influences of the considered factors bring to positive impact on *Science and Technologies*, *Banks* (especially *Assets*), *Demand* and *Trust* (in cluster *Population*). These results are consistent with well known economic regularities.

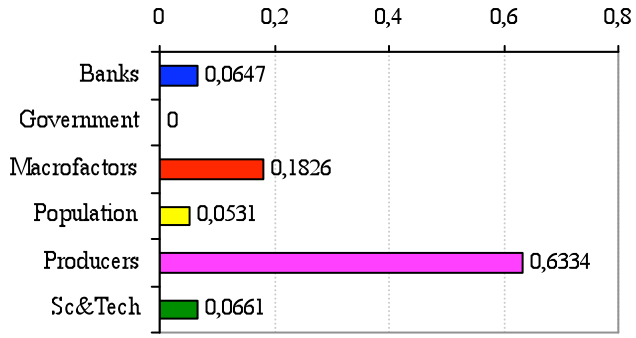

Figure 2. Limiting priorities of the clusters.

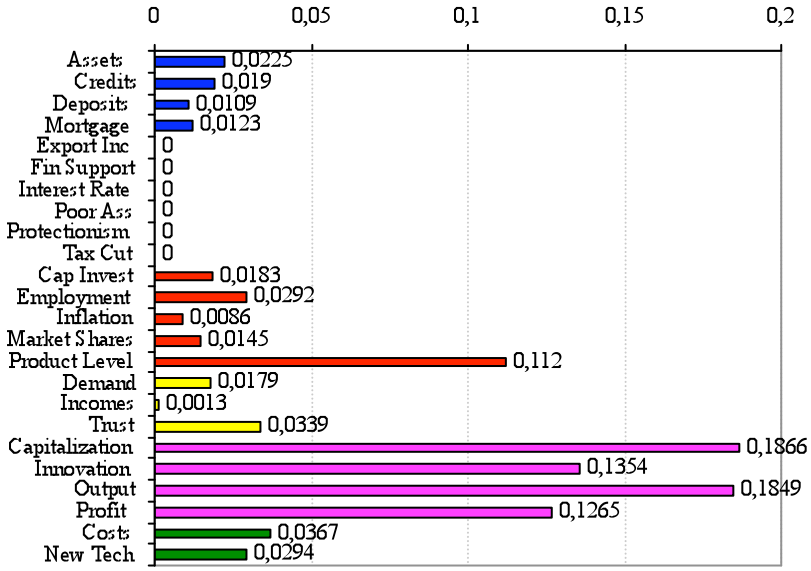

Figure 3. Limiting priorities of the nodes.

Note that cluster *Government* is a source in network, therefore limiting priorities of its nodes are zero. Moreover, if this cluster will be removed from network, then limiting priorities of remaining nodes will not change. The modified network model shown in Figure 4 gives the same limiting priorities of all nodes. These outcomes are brought in Table 4.

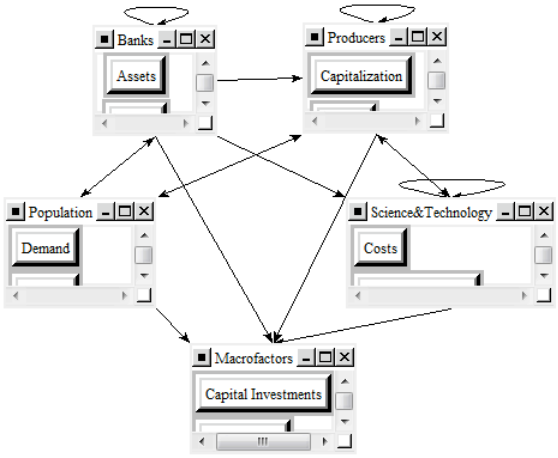

Figure 4. Modified network model.

3. Inverted network

We have satisfied that limiting priorities of *Macrofactors* and other clusters do not depend on clusters-sources provided all expert judgments are constant. But we are interested, what of the Government's nodes are more influential? To answer this question we have inverted our network model and consider the inverted task. The structure of this task is shown in Figure 5.

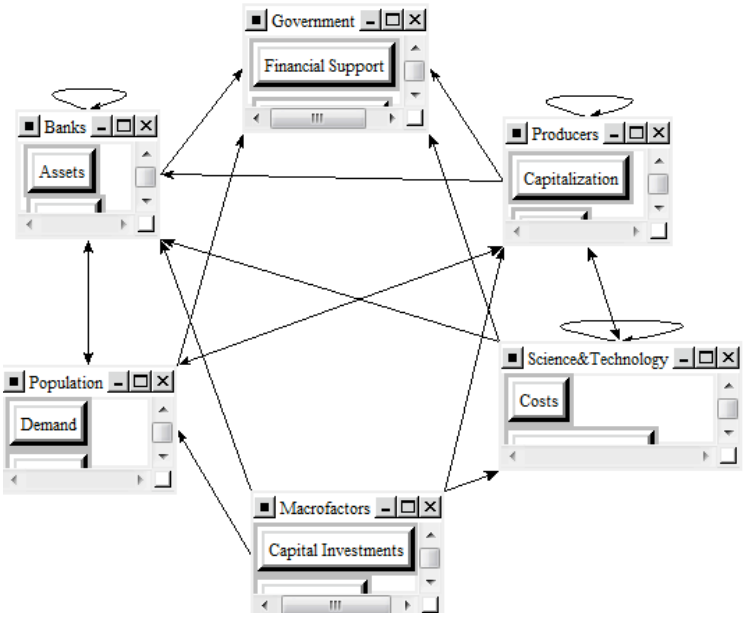

Figure 5. Network model for the inverted task.

When filling pair comparison matrixes, experts should answer the questions "What of two compared clusters (nodes) influence the analyzed cluster (node) more, and how much more?" Priorities calculated for all matrixes are brought in unweighted supermatrix (see Table 5). There is the weighted supermatrix in Table 6 and cluster matrix in Table 7. Limiting priorities of the nodes and clusters are shown in Table 4 and in Figure 6, 7.

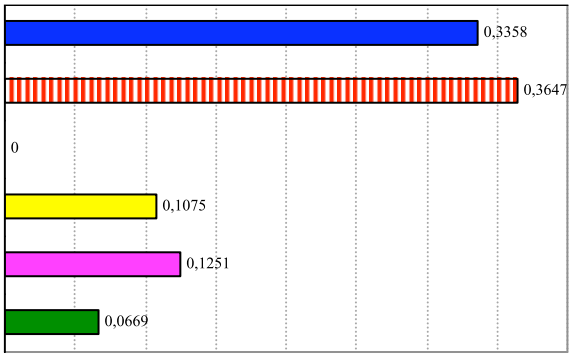

Figure 6. Limiting priorities of the clusters for the inverted task.

We can see that cluster *Government* is the most influential, after that the cluster *Banks* follows. Impact of clusters *Producers* and *Population* is considerably less. The most influential node is *Financial Support*, *Poor Assets' Purchase* is at the second place, *Protectionism* takes the latter place. Among the elements of the cluster *Banks* the most influential are *Mortgage* and *Credits*. Note, that *Innovation* is the most important element in the cluster *Producers*. *New Technologies* (cluster *Science and Technologies*), *Demand* and *Incomes* (cluster *Population*) have close limiting priorities.

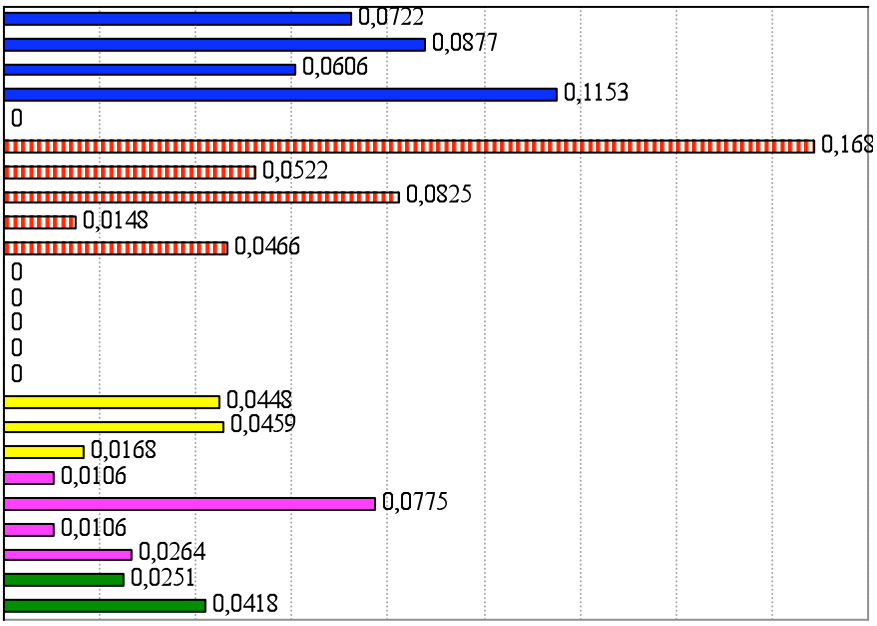

Figure 7. Limiting priorities of the nodes in inverted task.

The results obtained can help to understand, what consequences different measures can bring to. These outcomes are reasonable and correspond to real facts at the moment. Priorities of the measures and inten-

sities of influences can differ for different counties and can change in time. Researchers can change their preferences and the sets of considered elements. We hope this example demonstrate that ANP is very useful tool for system analysis and decision making.

APPENDIX

Table 1. Cluster matrix for network model.

Cluster Name	*Banks*	*Government*	*Macrofactors*	*Population*	*Producers*	*Sc & Tech*
Banks	0,4574	0,25	0	0,2857	0	0
Government	0	0	0	0	0	0
Macrofactors	0,087	0	0	0,1429	0,1409	0,1005
Population	0,1497	0,25	0	0	0,2628	0
Producers	0,2572	0,25	0	0,5714	0,4554	0,4331
Sc & Tech	0,0487	0,25	0	0	0,1409	0,4664

Table 2. Unweighted supermatrix for the network model.

	Assets	Credits	Deposits	Mortgage	Export Inc	Fin Support	Interest Rate	Poor Ass Purchase	Protection	Tax Cut	Cap Invest	Employm	Inflation	Market	Product Lev	Demand	Incomes	Trust	Capitalizat	Innovation	Output	Profit	Costs	New Tech
Assets	0	1	0,6	0,667	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Credits	0,5714	0	0,2	0,2222	1	0,5	0,75	0	0	0	0	0	0	0	0	0,6667	0,25	0,1634	0	0	0	0	0	0
Deposits	0,1429	0	0	0,1111	0	0	0	0	0	0	0	0	0	0	0	0	0,5	0,5396	0	0	0	0	0	0
Mortgage	0,2857	0	0,2	0	0	0,5	0,25	0	0	0	0	0	0	0	0	0,3333	0,25	0,297	0	0	0	0	0	0
Export Inc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fin Sup	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poor Ass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Protect	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tax Cut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cap Invest	0,75	0	0,6	0,75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,125	0	0,25	0	0,4804
Employm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,125	0,4778	0	0	0,2158
Inflation	0	0,2	0,2	0,25	0	0	0	0	0	0	0	0	0	0	0	0,1429	0,2	0	0	0	0,1281	0	0	0
Market	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,2857	0,2	0	0	0,25	0,138	0	0	0,1079
Prod Lev	0,25	0,8	0,2	0	0	0	0	0	0	0	0	0	0	0	0	0,5714	0,6	0	1	0,5	0,2561	0,75	0	0,1959
Demand	0	0,6	0	0,4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,3333	0	0	0	0
Incomes	0	0,2	0	0,2	0	0	0	0	0	0,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trust	0	0,2	1	0,4	0	0	0	0	0	0,5	0	0	0	0	0	0	0	0	0	0,6667	0	0	0	0
Capitaliz	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0,1516	0	1	0	0,5	0,3			
Innovat	0,3333	0,3333	0	0	0	0,5	0	0	0,3333	0,25	0	0	0	0	0	0,0758	0,2	0	0,3333	0	0,1	0,143	1	1
Output	0,6667	0,6667	0	0	0	0,5	0	0	0,6667	0	0	0	0	0	0	0,49	0,4	0	0,6667	0,25	0	0,2857	0	0
Profit	0	0	0	0	0	0	0	0	0	0,75	0	0	0	0	0	0,2828	0,4	0	0	0,25	0,6	0	0	0
Costs	1	0,75	0	0	0	0,25	0	0	0	0	0	0	0	0	0	0	0	0	0	0,75	0	0	0	1
New Tech	0	0,25	0	0	0	0,75	0	0	0	1	0	0	0	0	0	0	0	0	0	0,25	0	0	1	0

Table 3. Weighted supermatrix for the network model.

	Assets	Credits	Deposits	Mortgage	Export Inc	Fin Support	Interest Rate	Poor Ass Purchase	Protection	Tax Cut	Cap Invest	Employm	Inflation	Market	Product Lev	Demand	Incomes	Trust	Capitalizat	Innovation	Output	Profit	Costs	New Tech
Assets	0	0,4574	0,3954	0,4393	0	0	0	0,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Credits	0,3074	0	0,1318	0,1464	1	0,1667	0,75	0	0	0	0	0	0	0	0	0,1905	0,0714	0,055	0	0	0	0	0	0
Deposits	0,0769	0	0	0,0732	0	0	0	0	0	0	0	0	0	0	0	0	0,1429	0,178	0	0	0	0	0	0
Mortgage	0,1537	0	0,1318	0	0	0,1667	0,25	0	0	0	0	0	0	0	0	0,0952	0,0714	0,1	0	0	0	0	0	0
Export Inc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fin Sup	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poor Ass	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Protect	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tax Cut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cap Invest	0,0768	0	0,0752	0,094	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0176	0	0,0591	0	0,0483
Employ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0176	0,1129	0	0	0,0217
Inflation	0	0,0174	0,0251	0,0313	0	0	0	0	0	0	0	0	0	0	0	0,0204	0,0286	0	0	0	0,0303	0	0	0
Market	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0408	0,0286	0	0	0,0352	0,0326	0	0	0,0109
Prod Lev	0,0256	0,0696	0,0251	0	0	0	0	0	0	0	0	0	0	0	0	0,0816	0,0857	0	0,2363	0,0704	0,0605	0,1772	0	0,0197
Demand	0	0,0898	0	0,0863	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0876	0	0	0	0
Incomes	0	0,0299	0	0,0431	0	0	0	0	0	0,1667	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trust	0	0,0299	0,2157	0,0863	0	0	0	0	0	0,1667	0	0	0	0	0	0	0	0	0	0,1752	0	0	0	0
Capitaliz	0	0	0	0	0	0	0	0,5	0	0	0	0	0	0	0	0,0866	0	0,6667	0	0,2277	0,2291	0,4364	0	0
Innovat	0,1008	0,0857	0	0	0	0,1667	0	0	0,3333	0,0833	0	0	0	0	0	0,0433	0,1143	0	0,2546	0	0,0764	0,1091	0,4815	0,4331
Output	0,2016	0,1714	0	0	0	0,1667	0	0	0,6667	0	0	0	0	0	0	0,28	0,2286	0	0,5092	0,1139	0	0,2182	0	0
Profit	0	0	0	0	0	0	0	0	0	0,25	0	0	0	0	0	0,1616	0,2286	0	0	0,1139	0,4582	0	0	0
Costs	0,0573	0,0365	0	0	0	0,0833	0	0	0	0	0	0	0	0	0	0	0	0	0	0,1057	0	0	0	0,4664
New Tech	0	0,0122	0	0	0	0,25	0	0	0	0,3333	0	0	0	0	0	0	0	0	0	0,0352	0	0	0,5186	0

Table 4. Limiting priorities for different network models.

		Network model (Figure 1)			Modified model (Figure 4)	Inverted task (Figure 5)		
Cluster Name	Node Name	Limiting Priorities	Priorities, Normalized by Cluster	Sum in Cluster	Limiting Priorities	Limiting Priorities	Priorities, Normalized by Cluster	Sum in Cluster
Banks	Assets	0,0225	0,3479	0,0647	0,0225	0,0722	0,2150	0,3358
	Credits	0,019	0,2933		0,019	0,0877	0,2612	
	Deposits	0,0109	0,1687		0,0109	0,0606	0,1806	
	Mortgage	0,0123	0,1901		0,0123	0,1153	0,3432	
Government	Export Incentive	0	0	0		0	0	0,3647
	Financial Support	0	0			0,1686	0,4624	
	Interest Rate	0	0			0,0522	0,14318	
	Poor Assets Purchase	0	0			0,0825	0,2261	
	Protectionism	0	0			0,0148	0,0405	
	Tax Cut	0	0			0,0466	0,1278	
Macrofactors	Capital Investments	0,0183	0,1003	0,1826	0,0183	0	0	0
	Employment	0,0292	0,1601		0,0292	0	0	
	Inflation	0,0085	0,0468		0,0085	0	0	
	Market Shares	0,0145	0,0796		0,0145	0	0	
	Production Level	0,112	0,6132		0,112	0	0	
Population	Demand	0,0179	0,3368	0,0531	0,0179	0,0448	0,4165	0,1075
	Incomes	0,0013	0,0253		0,0013	0,0459	0,4269	
	Trust	0,0339	0,6379		0,0339	0,0168	0,1566	
Producers	Capitalization	0,1866	0,2946	0,6334	0,1866	0,0106	0,085	0,1251
	Innovation	0,1354	0,2138		0,1354	0,0775	0,6192	
	Output	0,1849	0,292		0,1849	0,0106	0,0844	
	Profit	0,1264	0,1996		0,1264	0,0264	0,2114	
Science & Technologies	Costs	0,0367	0,5552	0,0661	0,0367	0,0251	0,3754	0,0669
	New Technologies	0,0294	0,4448		0,0294	0,0418	0,6246	

Table 5. Unweighted supermatrix for the inverted network model.

	Assets	Credits	Deposits	Mortgage	Export Inc	Fin Support	Interest Rate	Poor Ass Purchase	Protection	Tax Cut	Cap Invest	Employm	Inflation	Market	Product Lev	Demand	Incomes	Trust	Capitalizat	Innovation	Output	Profit	Costs	New Tech
Assets	0	0,4	0,3333	0,5	0	0	0	0	0	0	0,4	0,4	0	0	0,2	0	0	0	0	0,5	0,25	0	0	0
Credits	0,25	0	0	0	0	0	0	0	0	0	0	0	0	0,25	0,6	0,75	0,3333	0,5	0	0,5	0,75	0	1	1
Deposits	0,5	0,4	0	0,5	0	0	0	0	0	0	0,2	0,2	0	0,5	0,2	0	0	0	0	0	0	0	0	0
Mortgage	0,25	0,2	0,6667	0	0	0	0	0	0	0	0,4	0,4	0	0,25	0	0,25	0,6667	0,5	0	0	0	0	0	0
Export Inc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fin Sup	0	0,6667	0	0,75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,3333	0,3333	0	1	1
Interest	0	0,3333	0	0,25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poor Ass	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Protect	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,3333	0,6667	0	0	0
Tax Cut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0,3333	0	1	0	0
Cap Invest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Employ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inflation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prod Lev	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Demand	0	0,6483	0	0,5	0	0	0	0	0	0	0	0	0	0,3333	0,6667	0	0	0	1	0,5	0,75	0,75	0	0
Incomes	0	0,2297	0,75	0,25	0	0	0	0	0	0	0	0	0	0,6667	0,3333	0	0	0	0	0,5	0,25	0,25	0	0
Trust	0	0,122	0,25	0,25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capitaliz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,2857	0,1429	0	0	0
Innovat	0	0	0	0	0	0	0	0	0	0	0,3333	0,3333	0,3333	0	0,1429	1	0	1	0,2857	0	0,2957	0,6667	1	1
Output	0	0	0	0	0	0	0	0	0	0	0	0	0,6667	1	0,2857	0	0	0	0,1429	0,1429	0	0,3333	0	0
Profit	0	0	0	0	0	0	0	0	0	0	0,6667	0,6667	0	0	0,5715	0	0	0	0,5714	0,5714	0,5714	0	0	0
Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
New Tech	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0	0	0	1	1	1	1	0

Table 6. Weighted supermatrix for the inverted network model.

	Assets	Credits	Deposits	Mortgage	Export Inc	Fin Support	Interest Rate	Poor Ass Purchase	Protection	Tax Cut	Cap Invest	Employm	Inflation	Market	Product Lev	Demand	Incomes	Trust	Capitalizat	Innovation	Output	Profit	Costs	New Tech
Assets	0	0,1143	0,2222	0,1429	0	0	0	0	0	0	0,113	0	0	0	0,052	0	0	0	0	0,0714	0,0357	0	0	0
Credits	0,0833	0	0	0	0	0	0	0	0	0	0	0	0,0755	0	0,1559	0,4838	0,2559	0,2698	0	0,0714	0,1072	0	0,0762	0,0762
Deposits	0,1667	0,1143	0	0,1429	0	0	0	0	0	0	0,0565	0	0,151	0	0,052	0	0	0	0	0	0	0	0	0
Mortgage	0,0833	0,0571	0,4444	0	0	0	0	0	0	0	0,113	0	0,0755	0	0	0,1613	0,5117	0,2698	0	0	0	0	0	0
Export Inc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fin Sup	0	0,381	0	0,4286	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0952	0,0952	0	0,238	0,238
Interest	0	0,1905	0	0,1429	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poor Ass	0,6667	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,4	0	0	0	0	0
Protect	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0952	0,1905	0	0	0
Tax Cut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,2325	0,1634	0	0,0952	0	0,3333	0	0
Cap Invest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Employ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inflation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Market	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prod Lev	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Demand	0	0,0926	0	0,0714	0	0	0	0	0	0	0	0	0,0313	0,0818	0,0539	0	0	0	0,2	0,0714	0,1071	0,125	0	0
Incomes	0	0,0328	0,25	0,0357	0	0	0	0	0	0	0	0	0,0626	0,0273	0,0269	0	0	0	0	0,0714	0,0357	0,0417	0	0
Trust	0	0,0174	0,0833	0,0357	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capitaliz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0816	0,0408	0	0	0
Innovat	0	0	0	0	0	0	0	0	0	0	0,1884	0,2626	0	0,5264	0,0742	0,355	0	0,297	0,1143	0	0,0816	0,2222	0,304	0,304
Output	0	0	0	0	0	0	0	0	0	0	0	0,5252	0,604	0,1755	0,1484	0	0	0	0,0571	0,0408	0	0,1111	0	0
Profit	0	0	0	0	0	0	0	0	0	0	0,3768	0	0	0	0,2969	0	0	0	0,2286	0,1633	0,1633	0	0	0
Costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,3818
New Tech	0	0	0	0	0	0	0	0	0	0	0,1523	0,2122	0	0,1891	0,14	0	0	0	0	0,1429	0,1429	0,1667	0,3818	0

Table 7. Cluster matrix for the inverted network.

Cluster Name	*Banks*	*Government*	*Macrofactors*	*Population*	*Producers*	*Science & Technologies*
Banks	0,2857	0	0,2598	0,5396	0,1429	0,0762
Government	0,5714	0	0	0,1634	0,2857	0,238
Macrofactors	0	0	0	0	0	0
Population	0,1429	0	0,0808	0	0,1429	0
Producers	0	0	0,5195	0,297	0,2857	0,3041
Science & Technologies	0	0	0,14	0	0,1429	0,3818

REFERENCES

Saaty, T.L. (2001). Decision making with dependence and feedback: The analytic network process. Pittsburgh, PA: RWS Publications.

SuperDecisions software (2009). Software for the ANP, downloaded from the website http://www.superdecisions.com.