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Computational Model of Collective Intelligence for Meta-level Analysis and Prediction of Free or Quasi-free Market Economy

Tadeusz Szuba*, Stanisław Szydło**, Paweł Skrzyński*

Abstract. This paper encourages the use of a computational model of Collective Intelligence as a major (meta-level) tool to analyze and predict behavior of socio-economical systems like free (or quasi-free) markets are. Researchers are aware, that economics is a study of human behavior, but lack of a proper formal tool has shifted research in economics into the language of money, production, consumption, etc. From an economic point of view, when analyzing free (quasi-free) markets, more important is group behavior than individual behavior because they result in changes of market indexes. Group behavior leads in specific cases to the emergence of "group intelligence" with the most famous case named "A. Smith invisible hand of market". A computational model of Collective Intelligence allows for the formal extraction of the "system of inference processes" which run in an unconscious way in socio-economic structures. The construction of a proper formal and simulation model of such Collective Intelligence inferences allows us to take an attempt to predict outcomes in terms of economical results. The paper will present a formal basis, methodology of constructing Collective Intelligence systems for given socio-economic structures.

Keywords: Collective Intelligence, computational model, free (quasi-free) market, economics, human behavior, simulation model

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1. INTRODUCTION

Secondary schools textbooks *define Economics as a study of human behavior*. When we look from this point of view around, it can be seen single human beings (individually more or less intelligent), various structures of organized humans like: companies, villages, cities, countries, etc. which are producing, transporting, selling, consuming, storing, etc. various goods, i.e. *doing their business as usual.* They all, individually or in a group way, are looking for their own profits in various ways – in most cases in egoistic way. Economy as a science describes the behavior and dynamics of this highly dynamical world in terms of money, production, consumption, reserves, etc.

* AGH University of Science and Technology, Poland; E-mail: szuba@ia.agh.edu.pl; skrzynia@agh.edu.pl
** AGH University of Science and Technology, Poland; E-mail: sszydlo@zarz.agh.edu.pl

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and derivatives of these terms like e.g. inflation, unemployment, GDP per capita, increase or decrease of GDP, etc.

The characteristic meta-property of the world of economy is, that global (summarized) result of the activity of single intelligent beings (humans) and it' structures (companies) – is a system which is considered as unpredictable and chaotic (Prokhorov 2001). It can be claimed that this unpredictability is caused because "the sum of small individual intelligences" has produced a new meta quality, i.e. Collective Intelligence active in the area of the economy; which cannot be comprehended easily by an individual. This meta-quality can be only perceived on the basis of it' symptoms.

In today economy characteristic is, that we cannot build any precise, complete economic model useful for analysis and prediction, because:

- always there are so many parameters;
- never given economic system can be considered as a close;
- moreover small and unpredictable variations can cause major changes to the system variables what suggests similarity to chaotic systems.

It can be claimed that the fundamental reason for this is, that it is not "a physical system driven by constant laws of physics", but a system driven by human intelligence.

Economic systems with intelligence in the background (if necessary) can easily evolve, because e.g. the emerged deficit of certain goods immediately fires intellectual + business activity (implying investments into research & technology) which usually results in major changes on the market. An excellent example has recently emerged in USA shale gas technology, which to some extent has overturned long term business plans of some major gas producers and price dictators like Russia (supplying Europe through pipelines) and Qatar (supplier of liquefied gas with the help of LNG ships).

However, there is one common denominator of all economies: intelligence resulting in economical behavior. The difficulty with this approach is, that in an economy individual intelligence is nested into restrictions, demands and activity of the social structure. Thus, if following this research way, there is a required formal tool able to translate individual intelligences acting in area of economy into group intelligence named here Economy oriented Collective Intelligence (EoCI).

The growing interest with Collective Intelligence and especially papers Szuba 1998, Szuba 2001a, Szuba2001b have provided a proper formal tool.Thus, this paper proposes to shift major the research focus in Economy from terms like money, inflation, etc. to Economy oriented Collective Intelligence – and to try to derive from this all economic parameters presently described with the help of money, production, consumption, transfer of goods; even technological progress.

Important here is to properly perceive EoCI. In general, individual intelligence is a personal tool which can be used for various purposes. In our case it is proposed to extract only those elements of intelligence activity which are related to the economy, however, sometimes it can be difficult, like when analyzing relation between shopping and holidays. Next, to properly perceive EoCI; it should be considered as "a computational process" run in an unconscious and distributed way by humans acting as economic information processing units, storage units and transportation units. The

Formal Language of this computational process is mathematical logic[1], where inference rules reflect economical thinking, atoms are mapped onto basic economic terms like money, production, etc. and formulas of goal are mapped onto economic targets.

The structure of the paper is as follows: at first will be given a description of the molecular model of computations which is used to define Collective Intelligence processes. Later on a general definition of Collective Intelligence will be given with it' a measure named IQS. All the time it will be underlined the suitability of this formal tool for deriving the outcome of economical processes from intelligence driven group behavior. Next small example will be given. The paper will be finished with some conclusions.

2. BASIC COMPUTATIONAL MODEL FOR COLLECTIVE INTELLIGENCE PHENOMENA

The discrete nature of social structures strongly suggests the use of molecular models of computation[2]. This model is also referred to by other researchers as CHAM (Chemical Abstract Machine) (Berry & Boudol 1992). The model designed for *CI* phenomena is described below. Let's name this model *mCIm* for "*molecular CI model*". The whole model is composed on the basis of only two[3] elementary abstract concepts: information molecule and membrane.

The 1st level Computational Space (*CS)* with internal quasi-random displacing Information Molecules (*IMs)* of facts, rules, and goals c_i is denoted as the multiset. Thus, facts, rules, and goals are themselves 0-level *CS* i.e. CS^0. For better readability, CS^0 let's denote as c_i , c_j etc..

For a given *CS*, we define a membrane similar to that of the Chemical Abstract Machine (Berry & Boudol 1992) denoted by $|\bullet|$ which encloses inherent facts, rules, and goals. It is obvious that $CS^1 = \{c_1, ..., c_n\} \equiv \{|c_1, ..., c_n|\}$. For a certain kind of membrane $|\bullet|$ its type p_i is given, which will be denoted as $|\bullet|_{p_i}$ to define which *CMs* can pass through it.

Such an act is considered as an Input/Output for the given *CS* with a given $|\bullet|$. It is possible to define degenerated membranes marked with $|\bullet$ or $\bullet|$ in the *mCIm* i.e. a collision-free (with membrane) path can be found going from the exterior to the interior of an area enclosed by such a membrane, for all types of *CMs*.

The simplest possible application of degenerated membranes in the *CS* simulating a given social structure is to make boundaries or streets for example. If the *CS* contains clauses c_i of facts, rules, goals as well as other *CSs*, then it is considered a higher order one, depending on the level of internal *CS*. Such an internal *CS* will be also labeled with $\hat{v}_i$ e.g.

$$CS^2 = \{|c_1, \ldots CS^1_{\hat{v}_j}, \ldots c_n|\} \quad \textit{iff} \quad CS^1_{\hat{v}_j} \equiv \{|b_1, \ldots b_n|\}$$
$$\textit{where} \quad b_i \;\; i = 1 \ldots m \quad \textit{and} \quad c_j \;\; j = 1 \ldots n \quad \textit{are clauses}$$

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[1] Predicate calculus with some modifications.

[2] One possible realization of this model is the famous DNA-computer: http://en.wikipedia.org/wiki/DNA_computer

[3] It is interesting to note that much like the digital computer where information coding and processing is based on 0/1 system, the computations in *mCIm* are also based on two elements: information molecule and membrane.

Every c_i can be labeled with $\hat{v}_i$ to denote the characteristics of its individual quasi-random displacements in Computational Space or inside a higher order information molecule. The general practice will be that higher level *CSs* will take fixed positions, i.e. will create structures, and lower level *CSs* will perform displacements. This reflects well e.g. displacement differences in the following hierarchy: company, businessman, goods/money.

Specific (even low-level) *CSs* "settling" in specific locations of the main *CS*, after a certain period of quasi-random displacements are also allowed in *mCIm* model of computations. Some inference processes require this because for inference, local unions are necessary which *emerge* (*evolve*) on the basis of *cooperation* or specific forms of *trade* between *Computational_Spaces*.

For a given *CS* there is a defined position function *pos*:

$$pos:\ O_i \rightarrow \langle position\ description\rangle \cup undefined \quad where\ O_i \in CS$$

Understanding of the position space is formal, i.e. the metrics depends on a specific case which is analyzed. For example, if information molecules will displace along a network of any abstract business connections, this network will define metrics.

If there are any two internal *CS* objects $O_i,\ O_j$ in the given *CS*, then there is a defined distance function $D\left(pos\left(O_i\right), pos\left(O_j\right)\right) \rightarrow \Re$ and a rendezvous distance *d*. We say that during the computational process, at any time t or time period Δt, two objects $O_i,\ O_j$ come to rendezvous iff $D\left(pos\left(O_i\right), pos\left(O_j\right)\right) \leqslant d$. The rendezvous act will be denoted by the rendezvous relation ®, e.g. O_i ®O_j which is reflective and symmetric, but not transitive. For another definition of rendezvous as the λ-operator, see Fontana, *et al.* (1994). In the *mCIm* model, the computational process for a given *CS* is defined as the sequence of frames F labeled by t or Δt, interpreted as the time (given in standard time units or simulation cycles) with a well-defined *start* and *end*, e.g. $F_{t_0}, ..., F_{t_e}$. For every frame the multiset $F_i \equiv (|c_1, \ldots, c_m|)$ is explicitly given, with all related specifications: *pos(.)*, membrane types *p*, and movement specifications v if available. The simplest case of *mCIm* is the 3-D cube with randomly traveling clauses of facts, rules, and goals inside. The *mCIm* process is initialized to start the inference process after the set of clauses, facts, rules, and goals (defined by the programmer) is injected into proper positions of *CS*.

More advanced examples of *CS* for the *mCIm* include a single main CS^2 with a set of internal CS^1 which take fixed positions inside CS^2, and a number of CS^0 which are either local for a given CS_1^i (because the membrane is not transparent for them) or global for any subset of $CS_1^j \in CS^2$. When modeling the Collective Intelligence of certain closed social structures acting in the area of economy, interpretations in the structure will be given for all CS_n^m, i.e. "this *CS* is a money"; "this is a single human"; "this is a company, a city", etc. The importance of properly defining $\hat{v}_j$ for very CS_j^i should be emphasized. As has been mentioned, the higher level CS_j^i usually take a fixed position to model substructures like factory or company. If we model a single businessman as CS_j^1, then $\hat{v}_j$ will reflect the displacement of this agent. Characteristics of the given $\hat{v}_j$ can be purely Brownian or can be quasi-random, e.g. in a lattice (of streets, company corridors, network of marketplaces, etc.), but it is profitable to subject it to the present form of CS_j^i. When $\hat{v}_j$ has the proper characteristics, there are the following essential tools:

- The goal clause, when it reaches the final form, can migrate toward a defined *Output* location. This can be a membrane of the main *CS* or even a specific, local *CS*. Thus, the appearance of a solution of a problem in the *CS* can be observable.
- Temporarily, the density of some *information molecules* can be increased in a given area of *CS* in such a way that after a given low-level CS_j^i reaches the necessary form, it migrates to a specific area or areas to increase the speed of the selected inferences.

The above discussed model of computations *mCIm* requires defining a new inference pattern due to its nature.

2.1. THE INFERENCE MODEL IN THE *mCIm*

The pattern of inference in *mCIm* generalized for any CS has the form:

Definition 2.1 (Generalized inference in CS^N).

Assuming that $CS = \{...CS_j^i...CS_l^k...\}$, on this basis we can define
CS_j^i Ⓡ $CS_l^k$and U(CS_j^i , CS_l^k)and C(one or more CS_n^m of conclusions) $\vdash$

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one or more CS_n^m of conclusions, R(CS_j^i or CS_l^k) ■

The above description should be interpreted as follows:

CS_j^i Ⓡ CS_l^k denotes a rendezvous relation;

U(CS_j^i , CS_l^k)denotes that unification of the necessary type can be successfully applied;

C(*one or more* CS_n^m *of conclusions*) denotes that CS_n^m are satisfiable.

Note that the reaction $\rightarrow$ in the chemical abstract machine (Berry & Boudol 1992) semantics is equivalent to inference. $\vdash$

R(CS_j^i or CS_l^k) denotes that any parent *CMs* are retracted if necessary.

Later, when discussing the N-element inference, we will only be interested in "constructive" inferences, i.e. when a full chain of inferences exists. Thus, the above diagram will be abbreviated as

$$CS_j^i; CS_l^k \xrightarrow{RPP} \textstyle\sum_n CS_n^m$$

without mentioning the retracted *CMs* given by $R(CS_j^i$ or $CS_l^k)$. In general, a successful rendezvous can result in the "birth" of one or more child *CMs*. All of them must then fulfill a *C(...)* condition; otherwise, they are aborted.

Please notice, that the inference model given in the above definition, allows flexible description as the inference in logic, of any production- or business-style interaction between production or business subjects. Logical conclusions reflect resultant business products.

Since our proposed *mCIm* is designed to analyze the inference processes of economic social structures, simplifying assumptions based on real life observation can be made.

It is difficult to find cases of direct rendezvous and inference between two CS_i^m *and* CS_j^n *if* $m, n \geqslant 1$ without an intermediary involved $CS_k^0 \quad k = 1, 2, \ldots$ (messages, money, observation of behavior, e.g. copying business behavior, etc.). Only if we consider CS^n at the level of nations, where mutual exchange (migration) of humans takes place, can such a case be considered as an approximation to higher level rendezvous and inferences. This is, however, just an approximation because eventually this exchange is implemented at the human personal contact level, which are just rendezvous and inferences of two CS_i^0 *and* CS_j^0 with the help of $CS_k^0 \quad k = 1, 2, \ldots$. Thus, rendezvous and direct inference between two CS_j^i *if* $i \geqslant 1$ will be discussed here. In this paper, we only make use of a single CS_{main}^n *for* $n > 1$ as the main *CS*. Single beings like humans can be represented as $CS_{individual}^1$. Such beings perform internal inferences (in their brains), independently of higher level, cooperative inferences inside CS_{main} and exchange of messages, goods, money, etc. of the type CS^0. Internal CS^k inside the main *CS* will be suggested for modeling socio-economic structures, but only as static ones (taking fixed positions) to define sub-structures such as streets, companies, villages, cities, etc.

For simplicity, however, in the example given below we will try to approximate beings as CS^0; otherwise, even a statistical analysis would be too complicated. It is also important to assume that the results of inference are not allowed to infer between themselves after they are created. Products of inference must immediately disperse. However, later inferences between them are allowed (Giarratano and Riley (1998) call this *refraction*).

3. FORMAL DEFINITION OF COLLECTIVE INTELLIGENCE

The entry assumption is that *CI* itself is a property of a group of agents and is expressed/observable and measurable. Surprisingly, it is <u>not necessary to assume</u> that agents are cooperating or are conscious or not (in individual or group way); nothing must be assumed about the communication; we don't even assume that these agents are alive. Thus, because nothing specific must be assumed about agents, the definition given later on, works for software agents, humans, companies, cities, and nations as well. To better understand the above issues, let's look at some examples. Suppose that we observe a group of ants which have discovered a heavy prey that must be transported, and we also observe a group of humans who gather to transport some heavy cargo. Ant intelligence is very low, and a simple perception/communication system is used – however, it is clear that ants display *CI*. On the other hand, humans, under supervision of the foreman who contracted some workers, after a lot of time spent for bargaining on payment, will also move the cargo; this is also *CI* but based on money. Because of such situations, the definition of *CI* must be abstracted from possible methods of thinking and communication between individuals. The definition must be based on the results of group behavior. Let's look into another case. In medieval cities there were streets with shoemaker shops only. They gravitated there because the benefits gained exceeded the disadvantages, e.g. when some customers decided to buy shoes from a neighbor. Some shoemakers were sometimes in fact, even enemies. In this example, *CI* emerges without any doubt; this is obvious just looking at the high amount and quality of shoes produced on such streets. Thus, we cannot assume willful cooperation for *CI*, or the definition of cooperation would have to be very vague.

Bacteria and viruses cooperate through exchange of (genetic) information; we know the power of Genetic Algorithms, which creates their *CI* against antibiotics, but it is questionable whether they are alive. Also, companies who cooperate and create Collective Intelligence in a business way, cannot be considered as "alive". Their human workers are alive, but it is probably small technological step to be done, to fully replace in some types of companies humans by computers, and to have "unmanned business" acting on the free market. Thus, the assumption about the existence of live agents in *CI* must also be dropped. The definition we give now is based on these assumptions, and will formally cover any type of being, structures, any communication system, and any form of synergy, virtual or real.

Let there be given a set S of individuals $indiv_1, \ldots, indiv_n$ existing in any environment *Env.* No specific nature is assumed for the individuals nor for their environment. It is necessary only to assume the existence of a method to distinguish $indiv_i \;\; i = 1, ..., n$ from the *Env.* Let there be also given a testing period $t_{start} - t_{end}$ to judge/evaluate the property of *CI* of $S\{\ldots\}$ in *Env.* Let there now be given any universe U of possible problems $Probl_i$ proper for the environment *Env,* and be given the complexity evaluation for every problem $Probl_i$ denoted by $f_O^{\mathrm{Probl_i}}(n)$.

CI deals with both *formal* and *physical* problems thus we should write the following:

$$f_O^{Probl_i}(n) \stackrel{def}{=} \begin{cases} if\ Probl_i\ is\ a\ computational\ problem,\ apply\ the\ standard \\ definition\ of\ computational\ complexity,\ where\ n\ gives \\ the\ size\ of\ the\ problem; \\ \\ if\ Probl_i\ is\ any\ problem\ of\ a\ "phisical"\ nature\ use \\ phisical\ measure\ units,\ e.g.\ mass,\ size,\ etc.\ for \\ expressing\ n. \end{cases}$$

Let's also denote in the formula the ability to solve the problems of our set of individuals S over U when working/thinking without any mutual interaction (absolutely alone, far from each other, without exchange of information):

$$Abl_U^{allindiv} \stackrel{def}{=} \bigcup_{Probl_i \in U} \max_S \left(\max_n f_O^{Probl_i}(n) \right)$$

This set defines the maximum possibilities of S when individuals are asked, e.g. one by one, to display their abilities through all the problems. Observe that if any problem is beyond the abilities of any individual from S, this problem is not included in the set.

Definition 3.1 (Collective Intelligence as a property).
Now assume that individuals coexist together and interact in some way. We say that *CI* emerges because of cooperation or coexistence in S, iff at least one problem $Probl'$ can be pointed to, such that it can be solved by a lone individual but supported by the group, or by some individuals working together:

$$f_o^{Probl_i}(n') \overset{significantly}{>} f_o^{Probl_i}(n) \in Abl_U^{allindiv}$$

or

$$\exists \text{ Probl' such that } (\forall n \text{ Probl' } \notin Abl_U^{allindiv}) \wedge (\text{Probl' } \in U) \qquad \blacksquare$$

The basic concept of the definition is that the property *CI* emerges for a set of individuals S in an environment U iff a new problem $\in U$ emerges which can be solved from that point, or similar but even more complex problems can be solved. Even a small modification in the structure of a social group, its communication system, or even in the education of some individuals, can result in *CI* emergence or increase. An example is shoemakers moving their shops from remote villages to the City. This could be the result of a king's order or the creation of a "free trade zone". The important thing is that the distance between them has been reduced so much that it triggers new communication channels of some nature (e.g. spying). Defining *CI* seems simple but measuring it is quite a different problem. The difficulty with measuring *CI* lies in the necessity of using a specific model of computations, which is not based on the DTM Turing Machine.

4. COLLECTIVE INTELLIGENCE QUOTIENT IQS

The two basic definitions for *CI* and its measure IQS (IQ Social) have the following forms:

Definition 4.1 (N-element inference in CS^N).
There is a given *CS* at any level $CS^n = \{CS_1^{a_1}, \ldots CS_m^{a_m}\}$, and an allowed Set of Inferences SI of the form

$\{set\ of\ premises\ CS\} \xrightarrow{I_i} \{set\ of\ conclusions\ CS\}$,

and one or more CS_{goal} of a goal. We say that $\{I_{a0}, \ldots, I_{a_{N-1}}\} \subseteq SI$ is an N-element inference in CS^n, if for all $I \in \{I_{a0}, \ldots, I_{a_{N-1}}\}$ the premises are present in CS^n at the moment of firing this inference, all $\{I_{a0}, \ldots, I_{a_{N-1}}\}$ can be connected into one tree by common conclusions and premises, and $CS_{goal} \in \{set\ of\ conclusions\ for\ I_{a_{N-1}}\}$ $\blacksquare$

Definition 4.2 (Collective Intelligence Quotient (IQS)).
IQS is measured by the probability P that after time t, the conclusion CM_{goal} will be reached from the starting *state of* CS^n, as a result of the assumed N-element inference. This is denoted as $IQS = P(t, N)$. ■

Comments: The above definitions allow that N-element inferences can be interpreted as any problem-solving, production, business process in a social structure or inside a single being, where N inferences are necessary to get a result; or any production process, where N-technologies/elements have to be found and unified into one final technology or product. Therefore, in the same uniform way we model inferring processes, production, economic processes within a social structure. This is very important because some inference processes can be observed only through resultant production or business processes or specific logical behavior. Simulating N-element inferences in the *mCIm* computational model allows us to model the distribution of inference resources between individuals, dissipation in space or time, or movements (or temporary concentration) in the *CS*. This reflects well the dissipated, moving, or concentrated resources in a social structure of any type. Cases can be simulated where some elements of the inference chain are temporarily unavailable, but at a certain time t, another inference running in the background or in parallel will produce the missing components. This is well known in human social structures, when for example a given business initiative is blocked until missing component will emerge. Humans infer in all directions: forward – e.g. from small business to big one, backward – e.g. from business idea through gathering business components until the start, and also through generalization – e.g. two or more business enterprises can be combined into one more general. A good example is fusion of companies specializing in production and transport. The N-element inference when simulated reflects all these cases clearly.

Now let's analyze a simple, but not a trivial example illustrating previously given theory.

Example: making business

Let us consider a human social structure. The greatest problem with CI in the economy is to properly map economic activity of social structure into proper model of CI inferences, in such way that there is no redundancy and all necessary threads of inferences will be present. Lack of some of them may result with a change of speed, or even lack of some economic processes. It can give quite different economic output than expected. Assume that:

a) There are some humans/companies with some *cash* only, willing to invest their money. They are moving/searching here and there inside the social structure, looking on how to invest. Let's represent them with *Information Molecule* carrying fact: `cash`.
b) There are some humans who have proper position in administration, and they can provide *permissions/license* to make business. Let's represent them with *Information Molecule* carrying fact: `permissions`.
c) In the social structure there are some humans with knowledge (experience) on how to do business successfully. They can only work for somebody as

mangers. Let's represent them with *Information Molecule* carrying rule: `cash` $\cap$ `permissions` $\rightarrow$ `business2do`.;

d) Let's assume, that there is abstract place where the business to be done "is waiting" for somebody, who will discover this place and opportunity to make business there. Assume that this place and chance can only discover individual coming with strong will to have profit. This deposit can be characterized with rule stating that this business "to be done" implies profit. Let's represent this place and chance with *Information Molecule* carrying rule: `business2do` $\rightarrow$ `profit`.

e) There are humans (perhaps there is only one) with strong willing to have profit (typical for businessmen). Let's represent them with *Information Molecule* carrying goal: `?profit`.

Other humans are logically void (from *CI* point of view). Nobody has total knowledge of all the necessary elements and their present position; everybody can infer, but only locally. For this social structure the CS^1 in *mCIm* can be defined as a set of CS^0:

$$CS^1 = \{\texttt{cash. permissions. cash} \cap \texttt{permissions} \rightarrow \texttt{business2do. business2do} \rightarrow \texttt{profit. ?profit.}\}$$

It is easily visible, that this system is an example of the 4-element inference.

Please remember, that some clauses will have multiple occurrences in CS^1 depending on how many humans have copies of given logical object in the social structure.

The next major step in this example is to build an internal structure of Computational Space (with the help of membranes) in such a way, that it reflects the environment where analyzed social structure exists. Usually it is mix of structures reflecting real objects e.g. streets, market places, etc. plus some abstractions. An example of such abstraction in the above example is "place where exists business to be done". Another typical abstraction is the necessity to model process of virtual traveling through the Internet, when e.g. looking for best price, or (in this example) who can give permission.

Now it is necessary to make assignments of displacement abilities for the above defined *Information Molecules*. For example, it can be assumed that *Information Molecules* carrying facts: `permissions`. will not move, reflecting style of work of typical administration. Most active in terms of displacements should be an *Information Molecule* reflecting businessman.

Collective Intelligence can be measured here in terms of how easy in this social structure is to make business, in terms of gaining profit. IQS will provide the probability function, that in a given period of time profit will be reached. Please notice the existence of red tape in the form of necessity to get permission. As mentioned before, this example looks simple but is not trivial. From the example many key-economic problems can be analyzed, e.g. relation between business and administration.

5. CONCLUSIONS

Formal tool of Collective Intelligence is apparently a perfect tool to model the economic behavior of social structures and on this basis to try to predict the behavior of free, or quasi free market in terms of production, money, inflation, jobless index, etc. The key issue now is to demonstrate a "working example" which will prove this in an exclusive way – i.e. other tool will be not able to do this. We (our research group) think, that we are not far from this, analyzing A. Smith Invisible Hand of Market as a Collective Intelligence process (Skrzyński 2011).

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