

Demonstration of a Multi-agent Simulation of the Impact of Culture on International Trade

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Abstract

A multi-agent model of trade in mono-cultural and multi-cultural setting will be demonstrated. The model allows for configuration of cultural background in individual agents, according to the Hofstede's five dimensions of national culture. The model is built as a tool for social-scientific research into the efficiency international trade and supply chain formation, in particular in a context of institutional economics. The emergence of different trade patterns under different cultural settings will be demonstrated.

1 Theoretical background

A series of papers by G.J. Hofstede et al. [1, 2, 3, 4, 5] describe the differentiation of behavior of individuals in trade processes according to the individual's cultural background. The papers are based on the work of G. Hofstede [6], who found that national cultures can be characterized according to five dimensions:

- the extent to which the less powerful in a society expect and accept that power is distributed unequally (power distance, or hierarchical versus egalitarian cultures);
- the extent to which the members of a society can accept that certain things are unknown and that rules for behavior are ambiguous (uncertainty avoiding versus uncertainty tolerant cultures);
- the extent to which the members of a society feel to be individuals responsible for their personal interest or group members responsible for common interest (individualism versus collectivism);
- the extent to which the members of a society are oriented toward performance and competition or toward care-taking and co-operation (masculine versus feminine cultures);
- the extent to which the members of a society pursue status, consumption, and immediate profit, or pragmatically pursue long-run goals and virtues (short-term versus long-term orientation).

The papers by G.J. Hofstede et al. [1, 2, 3, 4, 5] define rules for culturally differentiated behavior of trading agents in the processes displayed in figure 1. The purpose of these models of culture is to advance the understanding of international trade processes and supply chain formation in different mono-cultural and multi-cultural settings, in a context of institutional economics, and to compare the efficiency of institutions. The research method in which the models are applied, combines multi-agent simulation and human gaming simulation, as indicated in figure 2. For examples of such research, see [7, 8].

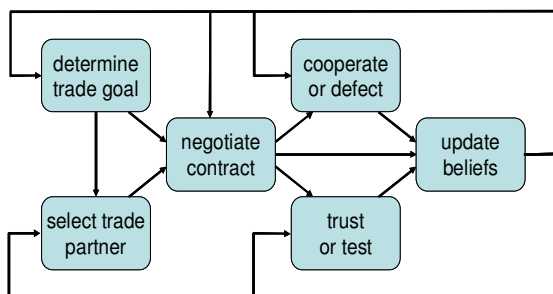


Figure 1. Process model of trading agents

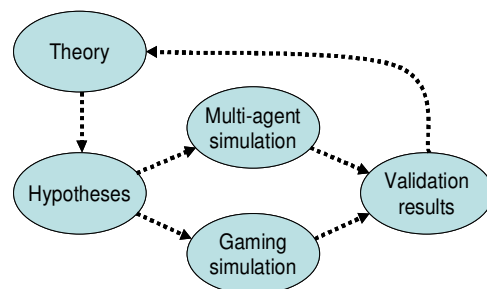


Figure 2. Research cycle

2 Multi-agent Simulation

The simulation application allows for configuring individual agents with cultural parameters, representing the Hofstede dimensions, and some personal traits, like impatience, and negotiation preferences and parameters. Agents have a role of either supplier or customers. They trade a commodity that has a hidden quality attribute, so the suppliers have an opportunity to cheat the customers. The customers can either trust the suppliers, or put their purchases to the test with the tracing agent, that will at the cost of a fee inform them about the real quality, and fine the supplier in case of deceit. A number of suppliers and a number of customers can be configured for a simulation run, with all customers connected to all suppliers. They may freely select a partner and send a trade proposal, and their partners are free to respond or ignore a proposal. Agents can enter into negotiations with only one partner concurrently. They may come to an agreement, or break-off negotiations if they feel there is insufficient progress or the partner makes unrealistic proposals. They may simply not respond any longer to partner's proposals, in which case the partner will start searching for a new partner after waiting for a while. Thus trade patterns emerge, of which some important observables, to be made at group level or for individual relations, are:

- the number of successful transactions,
- the average quality of commodities traded,
- the number of tracing requests,
- the number of revealed/unrevealed deceits,
- the number of failed negotiations,
- average duration of negotiations.

The application that will be demonstrated, has been implemented in Cormas (<http://cormas.cirad.fr/indexeng.htm>). The demonstration will show the emergence of patterns of some observables in different settings.

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Individualism and Collectivism in Trade Agents (Extended Abstract)

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Abstract

This paper was originally presented at IEA/AIE 2008 [1]. The current paper is an extended abstract for presentation at BNAIC 2008. Agent-Based Modeling can contribute to the understanding of international trade processes. Models for the effects of culture and cultural differences on agent behavior are required for realistic agent-based simulation of international trade. This paper makes a step toward modeling of culture in agents. The focus is one of the five dimensions of culture according to Hofstede: individualism versus collectivism. The paper presents an analysis based on social science literature about national cultures. For cultural differentiation of agent behavior, rules are formulated for individualist versus collectivist agent behavior with respect to negotiations, cooperation or defection in the delivery phase of transactions, trade partner selection, and trust. Example computations demonstrate the feasibility in multi-agent simulations.

3 Representation of Individualism and Collectivism in Trade Agents

Agent-Based Economics (ABE) studies economic processes as interactions of individual actors. Cultural differences are known to have their effects on international business interactions and on trust between business partners. Models of culture-bound agents will advance the understanding through ABE of intercultural trade processes as well as differences in trade processes across cultures. Culture has different aspects or dimensions [2]. The current paper focuses on the widely recognized distinction between individualistic and collectivistic cultures. It presents an exercise in multi-agent simulation, with the purpose of better understanding the mechanisms that promote or hinder international trade.

People are gregarious by nature. But the life conditions of societies vary, and they have adapted accordingly. Hunter-gatherers live in small bands, usually consisting of a few nuclear families. In agricultural societies, larger units have developed, and the people may live in extended families or clans. This is still the default model of social organization in most of the world, although it is being put under strain by urbanization. In modern, affluent industrial societies people tend to revert to nuclear families. The variation in basic group size and cohesion between societies has been shown by sociologists, e.g., in the distinction between *Gemeinschaft* and *Gesellschaft* that Tönnies introduced as early as 1887. In a *Gemeinschaft*, people share everything, both material and immaterial, whereas in a *Gesellschaft*, private property and other individual-centered institutions are possible. This variation has been confirmed by social psychological cross-national studies of practices or values, for instance the work of Triandis [3] and Hofstede [2]. These authors speak of the distinction between individualism and collectivism. Table 1 shows some typical distinctions. With respect to geographical distribution, national cultures of East-Asia and Central America are extremely collectivistic, while the Anglo countries are at individualistic extreme of the scale.

On the basis of Hofstede's theory, the paper formulates the expected influence of individualism versus collectivism on the behavior of traders in the processes of trade goal selection, trade partner selection, bargaining, and delivery and trust, as well as the maintenance of beliefs about potential trading partners. Subsequently, the verbal models of culturally differentiated behavior are formalized into production rules that take culture and personal traits of the agents into account.

Table 1. Some distinctions between norms in collectivist and individualist societies (source: Hofstede [2]).

Collectivist	Individualist
Maintain harmony, avoid confrontation	Speak your mind
High-context, implicit communication	Low-context, explicit communication
Use the word "we"	Use the word "I"
Show favor to in-group customers	Treat all customers equally
No business without a personal relation	Task is more important than a good relation
A relation brings rights and obligations	Mutual advantage is the basis of relations
Relations are given	Build and maintain relations actively
Save face for in-group	Keep self-respect
Responsible for group interests	Responsible for personal interests

4 Simulation Results and Conclusion

Table 2 presents some results of multi-agent simulations. Simulations in populations with collectivistic agents belonging to different groups typically show the distribution of run 1 in Table 2: in-group trade. Individualist agents rapidly develop networks of preferred relations, on which they trade very efficiently. In mixed settings like run 2, the individualists develop the same pattern, but collectivist agents stick to their in-group trade. However, in run 3 where no in-group partners are available, the collectivist agents develop the individual relations pattern. In run 4 only group C agents can find in-group partners and show the collectivist pattern, while the other collectivist agents develop the individual relations pattern.

The work presented in this paper shows that the approach to simulate cultural dependent behavior in agents, leads to behavior that corresponds to human behavior in trade simulation games. Therefore, the paper shows that agent-based simulation contributes to the understanding of international trade processes.

Table 2. Number of successful transactions in simulations with 8 suppliers and 8 customers.

1. Customers		collectivist gr A				collectivist gr B				2. Customers		individualist				collectivist gr A			
Suppliers		C1	C2	C3	C4	C5	C6	C7	C8	Suppliers		C1	C2	C3	C4	C5	C6	C7	C8
collectivist	S1	9	7	5	3	0	0	0	0	individualist	S1	3	2	24	0	0	0	0	0
group A	S2	3	8	9	3	1	0	0	0		S2	1	0	0	12	0	1	0	1
	S3	5	6	5	4	0	0	0	0		S3	0	16	1	2	0	0	0	0
	S4	2	3	5	11	0	0	0	0		S4	14	2	0	7	0	0	0	0
collectivist	S5	0	0	0	0	4	5	5	4	collectivist	S5	0	0	0	0	5	6	6	6
group B	S6	0	0	0	0	6	6	5	5	group A	S6	0	0	0	0	8	3	5	6
	S7	0	0	0	0	8	4	6	6		S7	0	0	0	0	5	7	5	8
	S8	0	0	0	0	8	7	8	9		S8	0	1	0	0	8	7	5	4
3. Customers		individualist				collectivist gr A				4. Customers		collectivist gr C				collectivist gr B			
Suppliers		C1	C2	C3	C4	C5	C6	C7	C8	Suppliers		C1	C2	C3	C4	C5	C6	C7	C8
individualist	S1	1	25	1	0	0	0	0	0	collectivist	S1	6	7	7	5	0	0	0	0
	S2	9	1	0	5	1	0	3	6	group C	S2	9	3	4	8	0	0	0	0
	S3	0	0	2	0	0	0	9	4		S3	4	7	6	6	0	0	1	0
	S4	2	0	0	1	15	3	5	0		S4	4	5	5	6	0	0	0	0
collectivist	S5	1	0	0	0	0	20	0	0	collectivist	S5	0	0	0	0	17	0	1	1
group B	S6	0	1	1	17	0	0	4	0	group A	S6	0	0	0	0	1	0	1	16
	S7	5	0	4	0	1	0	1	9		S7	0	0	0	0	0	23	1	1
	S8	1	0	18	0	1	0	1	1		S8	0	0	1	2	1	15	1	2

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