Which Buyer-Supplier Strategies on Uncertain Markets? A Multi-Agents Simulation

Corentin Curchod[a], Philippe Caillou[b], Tiago Baptista[c]

[a]AUDENCIA, Nantes, France

[b]LRI, Université Paris Sud 11, Orsay, France e-mail: caillou@lri.fr

[c]Department of Computer Science, University of Coimbra, Portugal

The relationship the firm has with its clients and suppliers largely determines the amount of value it is able to capture in the chain (Chatain and Zemsky, 2007; Porter, 1991). Generally, a distinction is made between power- and trust-based buyer-seller relations (Cannon and Jr, 1999) and their relative impact on value appropriation by the focal firm (Lado, Boyd, and Hanlon, 1997). Surprisingly, very little has been said about the impact of market environment on the choice of the best buyer-supplier strategy in terms of value appropriation, even if several studies have shown the organizational advantages of vertical integration or long-term relations in a situation of high uncertainty (Heide and Miner, 1992; Sutcliffe and Zaheer, 1998). The paper precisely proposes to investigate which among different types of buyer-supplier strategies brings more value to the buyer when market uncertainty increases. We rely on a very innovative method of multi-agents simulation based on an in-depth ethnographic observation phase of a real market in France. Some economists have already used such methods to understand the macro functioning of real markets (Härdle and Kirman, 1995). In the strategy and management field, simulations are mainly used for network analysis (Amaral and Uzzi, 2007; Hanaki *et al.*, 2007). Differently, this paper proposes to simulate and analyze buyer-supplier strategies in a micro and concrete market setting. It shows that the margin rate is not the only parameter to consider when choosing a buyer-supplier strategy but that regularity of supply plays an essential role, and that pure loyalty is not necessarily the best strategy when market uncertainty increases.

Theoretical backround

Value is a central concern in strategy. More specifically, how value is shared among the different actors in an industry constitutes a core issue for the classical power-based approach of competitive advantage (Brandenburger and Stuart, 1996; Porter, 1991) and more recently to the "architectural" view, considering that the amount of value the firm is able to capture depends on its capacity to shape the industry at its own advantage (Jacobides, Knudsen, and Augier, 2006). The micro-level – i.e. the level at which negotiations and pricing do happen – is certainly the most appropriate when studying the real process of value sharing (Brandenburger *et al.*, 1996; Zbaracki, 2007). The pricing process, since it constitutes the ultimate determinant of the amount of value captured by the firm over its clients, is more than an organizational routine: it is a capability that the firm should develop at both organizational and individual levels (Dutta, Zbaracki, and Bergen, 2003).

Value sharing does happen at the firms' interfaces: between the firm and its clients, between the firm and its suppliers, among others. Generally, the locus for value sharing is the several intermediate markets that separate and, at the same time, link the interdependent activities along a value chain. These markets can be clearly bounded – the extreme case is the existence of well-defined marketplaces – or not; they can emerge from unexpected changes in the organization of the activities along the value chains (Jacobides, 2005) or be stable. On these markets, firms are dividing value the concrete way, that is to say, they send individuals to negotiate. In this paper, we argue that firms' interrelations – the locus for value sharing – happen at the individual level, even if organizational processes and routines do exist. Negotiations, whether they occur on a well-defined competitive market or through specific bilateral relations, involve a complex intertwining of competition and cooperation (Sebenius, 1992). Literature has largely investigated the dynamics of negotiation and how competition and cooperation may occur through successive and clearly delineated sequences (Adair and Brett, 2005). Some authors insist on the multiplicity of negotiation types, depending on the specific negotiation strategies that buyers will choose (Cannon *et al.*, 1999; Perdue and Summers, 1991) or the type of relationships buyers and sellers have, with a distinct focus on power-based (Kim, Pinkley, and Fragale, 2005) or relational and more equalitarian interactions (Gelfand *et al.*, 2006).

We consider here that negotiation strategies depend on the type of relations the supplier and the client have together, and that these relations can be framed along a continuum from arm's length/short term to cooperative/long term type. Literature has shown how cooperation between buyers and sellers decreases the perceived risk on future transactions for both sides (Heide *et al.*, 1992) or may lead to a higher level of value creation and thus to competitive advantage (Lavie, 2006).

Very little has been said, however, on the impact of market environment on the output of the different types of relations between buyers and sellers. Transaction cost economics and the strategy field proposed that in

case of high uncertainty the best solution is to avoid market relations and to vertically integrate (Afuah, 2001; Richardson, 1996; Williamson, 1991), even if empirical tests show that the positive effects of vertical integration is far from obvious (Sutcliffe *et al.*, 1998). Market uncertainty creates room for new organizational forms and new types of interfirm relations, sometimes called "flexible forms" (Volberda, 1996). But vertical integration cannot possibly constitute a global solution against market uncertainty, simply because in most industries firms are unable to vertically integrate, for financial or strategic reasons. In those cases, long-term suppliers relations may offer stability in unstable markets (Heide *et al.*, 1992). But whether this solution is the most interesting in terms of value appropriation remains an unanswered question yet.

In this paper, we precisely propose to investigate these issues and, more specifically, which type of buyer-seller relation constitutes the best strategy for the seller when market uncertainty increases. The output we consider is the amount of value the seller is able to capture from the relation.

Methodology

The research adopts an experimental design based on a simulation of a real market for professionals in France, the "Rungis" market. The Rungis Market – which has the official label of "Market of National Interest" – locates near Paris and is the biggest market for fresh products in the world, with a surface area of 232 hectares. It gathers sellers of fresh products like fruits, vegetables, fishery goods or meat, all small or medium sized firms, and buyers like retailers or restaurateurs. The market is strictly controlled by market authorities and governmental bodies. Transactions happen by private mutual agreements between the buyer and the seller: there is no posted price by the sellers, no electronic quotation or auction mechanism. Governmental bodies publish a daily quotation list by product, based on the informal information they can gather on the market. The quotation list published day N gives averages prices collected day N-1 for each type of product and each quality. Since the goods are highly perishable and the time schedule for transactions is limited to 4 or 5 hours a day, the market is highly liquid and volatile. Because of the absence of rigid frame for pricing, each buyer is free to adopt a specific strategy with the sellers. Some spend much time to compare the different prices and qualities of the goods. Some others choose a seller for each good or bunch of goods and maintain long term relations with him.

Table 1: experimental design

Exp #	Description	Inputs and experimental conditions	Market environment	Outputs
XP 1	Five types of relations are isolated and compared, on the buyer's side: A: search strategy, high propensity to compare prices, systematic negotiation, no loyalty B: long term relation with one seller for each good, stable prices negotiated once and for all C: same as B plus frequent check that other suppliers do not make better offers, capacity to change suppliers if a better offer. D: preferred relation with three sellers for each good, systematic comparison among these three and choice of the best offer E: same as D plus frequent check that other suppliers do not make better offers, capacity to change suppliers if a better offer.	-Four buyers corresponding to the five defined profiles (A-E) are inserted among the other buyers -duration of each simulation: 30 days -number of simulations: 5[1]	No uncertainty: both supply and demand are stable	-margin rates and values for each of the five tested buyers -time spent on the market -quantity bought each day
XP 2	Same as #1 plus: -high uncertainty of the market on the demand side	Same as #1	Variance of demand for each buyer = 30%	Same as #1
XP 3	Same as #1 plus: -high uncertainty of the market on the supply side	Same as #1	Variance of supply for each supplier = 30%	Same as #1
XP 4	Combined experiment #2 and #3	Same as #1	Same as #2 and #3	Same as #1

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[1] More simulations are planned in the following months to reinforce the validity of the results.

In the first phase of the research, one of the three authors obtained a pass to spend ten days on the market, and gathered data on the real day-to-day interactions between buyers and sellers, through interviews and observations. He obtained the right to spend time with the employees of two main wholesalers and observe their selling strategies. He also was able to follow a buyer during his purchases and to observe usual buyer-seller relational strategies. A total of 13 interviews were also carried out with sellers, buyers and market authorities. This phase followed an ethnographic approach as socio-economists of markets commonly do (Abolafia, 1998; Sherry Jr, 1990) with an objective of pure description. At the end of the observation phase, a 80 pages report was written describing the functioning of the market. Then the second phase began. The second author transcribed the report into a frame for a multi-agents system model. This 14 pages algorithm were checked and discussed by the first author in a third phase, with numerous rounds of program rewriting and going back and forth between the case and the model. Due to the complexity of the agents' strategies, a 3d cognitive multi-agents simulation was chosen, with the following main advantages: i) the intuitive rule-based and agent-centred simulation definition; ii) the capacity to test different scenarii and study parameter sensitivity; iii) the human-friendly visualisation interface, essential for the validation of behaviours. In a fourth phase, the second and third authors wrote the program and designed the simulation, followed by a phase of calibration and validation. Concerning this latter phase, we retained two criteria: firstly, when considering a full day for a specific buyer, no incoherence or unrealistic behaviour should occur; secondly, the market should follow the law of supply and demand for each type of good. See appendix 1 for a short description of the program.

The experimental phase was designed as explained table 1. To compare basic strategies, we added 5 buyer agents to a realistic market simulation. Each of this "tested" buyers follow one of the prototypic strategies defined in Table 1.

Results

Figure 1 : average margins per day[23] and per strategy when there is no market uncertainty (XP1)
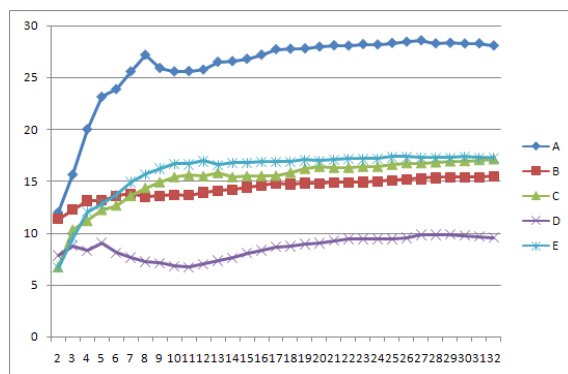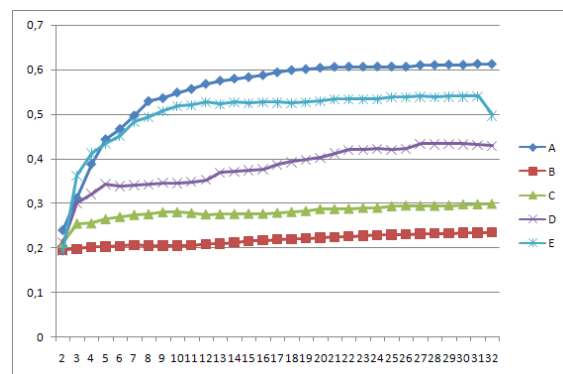
Figure 2: average margin rates per day and per strategy when there is no market uncertainty (XP1)

Value appropriation when there is no market uncertainty (XP1)

Our first set of results shows that, when there is no market uncertainty, the search strategy (A) is more profitable in both absolute and relative value than the others. Figures 1 and 2 give the evolution of the margins and the margin rates for each strategy A-E, from day 2 to day 32. Figures 1 and 2 invite to make a distinction among three subgroups: strategy A, as already said, is highly profitable. On the opposite, strategies of building long term relations with one seller and a guaranteed price (B and C) leads to a low rate of profitability but acceptable level of profits. The strategy consisting in building long term relations with three sellers – but without a guaranteed price – leads to an increasing margin rate and still a low margin in absolute value. Difference between margin rates and margins in absolute value is due to differences in quantity bought. Figure 3 gives the average number of purchased goods for each strategy. Interestingly, one notices that the worst strategies in terms of profitability are also the best strategies in terms of regularity of supply: on average, each buyer adopting strategy B or C is able to purchase the totality of what he wanted to purchase. In other words, when developing long-term relations with one seller per product, the buyer has the guarantee to obtain what he needs – which is highly valuable when final clients are expecting regularity of supply – but at a higher price. A pure search

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[2] The price that a seller pays to his producer for one lot of goods ranges from 10 to 20 depending on quality. Similarly, the price the buyer is able to set to his final client ranges from 20 to 40. The maximum margin per day for a buyer is thus 120 (3 top quality lots sold 40 on the final market and acquired for free from a seller)

[3] In the experiments, we excluded days 0 to 5 which are not representative of the normal behaviour of the market (buyers and sellers build relationships and there is no obsolete goods on the market)

strategy also leads to a good regularity in this market configuration. But, if one considers the time spent on the market (Fig.7) the search strategy is not efficient compared to B or C. Intermediate strategies D and E, by which the buyer has three preferred sellers, are also time consuming and the buyer runs the risk to leave the market with a small portion of what he needs because most goods are already gone (see Fig. 3).

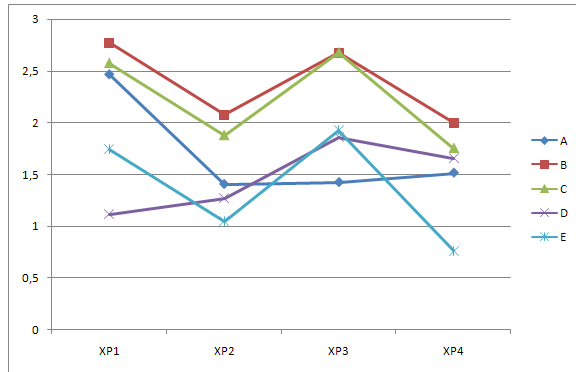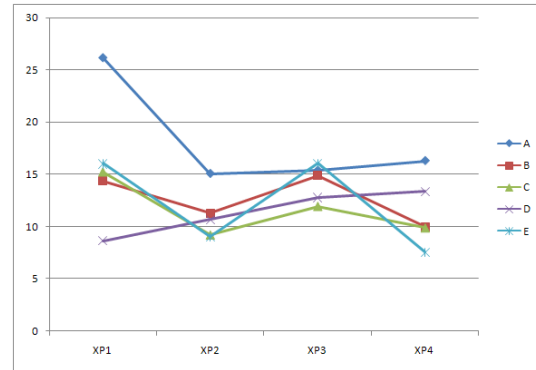*Figure 3: average number of products bought per strategy (A-E) for each market configuration.[4]*

Figure 4: average margin per day and per strategy (A-E) for each market configuration (XP1-XP4)

Value appropriation in the case of demand uncertainty (XP2)

Now, we introduce demand uncertainty on the market: buyers do not know if the demand will be high – with a risk of high prices and market shortage – or low.

Figure 5: average margin rates per day and per strategy in the case of demand uncertainty (XP2)
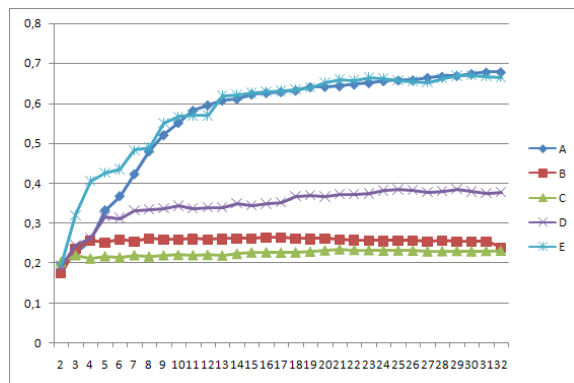

Figure 6: average margin rates per day and per strategy in the case of supply uncertainty (XP3)
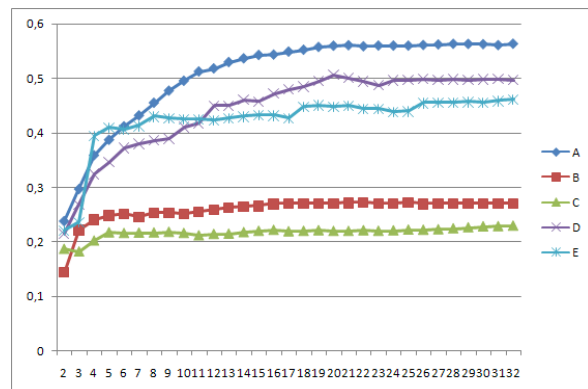

Figure 5 gives the average margin rate per strategy. The distinction we had in XP1 is even more clear-cut now, between a group of very profitable strategies A and E and a group of low profitability strategies C and B. More striking, strategies consisting in delineating a submarket of three sellers (D and E) lead to bad outputs in terms of quantities purchased (Fig. 3). In this configuration, there is a final equivalence in terms of total margins between strategies performing well on the unitary margin but badly on the regularity of supply – D and E – and those doing well on the regularity of supply but leading to low unitary margins (B and C). But pure search is still a dominating strategy in terms of total profits (see Fig. 4).

Value appropriation in the case of supply uncertainty (XP3)

In the case of supply uncertainty, buyers do not know in advance which quantity of each good the market offers but, if they spend enough time and gather information, they can guess. Here, a buyer with one single preferred seller per product (strategies B and C) will be less profitable than a buyer with three preferred sellers per product (D and E), himself less profitable than pure search strategy (A). This is coherent with the idea that buyers must guess which quantity is offered on the market and may adapt their negotiation strategy accordingly. However, a second result is more puzzling: strategies D and B lead to higher margin rates than strategies E and C respectively (see Fig. 6), which means that organizing an external competition with the

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[4] For each buyer A-E, the desired quantity is fixed and equal to 1 (lot) per category of product, thus a total of 3 lots of goods.

preferred seller or with the preferred group of sellers does not bring a surplus of value compared to pure loyalty. That is counterintuitive but may be explained by the fact that by switching to a new seller one day because this latter has an extra offer, the buyer may lose the favoured relationship with his usual seller. The one-time gain he will make can hardly exceed the repeated reward due the fact that sellers accept to decrease their price if their regular clients are loyal. In other words, in the case of highly volatile supply, risk-adverse and stable strategies are more profitable for buyers: when the firm has one or several preferred sellers, it will not run the risk to loose the advantages associated with these specific relations for a one time good opportunity. In the end, both pure search and pure loyalty strategies (A and B) lead to the same level of margin in absolute value (Fig. 4).

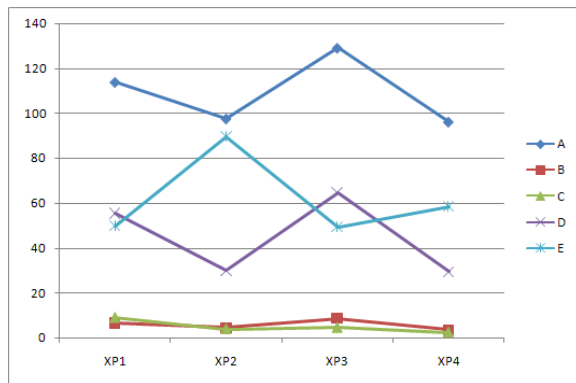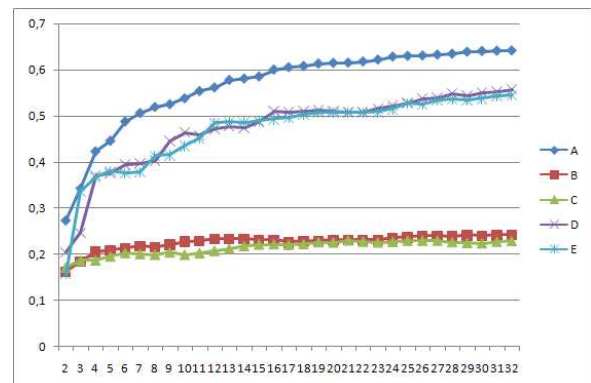| *Figure 7: Average time spent on the market per day and per strategy for each experiment XP1-4*	*Figure 8: average margin rates per day and per strategy in the case of high market uncertainty (XP4)*

Value appropriation in the case of both supply and demand uncertainties (XP4)

When both supply and demand are highly volatile, buyers cannot easily guess the market price. They run the risk of either buying at an exaggeratedly high price or leaving the market with only a small portion of what they need. Concerning profitability, Fig. 8 clearly shows that strategies of competition among three sellers or more (A, D and E) bring a much higher margin rate than strategies of pure or relative loyalty towards a single seller (B and C). Contrarily to what happened in the other configurations, loyalty does no longer bring a clear advantage in terms of regularity of supply when the market is highly volatile (see Fig. 3). Consequently, when considering the total margin at the end of the day, the strategy consisting in creating submarkets of three sellers and limiting the search to them (D) outperforms the others except the pure search strategy, which has however the disadvantage of being three times more time consuming than D (Fig. 7). The strategy D is better than strategy E particularly when the ratio supply over demand is low: a limited submarket of three sellers is easy to handle for the buyer, who is able to make his purchases quickly enough and to avoid potential shortage. It is better than strategies B and C when the ratio supply over demand is high, because it gives more room for negotiation and comparison. The strategy D has thus a competitive advantage over the others, let aside strategy A much too time consuming. Strategy E is clearly a bad strategy regarding the regularity of supply, and, as a consequence, the total margin (the worst of the five strategies).

Discussion

Following transaction costs economics and its theoretical approach of vertical relations, authors in strategy largely agree that in the case of market uncertainty, short-term purely market-based relations lead to lower performance than long-term cooperative ones (Heide *et al.*, 1992), which may even go as far as vertical integration (Afuah, 2001; Sutcliffe *et al.*, 1998). Our research partially contradicts this global idea and brings substantive new theoretical insights about at least two points: first, pure loyalty is on average less profitable than mixed strategies of both cooperation with a few suppliers and simultaneously bringing competitive pressure among them; secondly, the best strategies in terms of profitability may be the worst in terms of regularity of supply, depending on market uncertainty.

Our approach has some limitations, in particular the simulation is based on a specific real market which brings internal validity and consistency but also may lead to a lack of external validity. However, we consider that the underlying empirical market can be considered as an ideal-type for many forms of markets.

This paper proposes a new tool to study buyer-seller strategies in the corporate world, based on multi-agents simulation. This innovative method opens the door to experimental designs that are difficult – if not impossible – to realize in a purely empirical setting. This may have strong methodological, theoretical and empirical implications. For example, our results justify strategies we observed on the real market, like the

restaurateurs, who need a strong regularity of supply and who are generally loyal to a single seller per good or, at the opposite, buyers spending hours strolling up and down the market, searching the very best prices for clients who do not expect regularity of supply. Our model renews the methodological apparatus for studying value repartition along value chains and paves the way for new experimental research on buyer-supplier strategies.

Appendix: main parameters of the simulation

Global market parameters
- Number of sellers = 20
- Number of buyers = 50
- Number of different types of good = 3. All goods are perishable.
- Quality ranges from 1 (perfect) to 0 (improper for consumption). Quality of unsold goods decreases day after day.
- Published quotation everyday (see methodology).

Discussion protocol

Coherent with the market reality, the seller initiates the negotiation and asks for a type of product with a minimum quality. Discussions happen as follow:
- Seller: Hi
- Buyer: HowMuchFor;Product; min quality
- Seller: Propose;price (the starting price is fixed for each specific set of seller-product-quality)
- Buyer: Propose;price;quantity,
- Seller: Propose;price
- Buyer: Propose;price;quantity...
- until they reach an agreement or quit or switch to another product

Buyers may look for very cheap items or for very good quality, depending on their final clients. They may have time for comparing the offers of several sellers or rush and buy to their usual sellers. To fit the real observed market, four kind of buyers interact, each having different strategies, defined from empirical observations.

Sellers buy goods to producers. They are able to propose a maximum of three different types of good to buyers, with different quality. They are aware of competition and adapt their prices. The unsold goods are stocked and proposed again the day after, with a lower level of quality.

Screenshot: Simulations where conducted using the BitBang Simulation Framework:
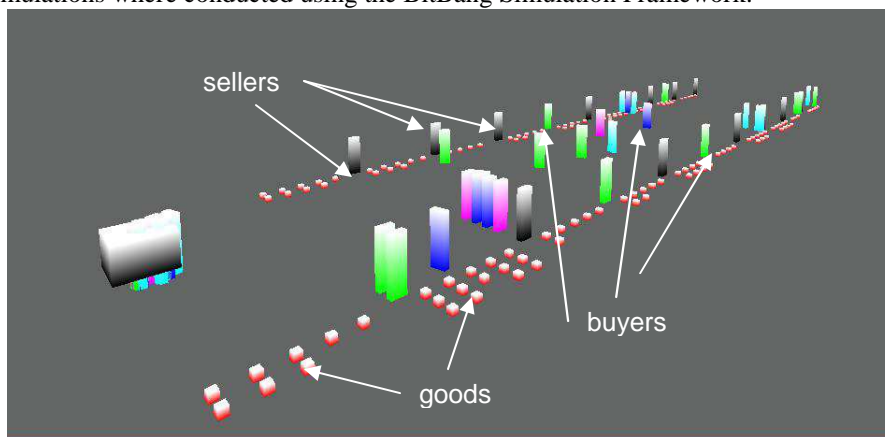
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