

Effects of exploration and experimentation capacity on industry competitiveness

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“Exploration” in the standard view

- Juxtaposed to exploitation
- Referred (almost exclusively) to individuals or routines or functions within organizations
- A broad set of activities, including (March, 1991):
- **Searching** (collecting, computing and evaluating information), flexibility, discovering, innovating, **experimenting**
- Deciding?

Besides referring to inter-organizational relationships (specifically supplier-buyer), by distinguishing among the broad set of activities

“exploration” in this work means:

- 1) Searching (Gathering and storing information into four types of memory),
- 2) Deciding (Running a quite complex decision making algorithm)

“Experimentation” means

Testing many suppliers,

that is,

splitting a firm’s whole purchases
between many suppliers

Rationales

- **These are two (still broad) set of activities, and an organization can be good in one and bad in the other**
- **Exploring without experimenting is supposed to be much more effective if agents are honest than if they lie**

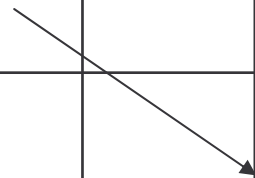
That is

In a context of opportunistic behaviors and bounded rationality information could not help profitability (finding the best suppliers)

4 extreme strategies

		Experimentation <small>Very risky</small>				
		low	medium		high	
			1	2	4	8
Exploration	low	4	0.88	0.92	0.94	0.95
	medium	8	0.88	0.92	0.94	0.94
		16	0.87	0.93	0.95	0.96
	high	40	0.88	0.93	0.94	0.93

Scarce resources



Very prudent



Abundant resources



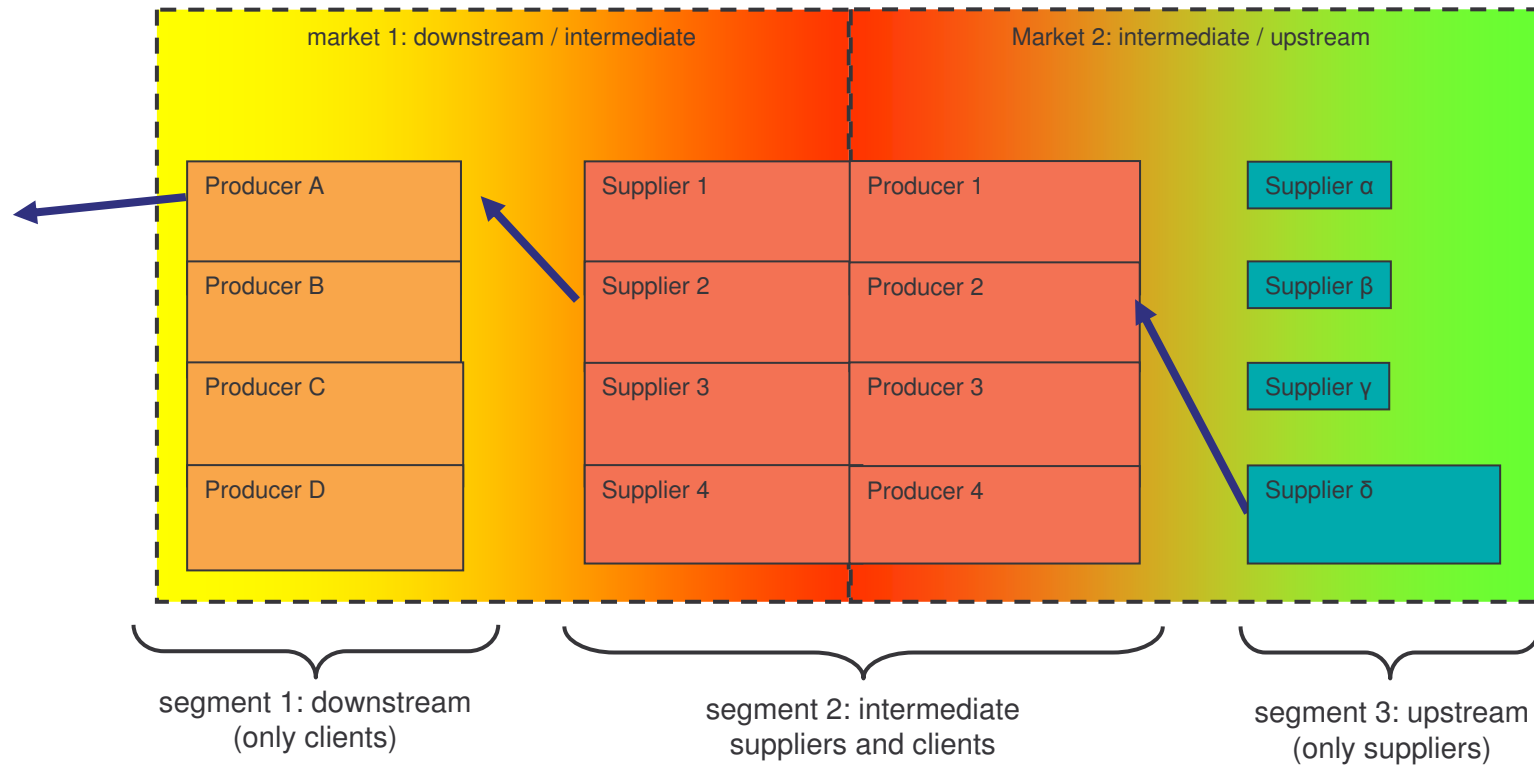
This model has been written with LSD platform and language

It is based on a more general model called **CIOPS** (Cognitive Inter-organizational Production System), which I built with Enrico Sevi

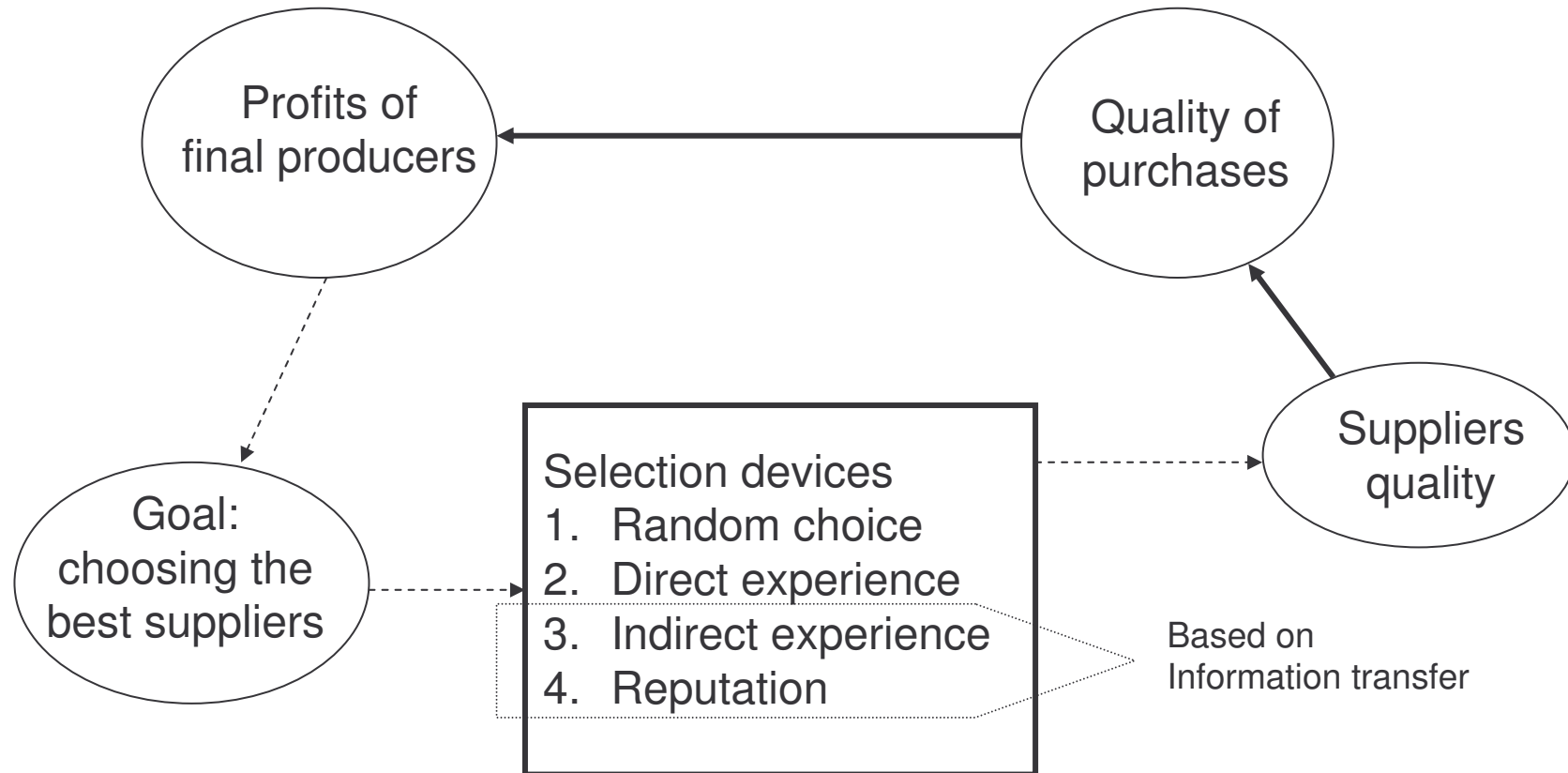
Its detailed structure and source code will be uploaded soon on www.knownetlab.it

Filiere and market structure

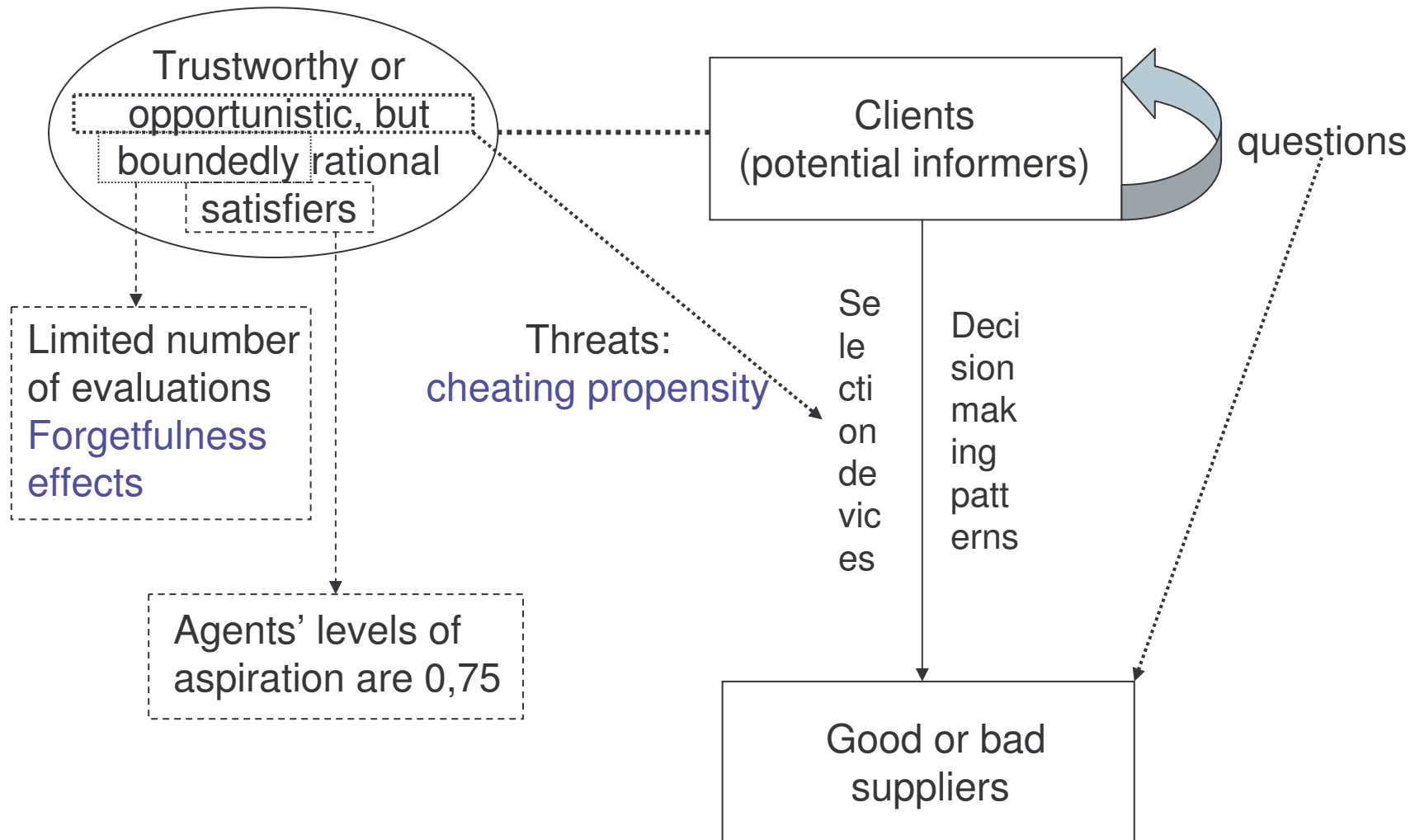
Sequential Technology



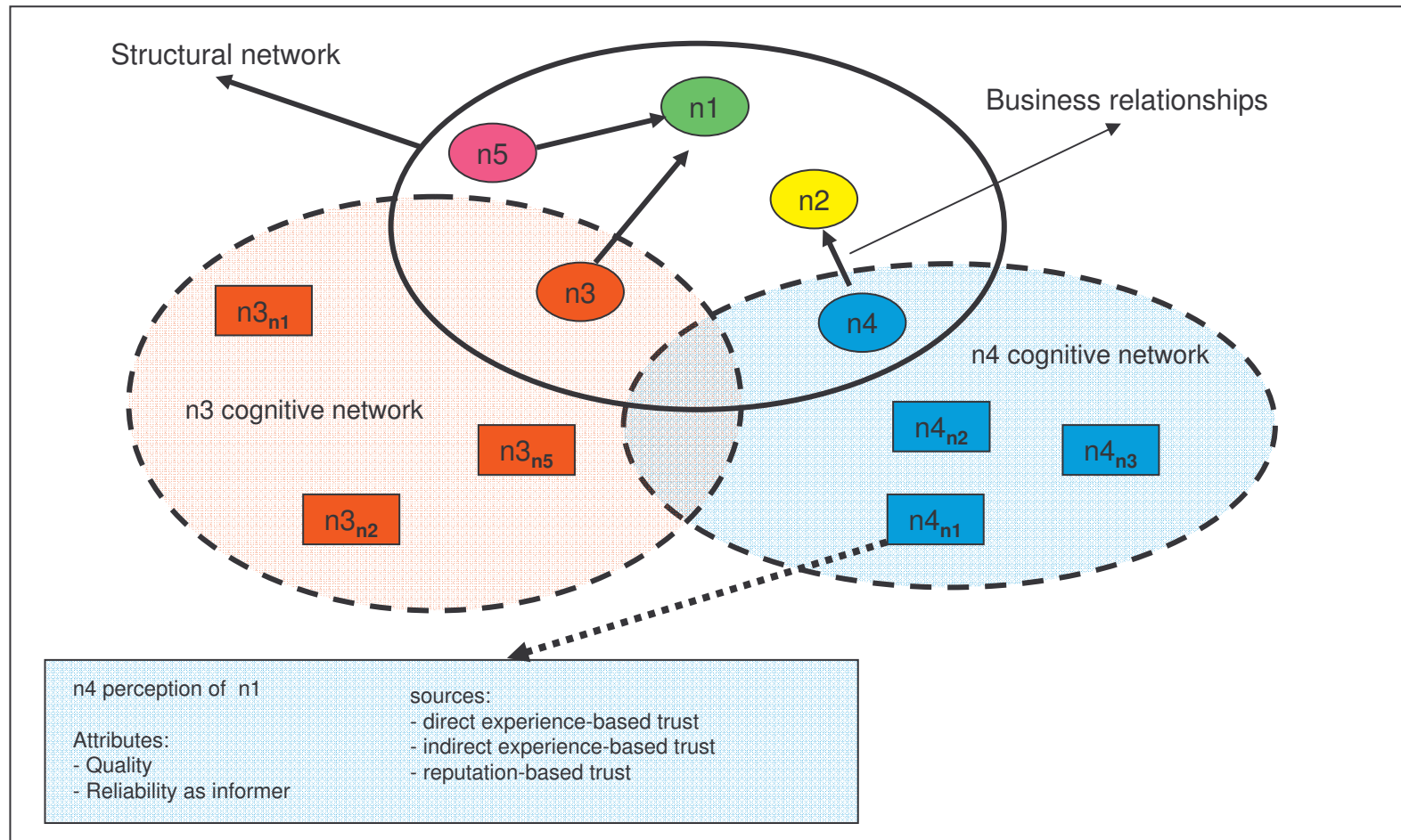
The general structure



The nature of agents and their selection processes



The interaction between trade and cognitive networks



How to improve the search for the best suppliers?

Exploration

by enlarging the share of information
and decision space

gathering, storing, and comparing information
and choosing the best (satisfying) suppliers

Experimentation

by testing a higher number of suppliers
distributing the same volume of purchases
between a higher number of suppliers

Agents' (uniform) behavior

- **They do not learn:** they just compare past and present information
- **They are totally honest or totally dishonest** (in different configurations)
- **They forget inactivated information:**
 - After 100 steps for direct experience,
 - After 40 steps for indirect experience,
 - After 60 steps for reputation,
 - After 60 steps for non-consulted informers

Research questions

1. Could exploration capacity help compensating losses due to opportunism?
2. Does experimentation produce outcomes different than exploration to industry competitiveness?
3. Which role is played by clients' competitive pressure to acquire the best suppliers?
4. Which role is played by forgetfulness effects?

Industry competitiveness (performance) is measured in terms of average quality

400 intervals

In each interval all the operations are finalized:

- Selecting reliable informers;
- Asking questions;
- Updating memory;
- Making decisions;

exploration

- Placing orders;
- Producing;
- Paying;
- Getting outcomes;
- Updating memory (good or bad supplier;
reliable or unreliable informer)

experimentation

200 agents industry: 40 FP, 80 FT, 80 ST

Conclusions (1)

- 1) opportunistic behaviors through cheating severely damage industry competitiveness (10-16 percentage points)
- 2) exploration and experimentation capacities have different effects on performance
- 3) exploration capacity helps only FT with 4 and 8 subcontractors, and it never compensates the negative effects of opportunism

Red = experimentation; green = exploration

	FINAL PRODUCERS				FIRST TIERS			
	Honest agents							
	1	2	4	8	1	2	4	8
4	0.88	0.92	0.94	0.95	0.87	0.85	0.84	0.83
8	0.88	0.92	0.94	0.94	0.88	0.85	0.85	0.83
16	0.87	0.93	0.95	0.96	0.88	0.86	0.85	0.85
40	0.88	0.93	0.94	0.93	0.88	0.85	0.86	0.85

Synthesis of main results (400 steps)

	FINAL PRODUCERS				FIRST TIERS			
	Dishonest agents							
	1	2	4	8	1	2	4	8
4	0.79	0.83	0.81	0.80	0.79	0.78	0.76	0.73
8	0.79	0.83	0.81	0.81	0.79	0.78	0.76	0.76
16	0.79	0.82	0.79	0.78	0.79	0.79	0.77	0.74
40	0.78	0.85	0.79	0.76	0.79	0.79	0.77	0.77

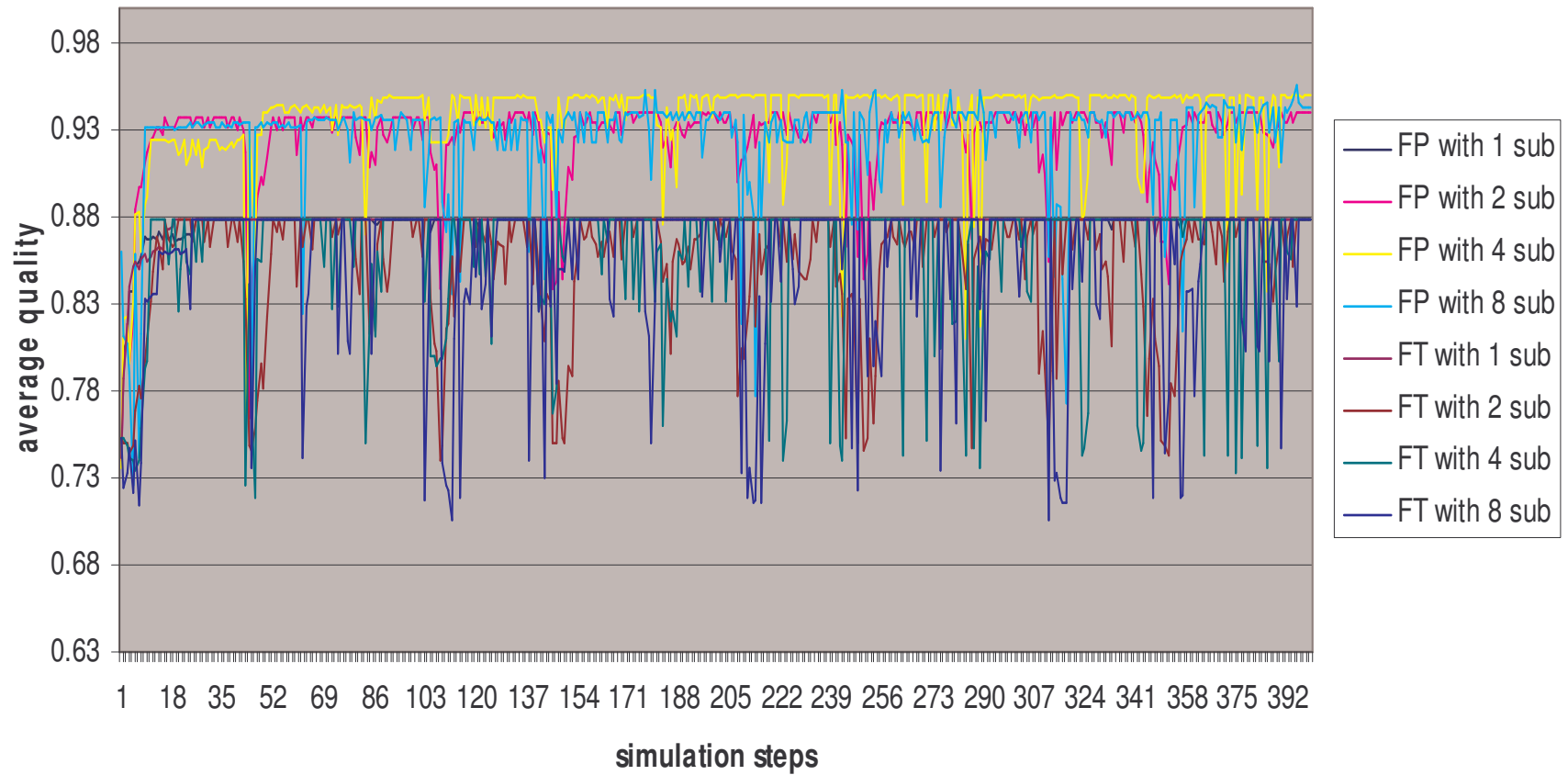
Conclusions (2)

- 4) more experimentation capacity significantly improves performance of honest FP (but at a decreasing rate) and dishonest FP (only when the *ratio of potential transactions between clients and suppliers* grows from 0,5 up to 1), that is until occurs a state of demand excess of suppliers
- Note: The ratio of potential transactions between clients and suppliers depends on the ratio of subcontractors per client or on the ratio between all clients and suppliers

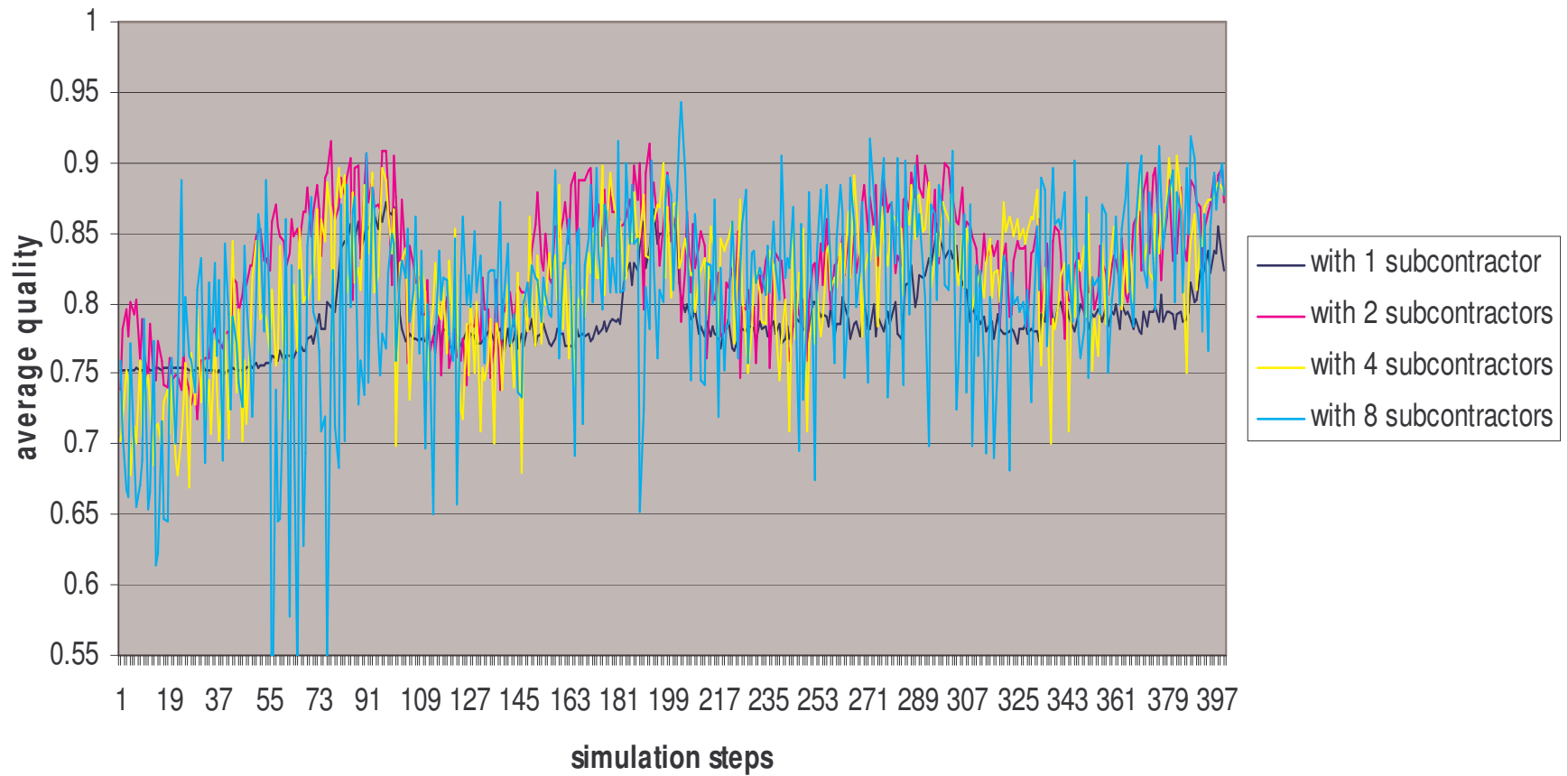
Conclusions (3)

- 5) more experiments (more than 1 subcontractor) make industry behavior chaotic
- 6) summing more exploration and more experimentation further increases chaotic behavior, which, especially with dishonest agents, can produce even a (net) decreasing outcome

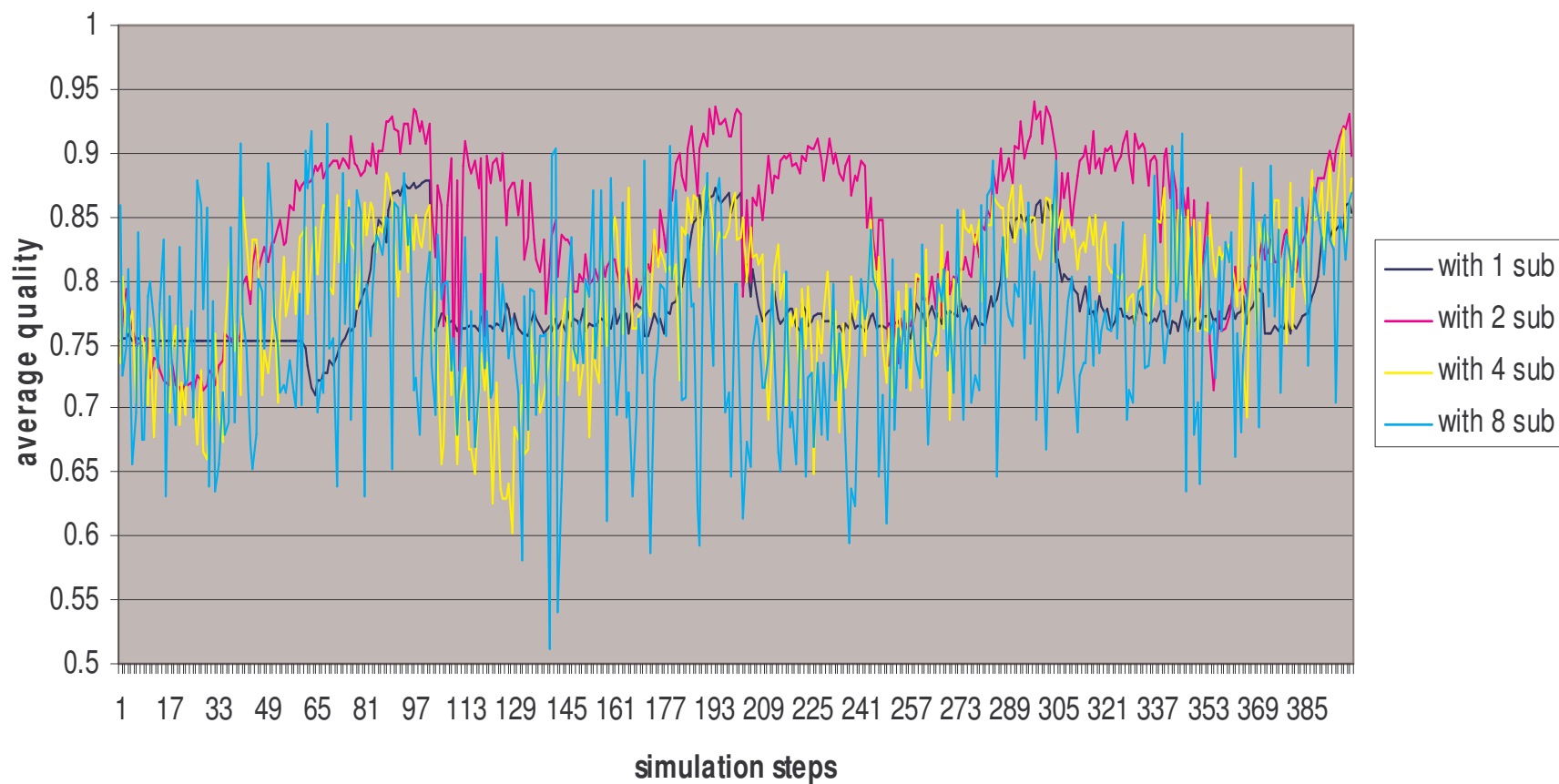
**Effects of experimentation capacity on FP and FT competitiveness in 200 honest agents
size industry with high exploration capacity (40 questions)**



Outsourcing (experimentation capacity) effects on honest FT with low (4 questions) exploration capacity



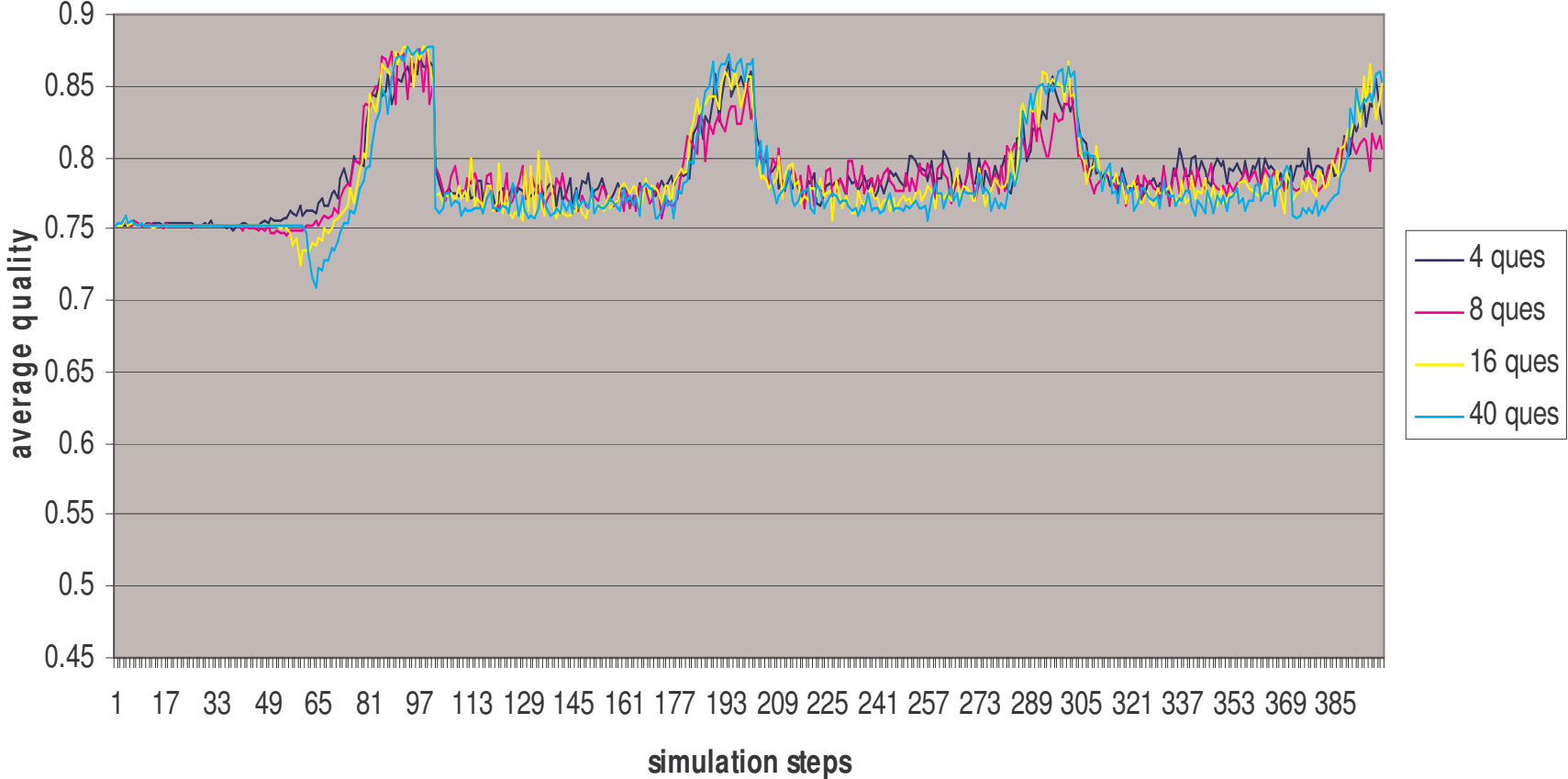
Effects of experimentation (outsourcing) capacity on FP competitiveness in 200 cheating agents industry with high exploration capacity (40 questions)



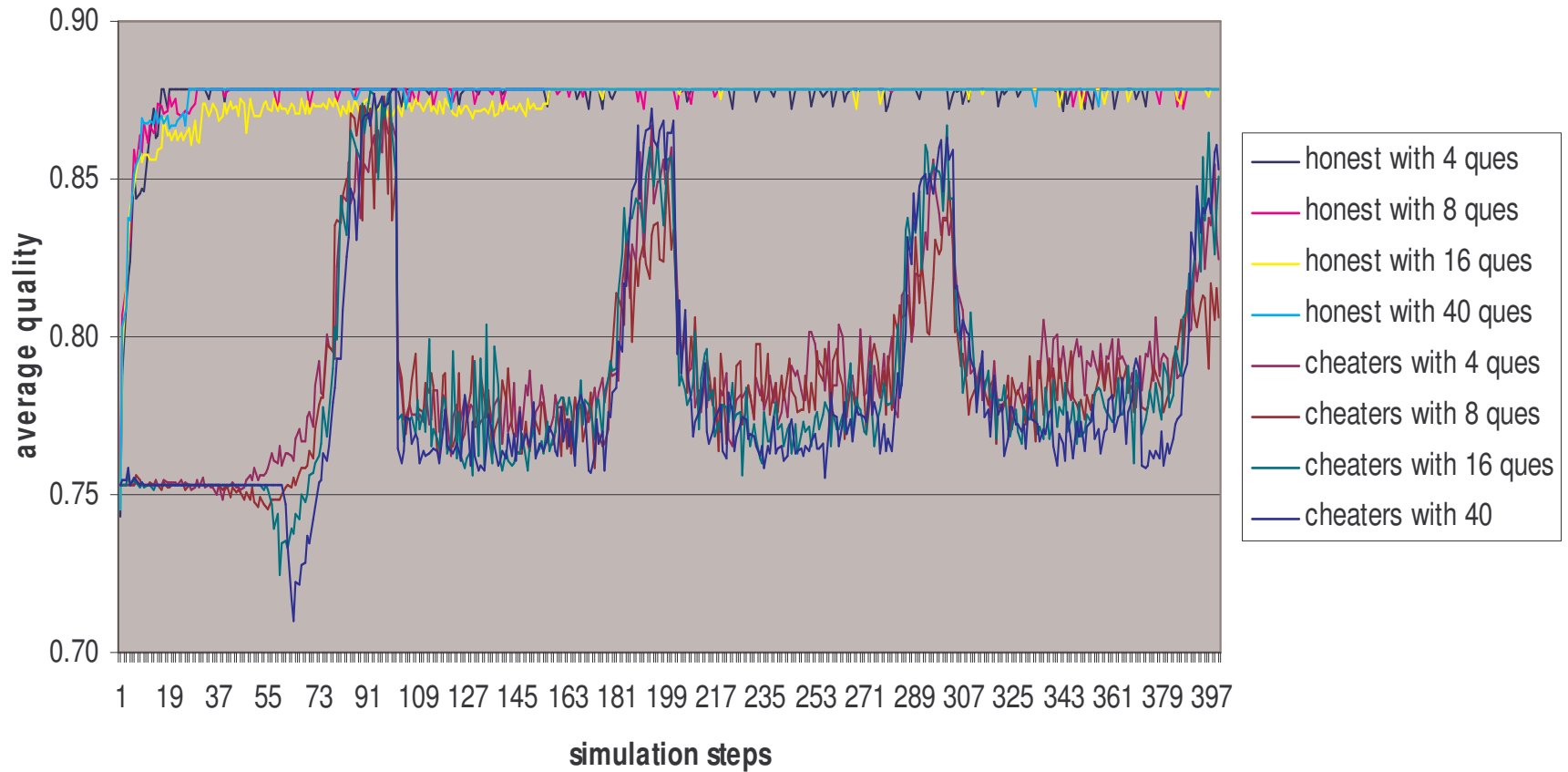
Conclusions (4)

- 7) the cumulated effects of forgetfulness dramatically reduces industry competitiveness with opportunistic behaviors
- 8) forgetfulness effects are insensitive to exploration or experimentation capacity

Effects of exploration capacity on FP with minimum experimentation capacity in 200 cheating agents industry



Effects of exploration capacity on cheating and honest FP with minimum experimentation capacity in 200 agents industry



Research answers

1. Could exploration capacity help compensating losses due to opportunism? **YES**
2. Does experimentation produce outcomes different than exploration to industry competitiveness? **YES**
3. Which role is played by clients' competitive pressure to acquire the best suppliers? **HIGH**
4. Which role is played by forgetfulness effects? **HIGH (with dishonest agents)**

Industry competitiveness (performance) is measured in terms of average quality

Conclusions (3)

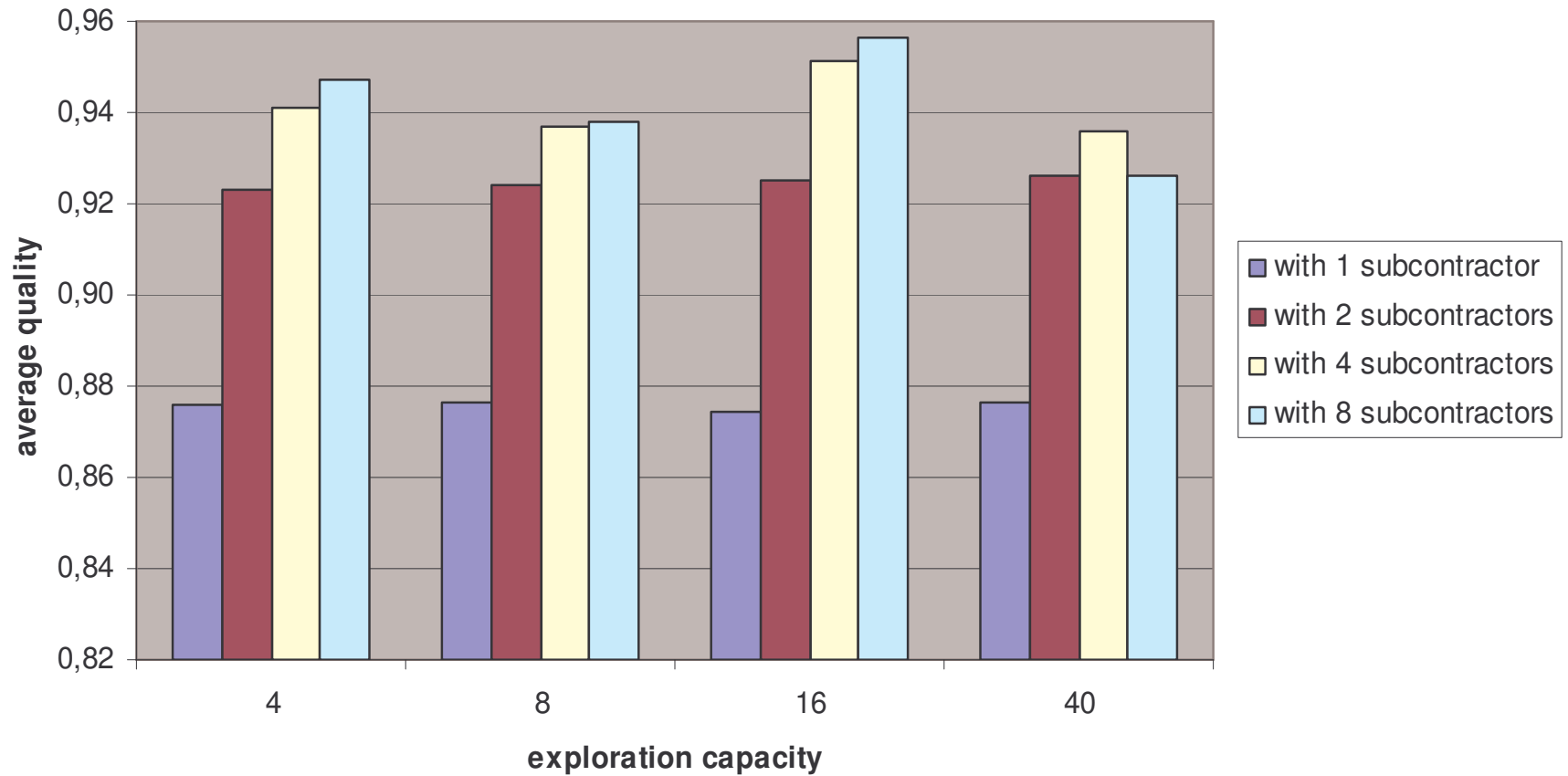
- Industry performance and firms failures are very sensitive to three factors:
- Experimentation rather than exploration capacity
- Learning ability else than pure computational capacity
- The ratio of potential transactions between clients and suppliers
- Forgetfulness effects

Effectiveness of decision making patterns

- ✓ When agents cheat, it is better to trust direct than indirect experience in order to avoid false information.
- ✓ Information reliability (quality) is more strategic than its quantity.

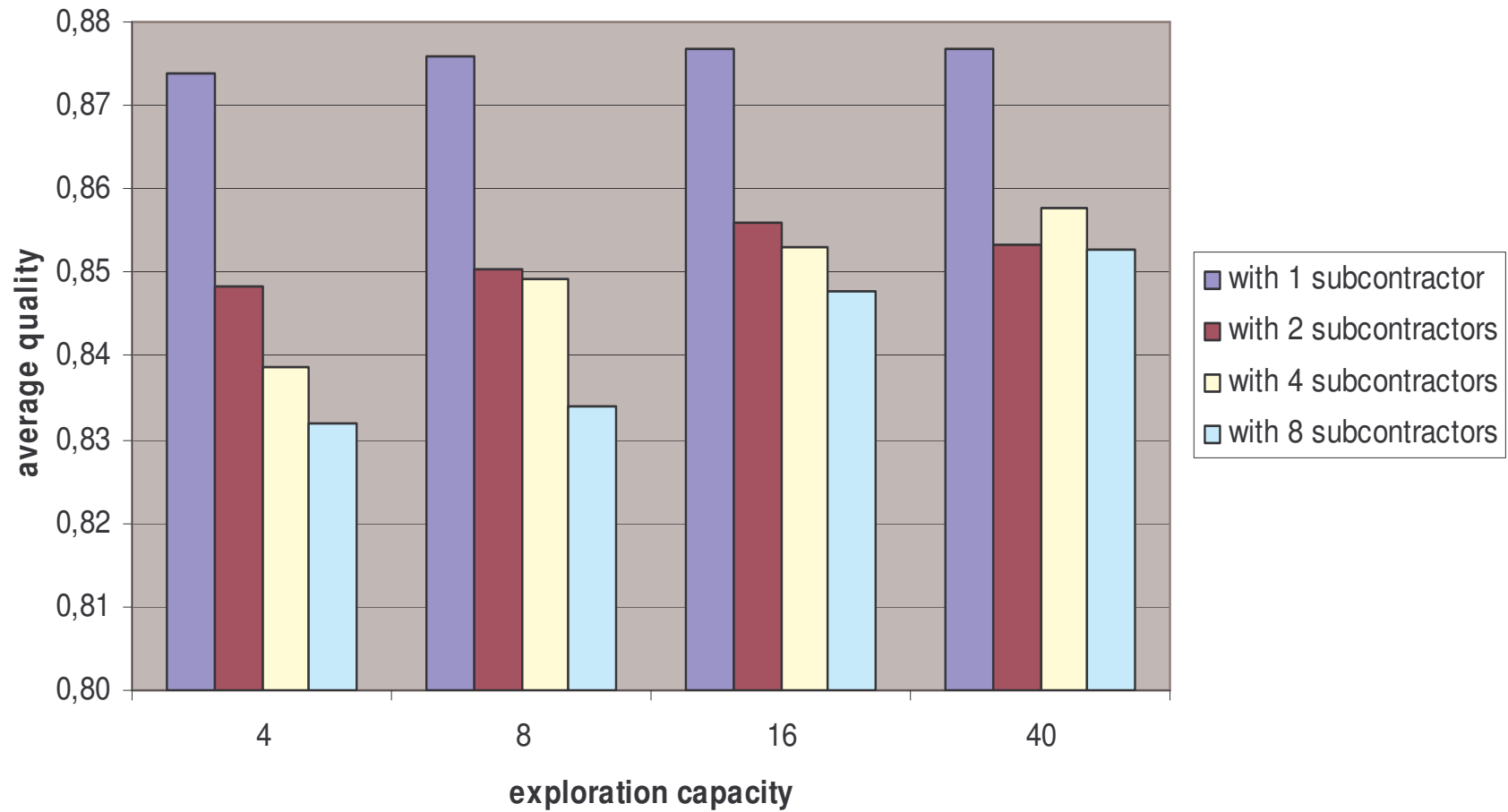


Combined effects of exploration and experimentation capacity of FP honest agents

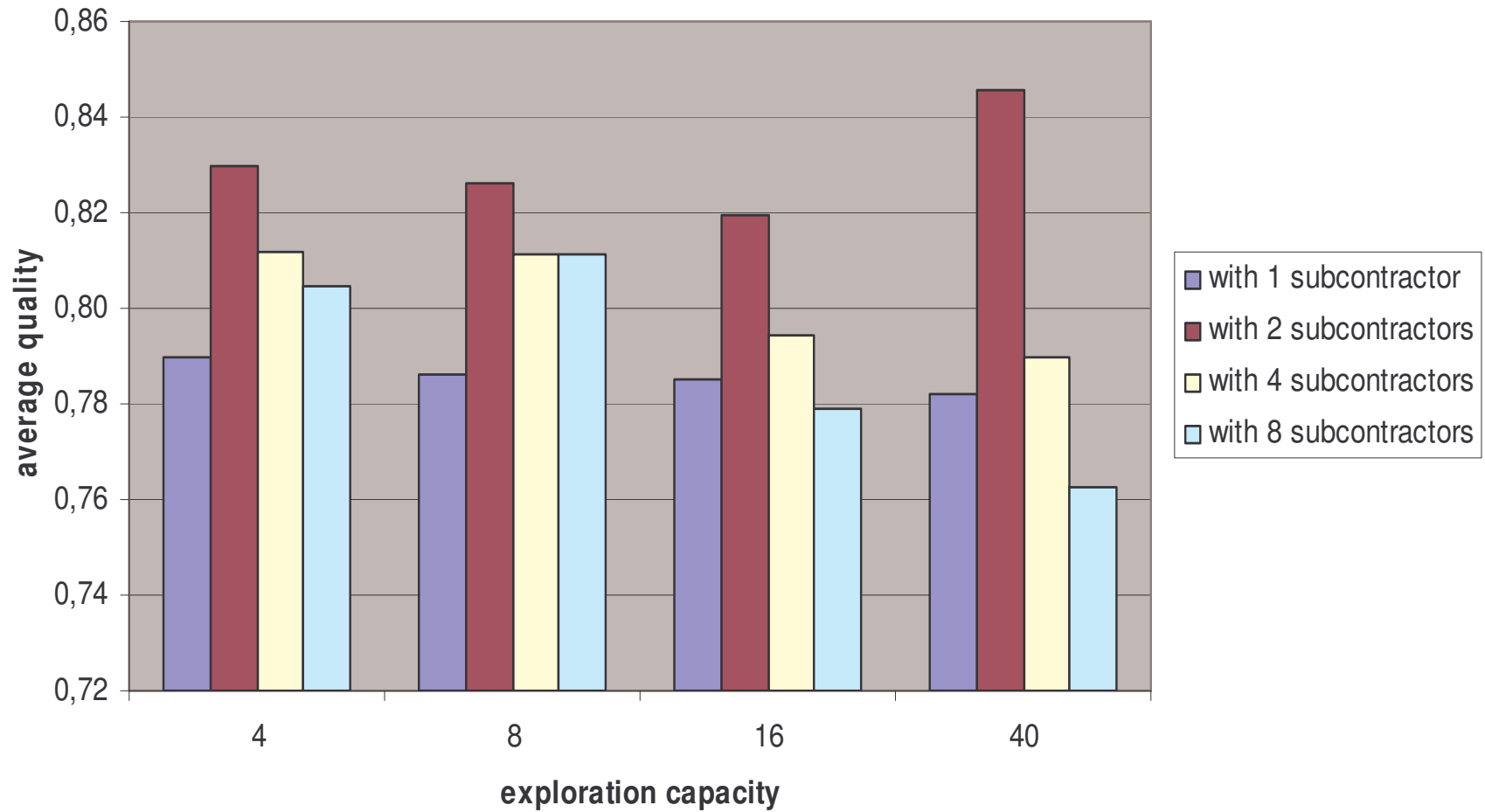


Industry structure: 40 final producers (FP), 80 first tiers (FT), 80 second tiers (ST)

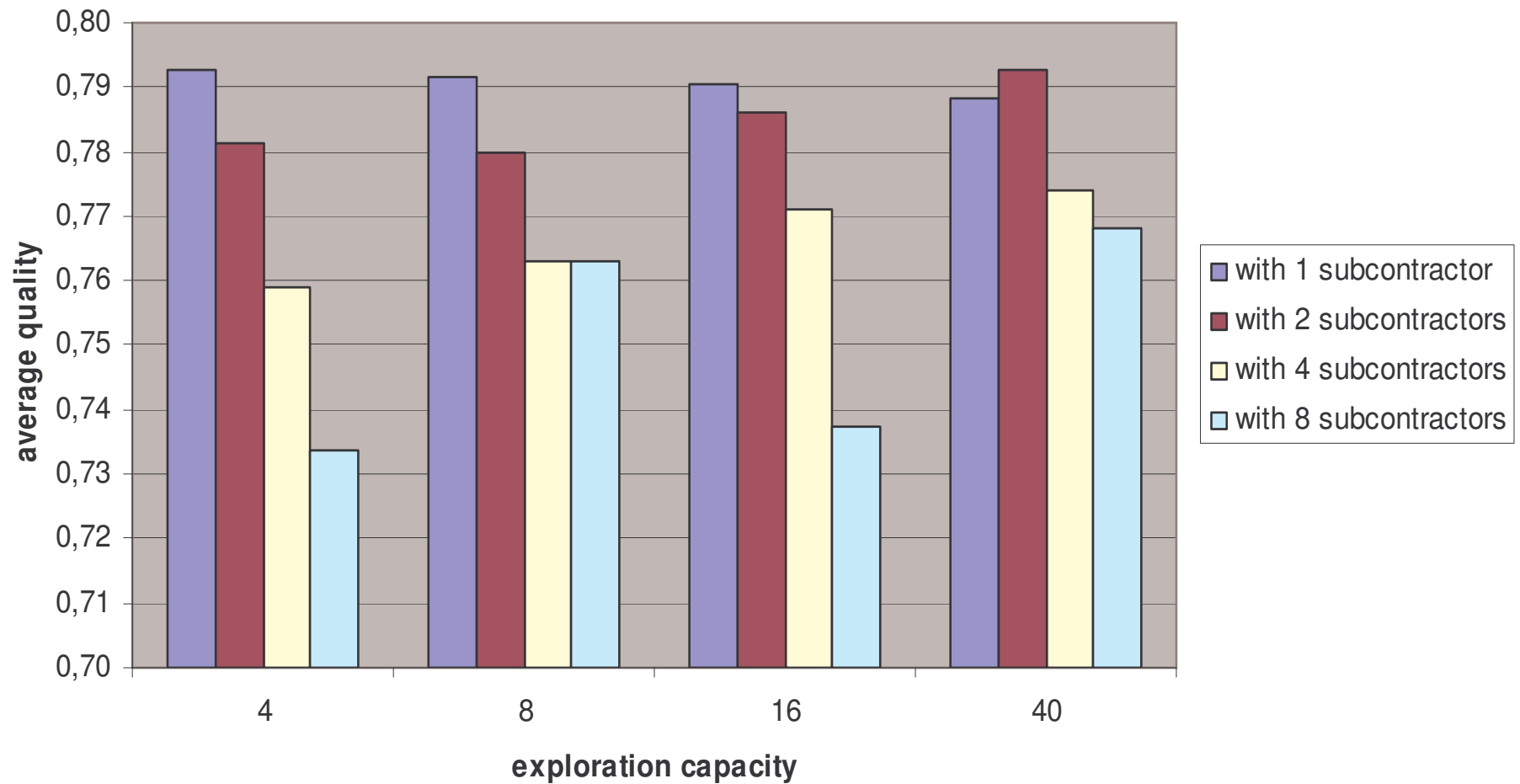
Combined effects of exploration and experimentation capacity of FT honest agents



Combined effects of exploration and experimentation capacity of FP dishonest agents



Combined effects of exploration and experimentation capacity of FT dishonest agents

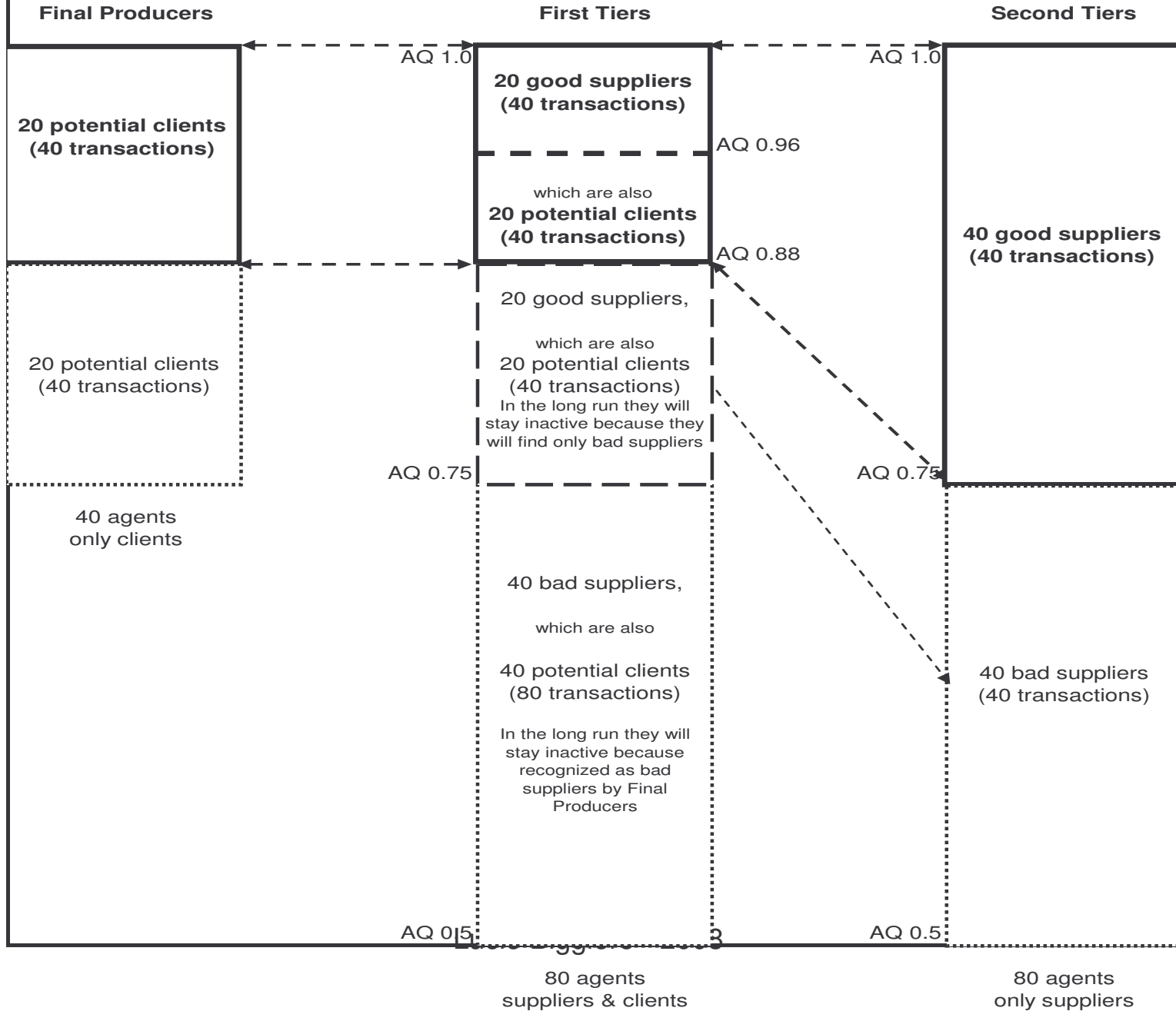


Virtual experiments parameters

Structural parameters with constant values		Cognitive parameters with constant and uniform values	
Filiere segments	3	Decision making processes	RND, DEBT, INDEBT, REBT.
Industry size	200 firms	Quality threshold	0.75
Ratio FP/FT = 1/2	40 downstream firms, 80 suppliers in intermediate segment and 80 suppliers in upstream segment.	Clients' requirement of informers' reliability	1
Quality	Randomly uniform distribution between 0.5 and 1	Number of convergent information to form reputation	4
Maximum Average Quality (AQ) with 1 supplier per client	0.88	number of intervals to forget inactivated DEBT	100
Maximum AQ with more than 1 supplier per client	up to 1.0, depending on the configuration	number of intervals to forget inactivated INDEBT	40
Minimum AQ with 1 supplier per client	0.63	number of intervals to forget inactivated REBT	60
Minimum AQ with more than 1 supplier per client	up to 0.50, depending on the configuration	number of intervals to forget inactivated informer	60
Varied structural parameters		Varied cognitive parameters	
Outsourcing degree as a measure of experimentation capacity	1, 2, 4, 8, subcontractors for each client	Number of questions as a measure of exploration capacity	4, 16, 40, 80
		Inclination to cheat	0 or 1

Interaction processes between segments

Configuration with 2 subcontractors per client



In many markets prices are not good signals

In this model price and quality carry the same information, because price is a direct function of quality

But both lose its informative utility when:

1. Agents lie;
2. It's difficult to define price or quality requirements and to check it ex-ante (i.e. experience goods, health care, house renovation, etc)

In this model prices do not help
finding the best suppliers

because

They are not good signals

It is supposed that clients can
sell any quantity depending on
purchasing quality

Decision and information space

Suppliers \longrightarrow Decision space (DS)

$DS(\Sigma REBT + \Sigma INDEBT)$ \longrightarrow Information space

