

# The relative advantages of efficiency and redundancy in facing with environmental shocks and the moderating effects of agents' opportunism

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Redundancy indicates an excess of something respect to its minimum requirement

rules or signals (information theory), variety (cybernetics), links among nodes (network analysis),

**Economics:** *inefficiency due to slack resources*

that is  
costs higher than possible minimum

# ***slack resources***

Multi-dimensional concept (phenomenon):  
slack of what types of resources?

however

Typically treated by standard economic theory as  
mono-dimensional in terms of total costs

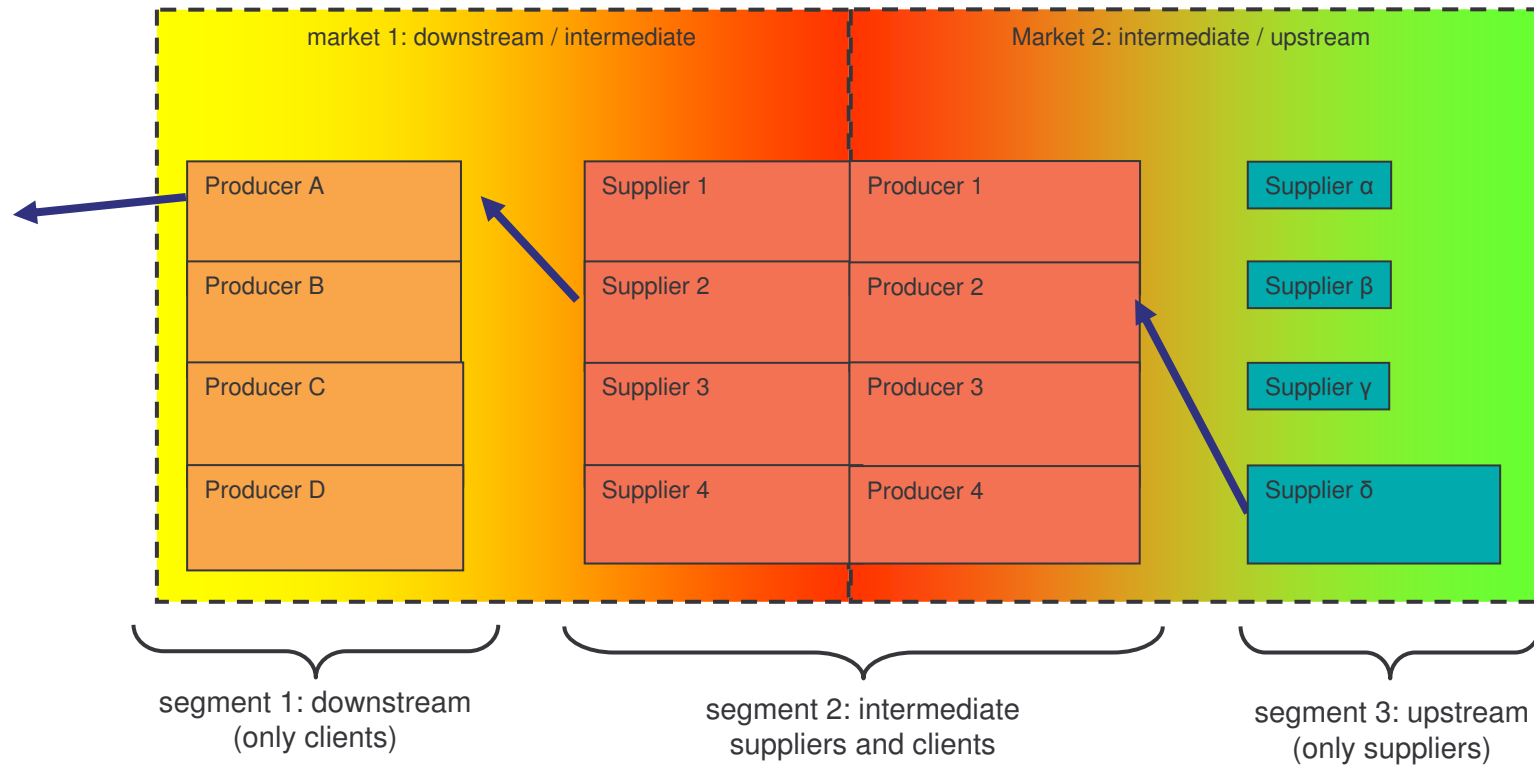
**Here it refers to knowledge resources of  
firms within an industry**

# Dominant view

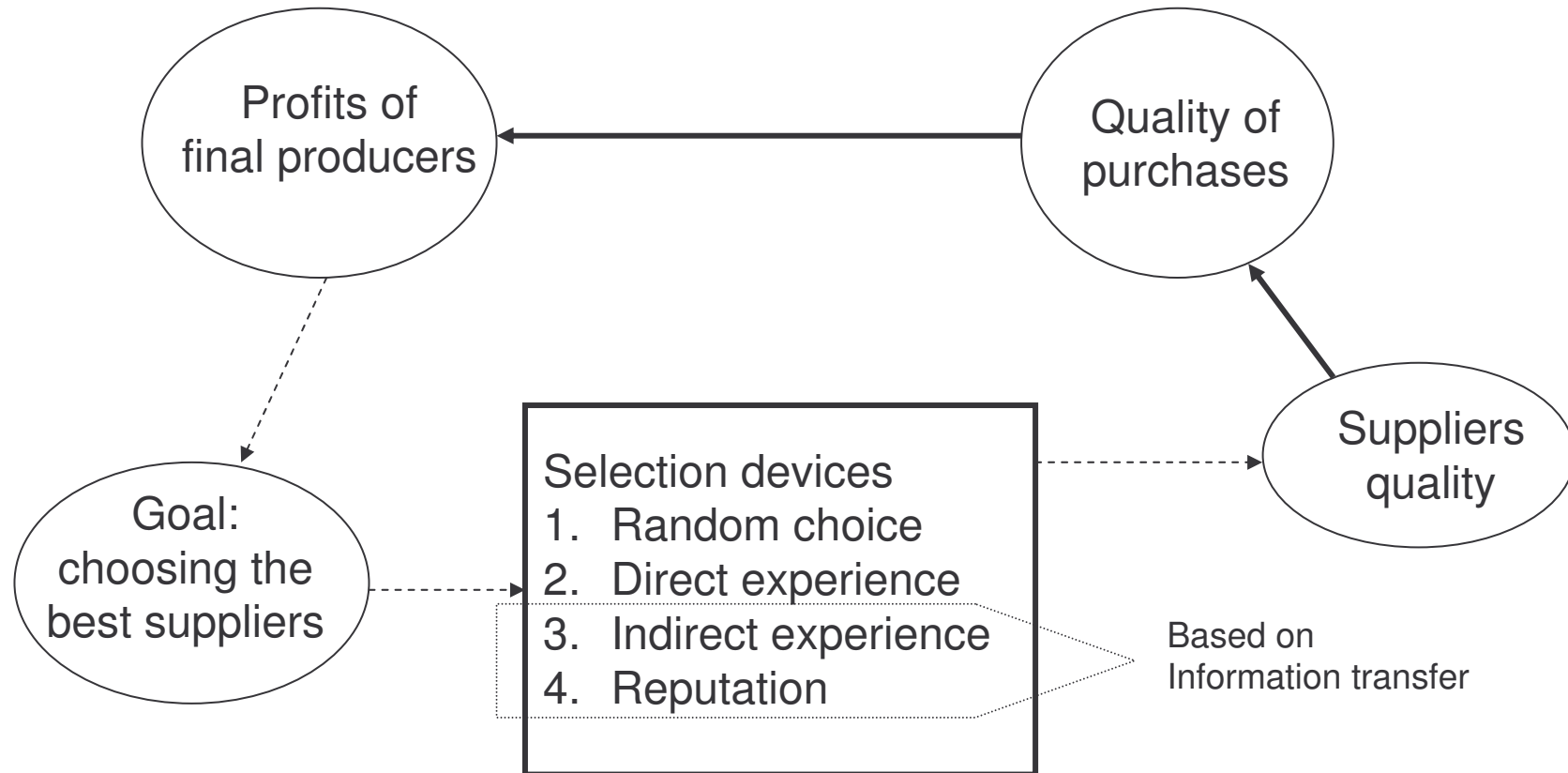
- Inefficiency is bad because it reduces profits
- More knowledge is costly, because information and its treatment are costly
- The key question is whether the environment is stable or uncertain

# Filiere and market structure

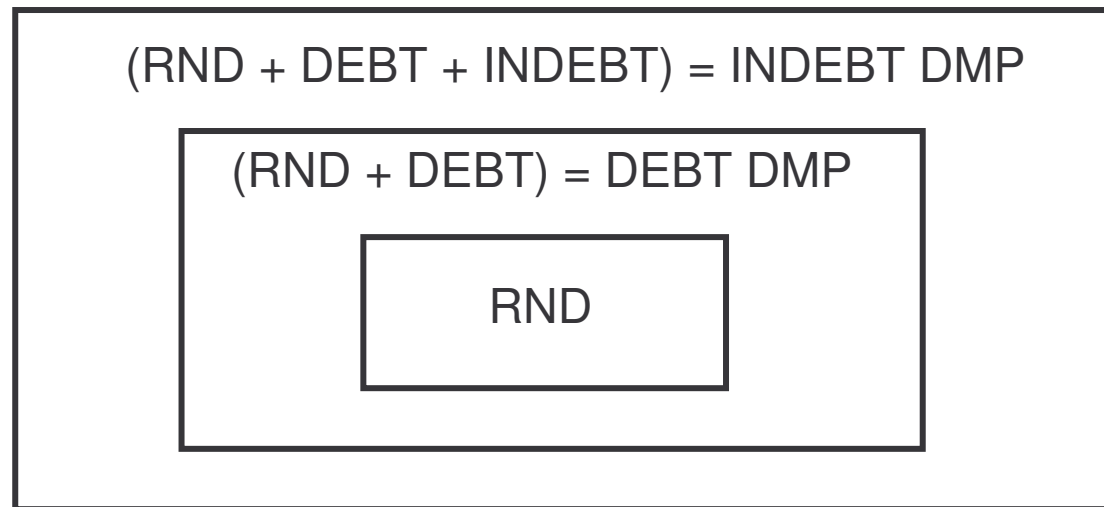
## Sequential Technology



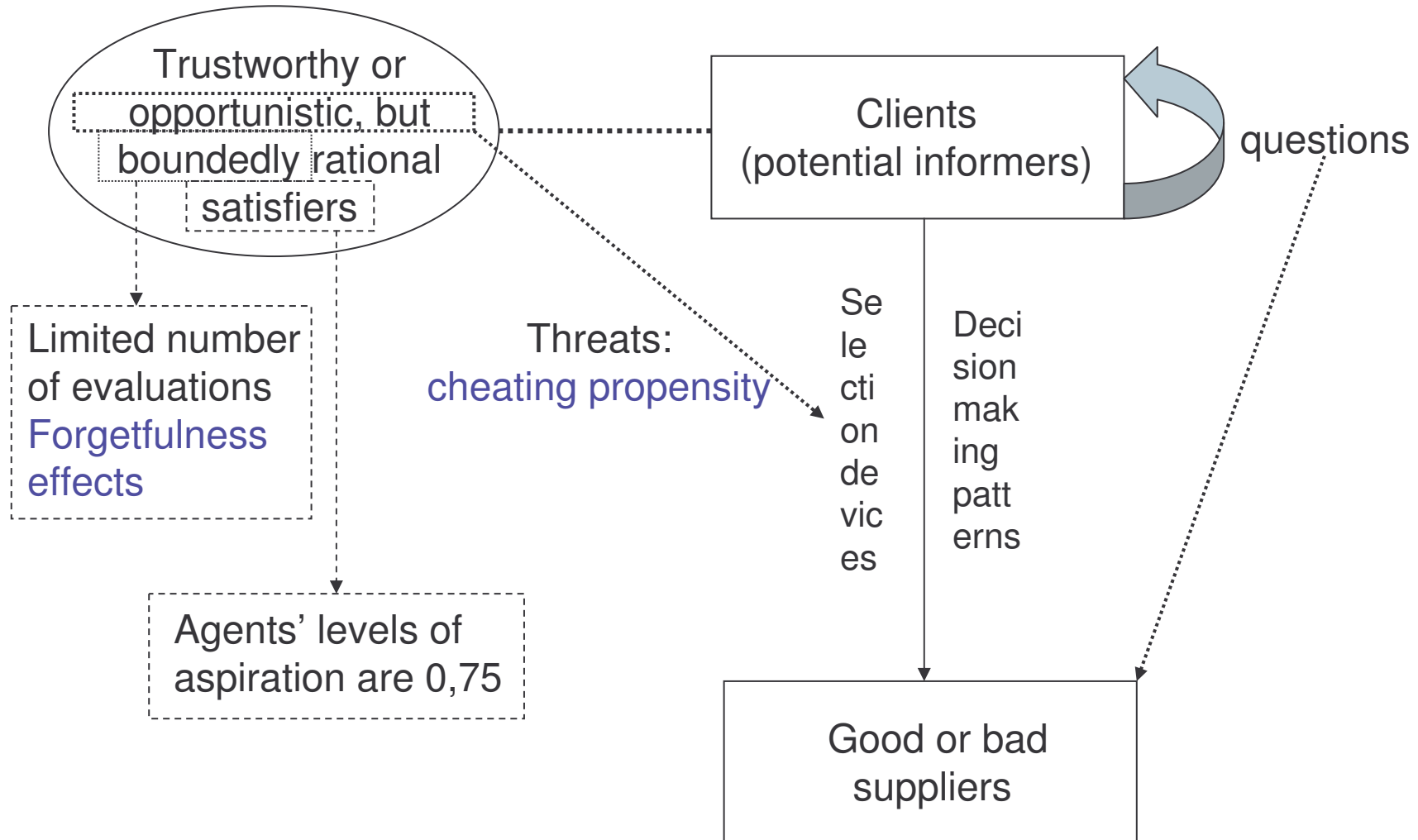
# The general structure



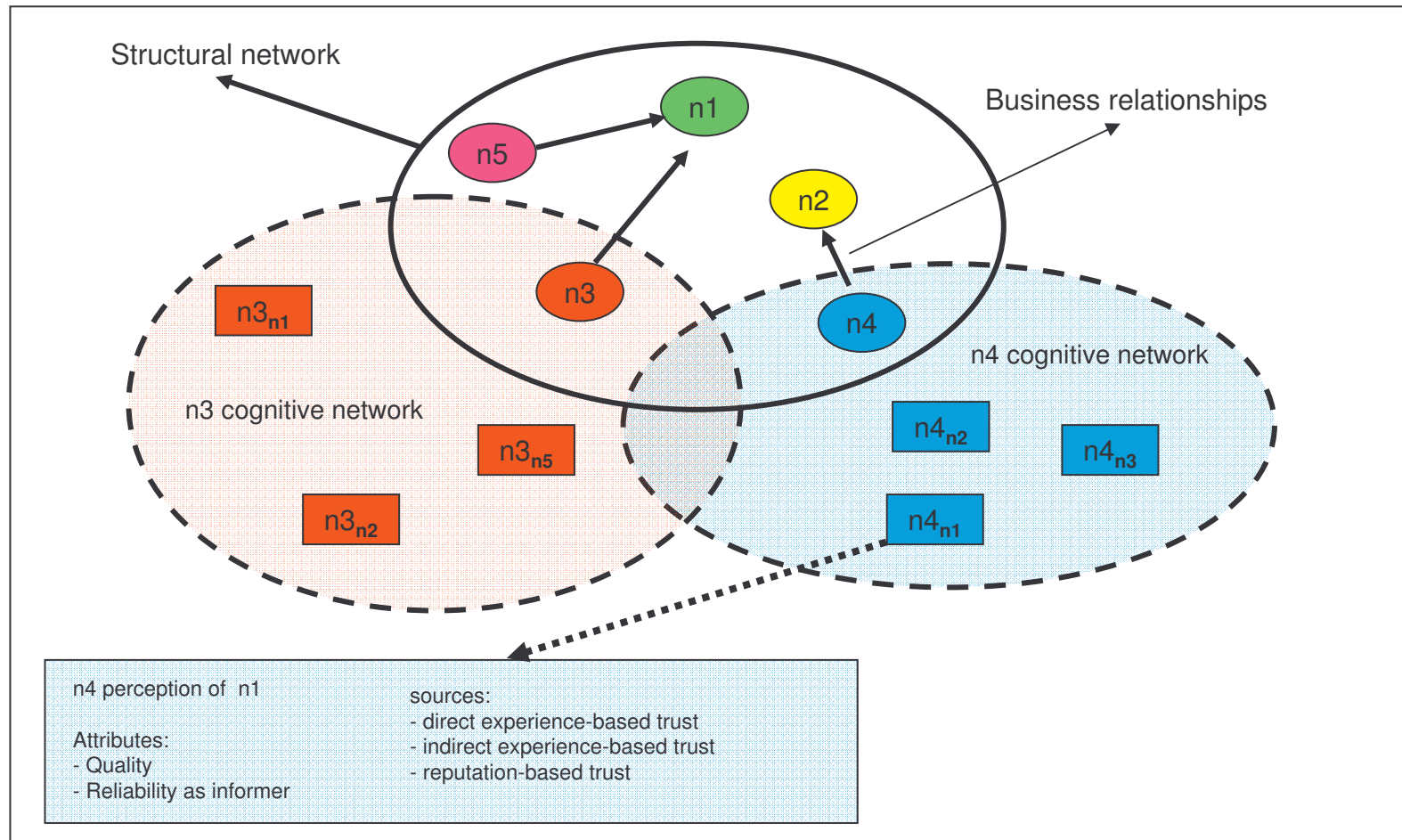
# The nested complexity of decision-making patterns (DMP)



# The nature of agents and their selection processes



# The interaction between trade and cognitive networks



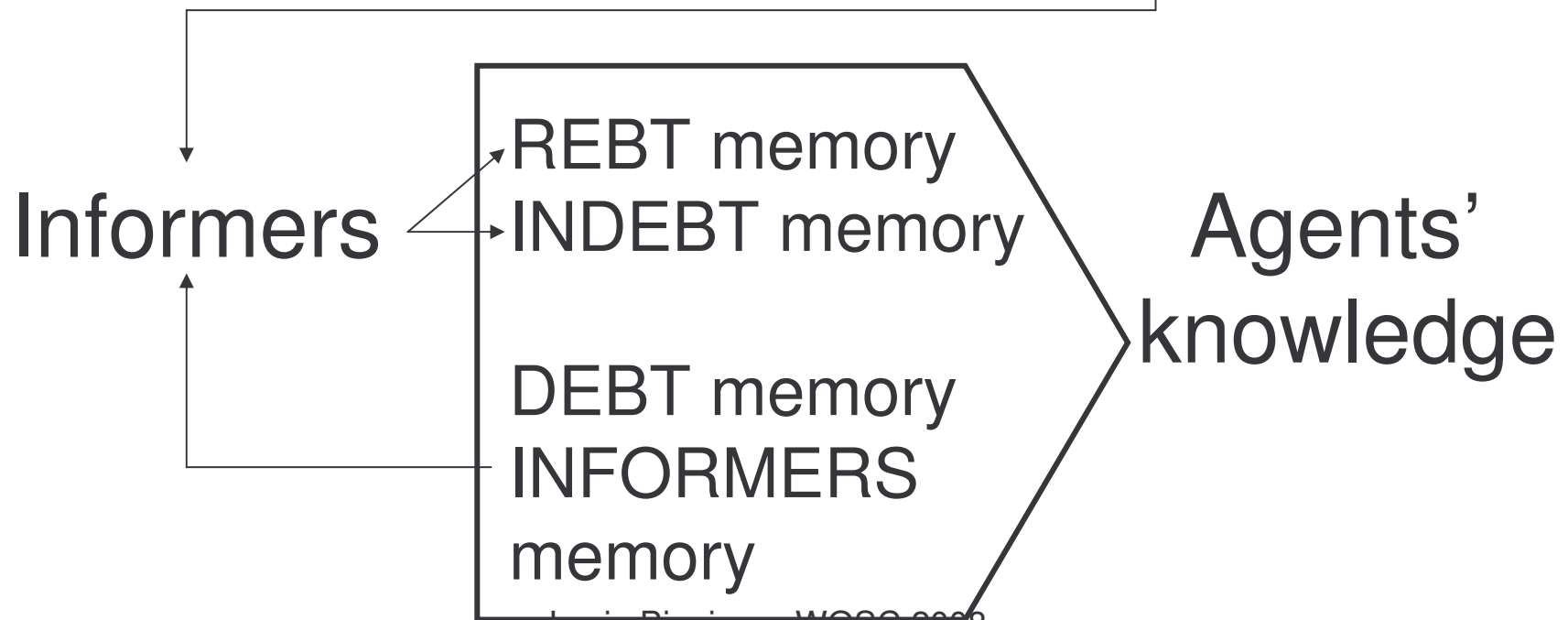
# Agents' (uniform) behavior

- They do not learn: they just compare past and present
- 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

# Decision and information space

Suppliers  $\longrightarrow$  Decision space (DS)

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



# Research questions

- 1) Does information exchange improve performance?
- 2) Does opportunism (cheating behavior) damage performance?
- 3) Does knowledge redundancy help facing with environmental shocks?
- 4) Do industry segments perform in the same way under the same circumstances?

# 400 intervals

In each interval all the operations are finalized:

- Selecting reliable informers;
- Asking questions;
- Updating memory;
- Making decisions;
  
- Placing orders;
- Producing;
- Paying;
- Getting outcomes;
- Updating memory (good or bad supplier; reliable or unreliable informer)

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

This model has been written with LSD platform and language

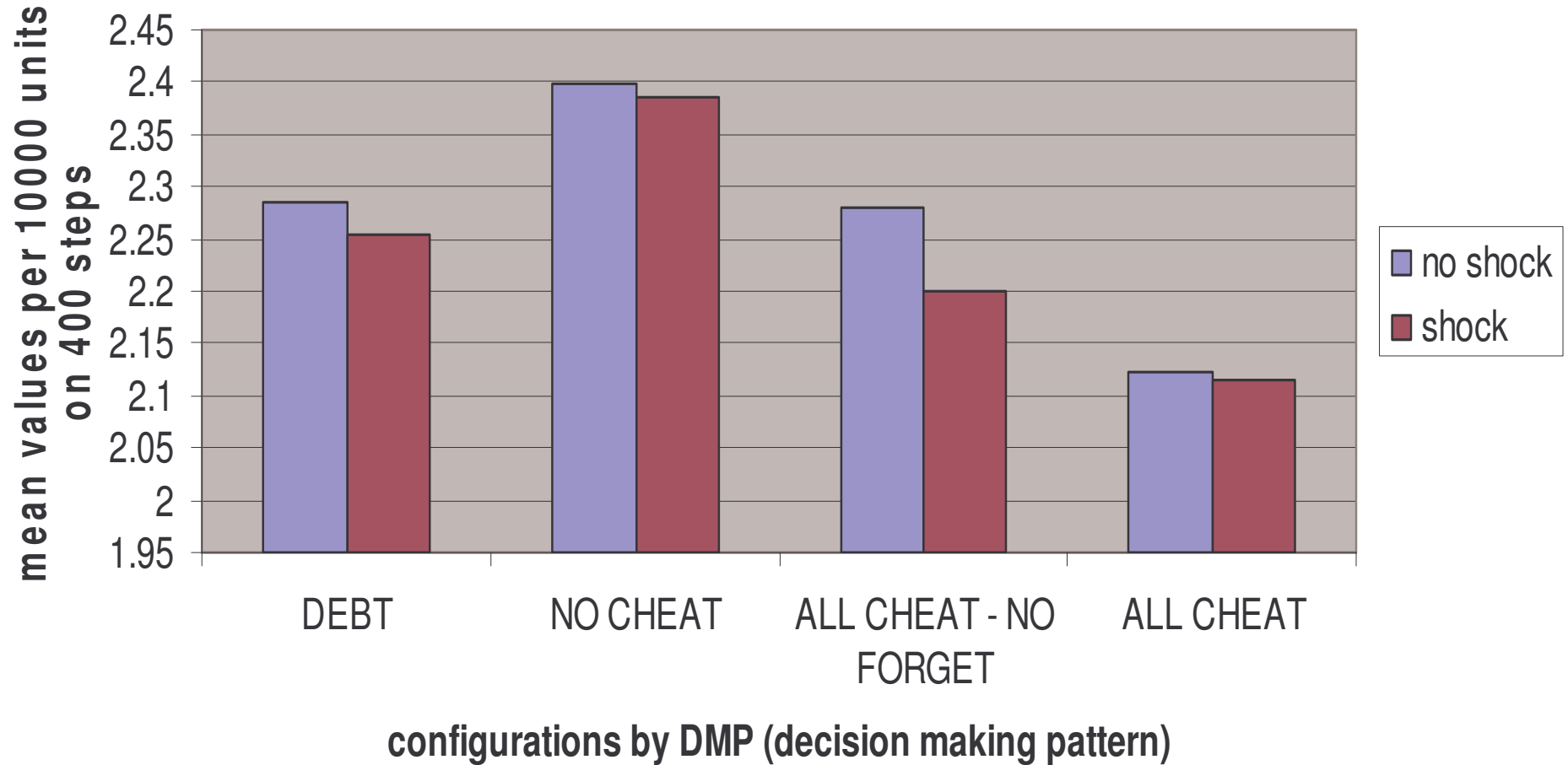
It is based on a more general model called **CIOPS** (Cognitive Inter-organizational Production System), which I built with Enrico Sevi

Its detailed structure and source code will be uploaded soon on [www.knownetlab.it](http://www.knownetlab.it)

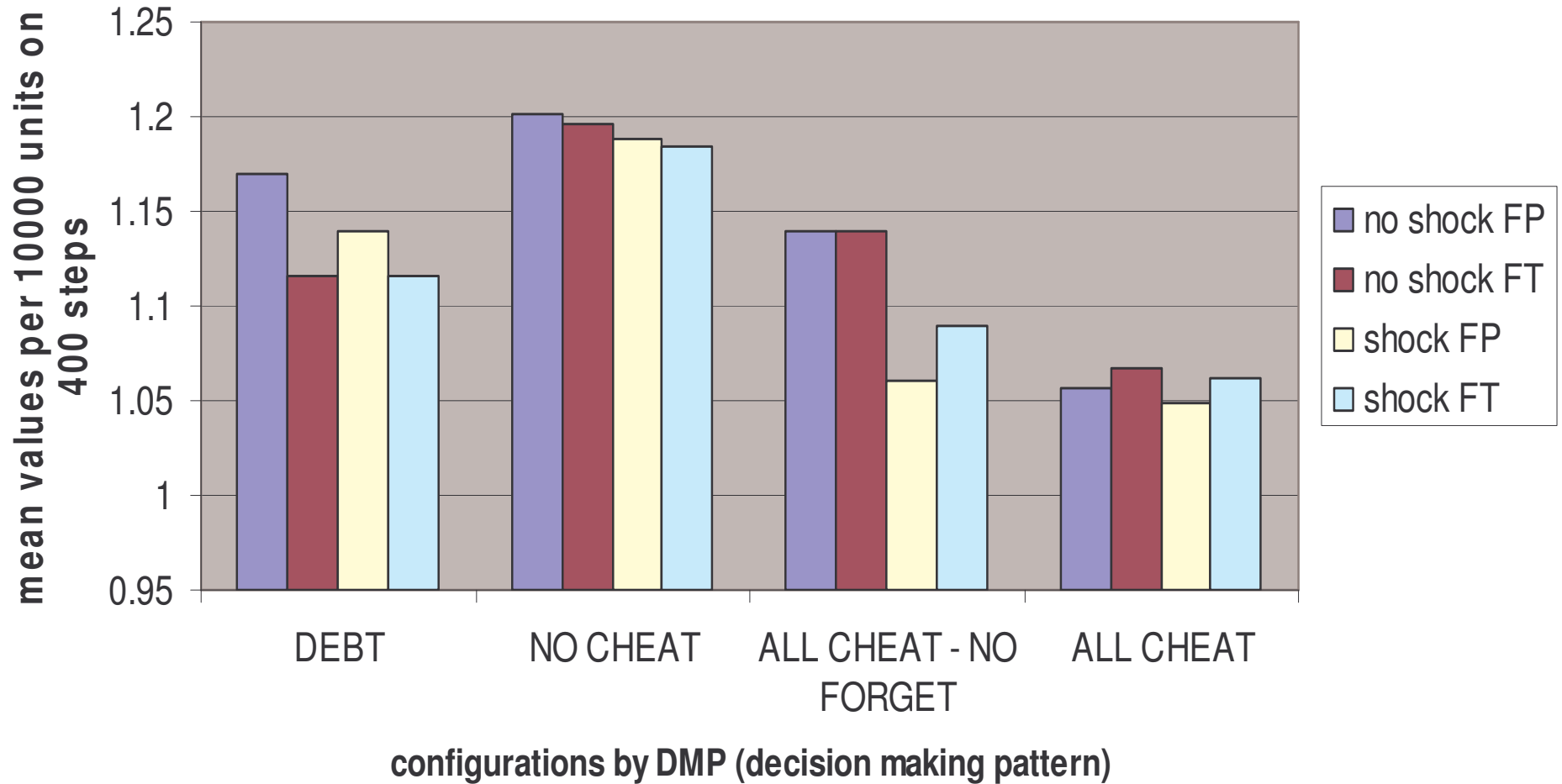
Industry competitiveness is measured in terms of average quality, total profits, total cumulated profits, knowledge efficiency and neutralization time

	INDEBT – DEBT DMP Comparisons							
	without shock				with shock			
	FP		FT		FP		FT	
	AQ	TP	AQ	TP	AQ	TP	AQ	TP
DEBT	0.87	1.17	0.86	1.12	0.86	1.14	0.86	1.12
INDEBT no cheating	0.88	1.20	0.87	1.20	0.87	1.19	0.87	1.18
INDEBT all cheating	0.85	1.06	0.85	1.07	0.84	1.05	0.85	1.06

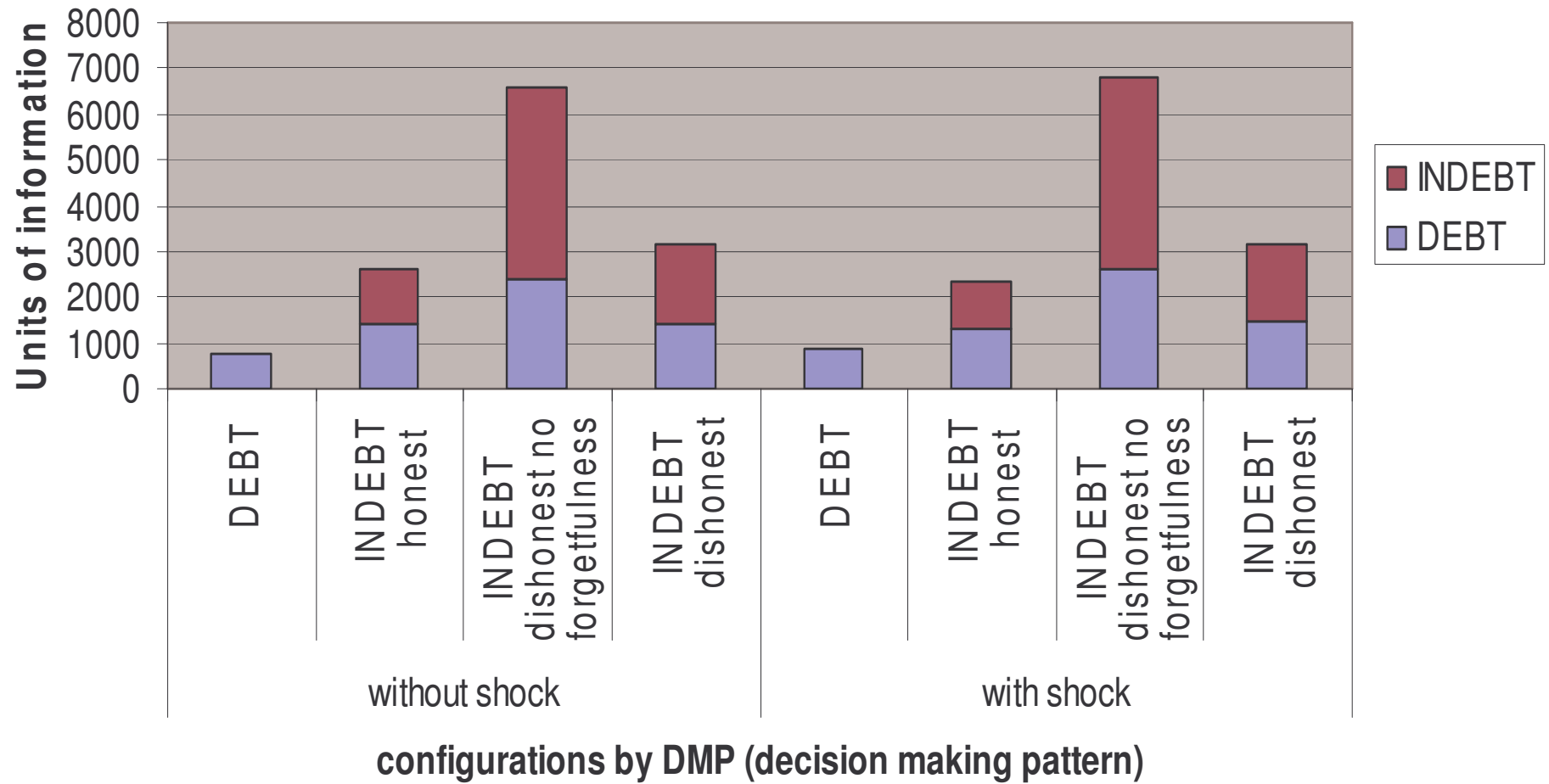
## Total profit of the whole industry

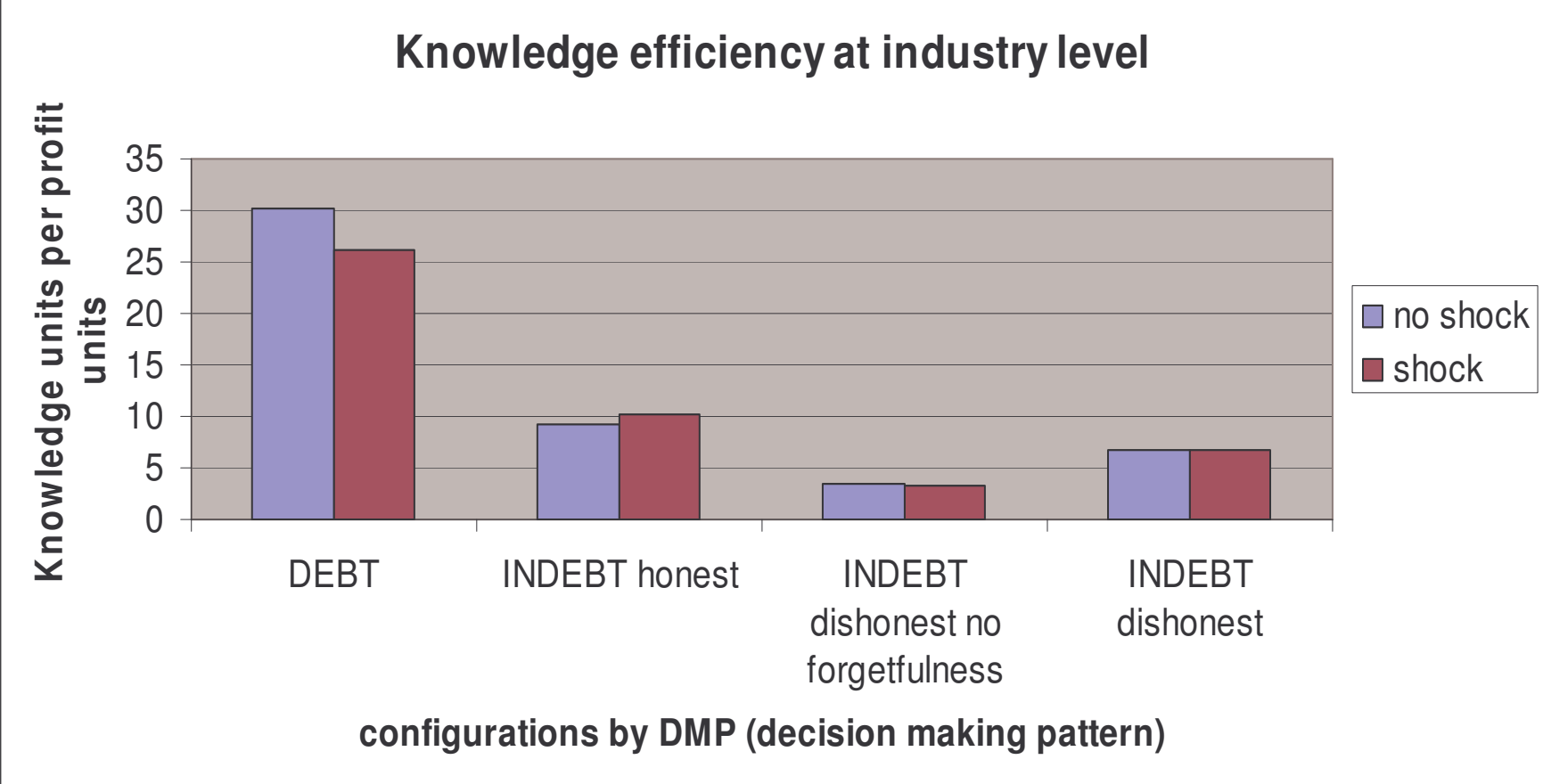


## Total profit by industry segment



## Knowledge used in the whole industry





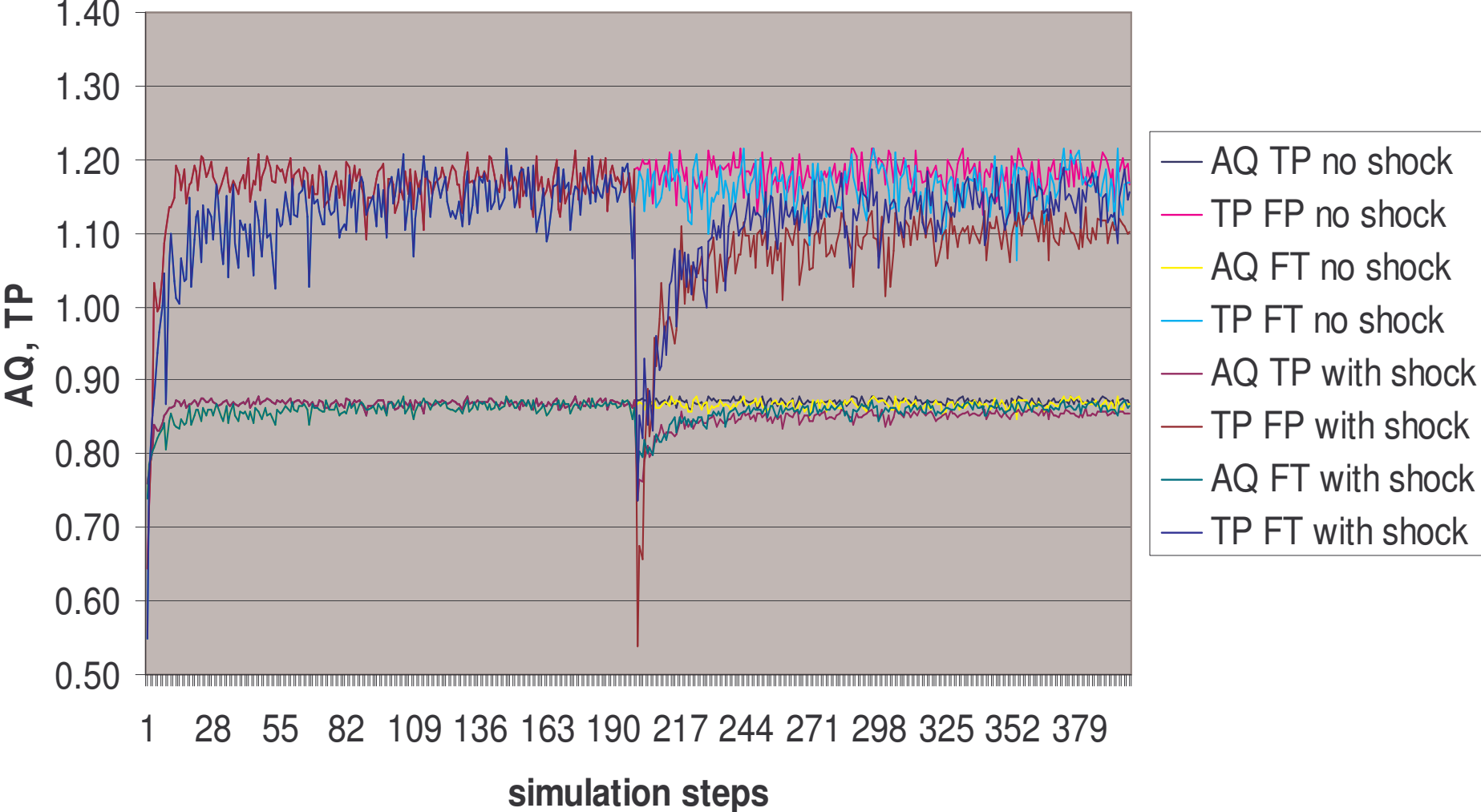
	<b>Profit variation among DMP</b>	
	<b>no shock</b>	<b>shock</b>
<b>Final Producers</b>		
<b>DEBT-INDEBT honest</b>	<b>2.68%</b>	<b>6.55%</b>
<b>INDEBT honest - INDEBT dishonest</b>	<b>-12.11%</b>	<b>-10.23%</b>
<b>DEBT - INDEBT dishonest</b>	<b>-9.75%</b>	<b>-4.35%</b>
<b>First Tiers</b>		
<b>DEBT-INDEBT honest</b>	<b>4.67%</b>	<b>6.10%</b>
<b>INDEBT honest - INDEBT dishonest</b>	<b>-12.29%</b>	<b>-10.34%</b>
<b>DEBT - INDEBT dishonest</b>	<b>-8.20%</b>	<b>-4.86%</b>
<b>Whole industry</b>		
<b>DEBT-INDEBT honest</b>	<b>3.66%</b>	<b>6.33%</b>
<b>INDEBT honest - INDEBT dishonest</b>	<b>-12.20%</b>	<b>-10.28%</b>
<b>DEBT - INDEBT dishonest</b>	<b>-8.98%</b>	<b>-4.61%</b>

	INDEBT – DEBT DMP Comparisons		
	no shock	shock	
	TotCumProf	TotCumProf	Profit loss
Final Producers	Abs. val.	Abs. val.	
DEBT	468	446	<b>4.70%</b>
INDEBT- honest	481	475	<b>1.11%</b>
INDEBT-dishonest	422	427	<b>-1.00%</b>
First Tiers			
DEBT	457	446	<b>2.34%</b>
INDEBT-honest	479	474	<b>1.00%</b>
INDEBT-dishonest	420	425	<b>-1.21%</b>
Whole industry			
DEBT	925	893	<b>3.53%</b>
INDEBT-honest	959	949	<b>1.05%</b>
INDEBT-dishonest	842	851	<b>-1.11%</b>

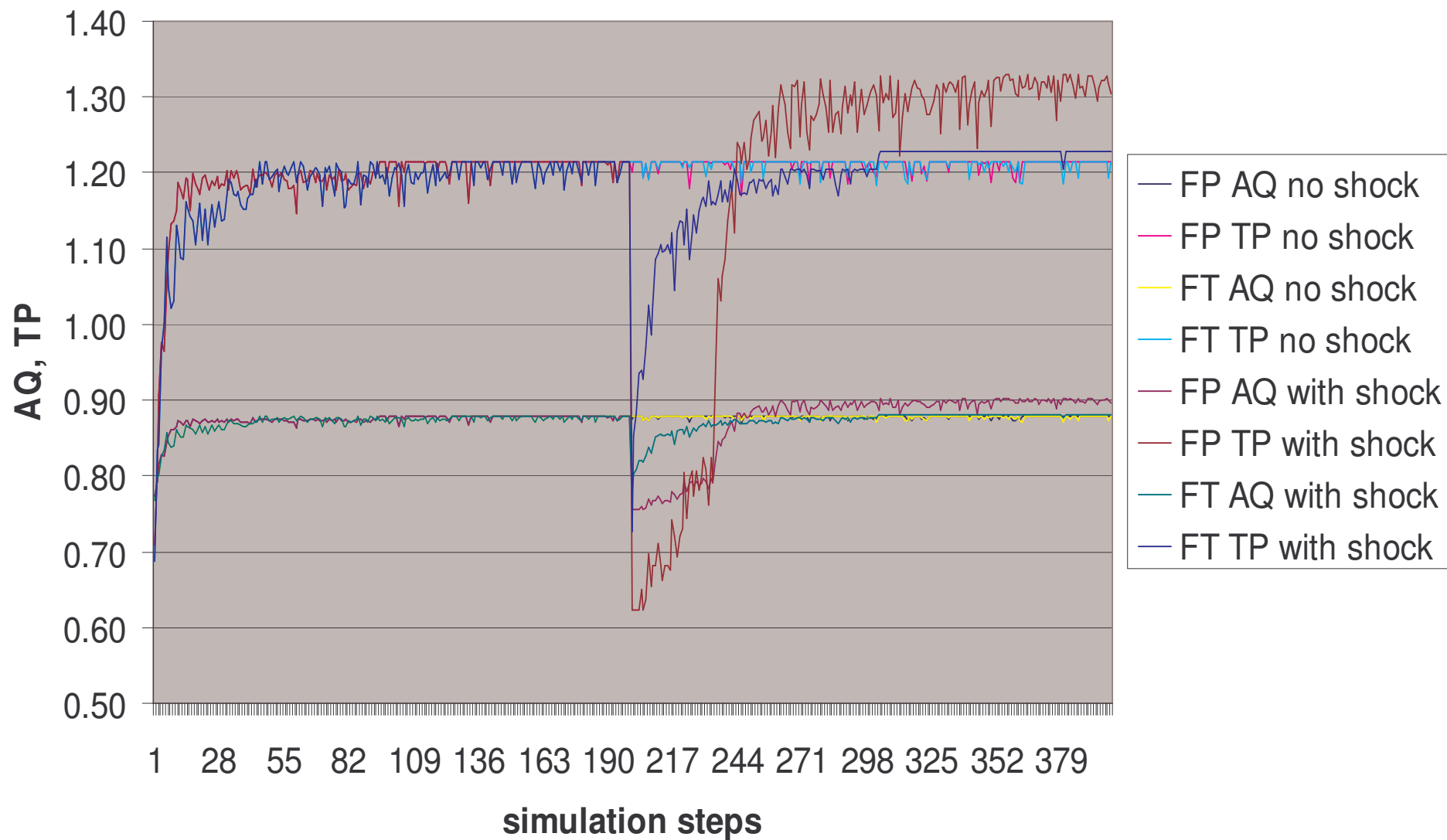
## *Shock contingent profit loss and neutralization time*

	<b>Impact of shock on different DMPs</b>			
		Profit loss	Profit loss	steps to neutralize
Final Producers		Abs. val.	% TotCumProf	
DEBT-shock		22	4.70%	<b>200</b>
INDEBT-honest-shock		18.4	3.83%	<b>43</b>
INDEBT-dishonest-shock		0.22	0.05%	<b>2</b>
First Tiers				
DEBT-shock		6	1.33%	<b>45</b>
INDEBT-honest-shock		6.39	1.33%	<b>103</b>
INDEBT-dishonest-shock	No impact (because chaotic)			

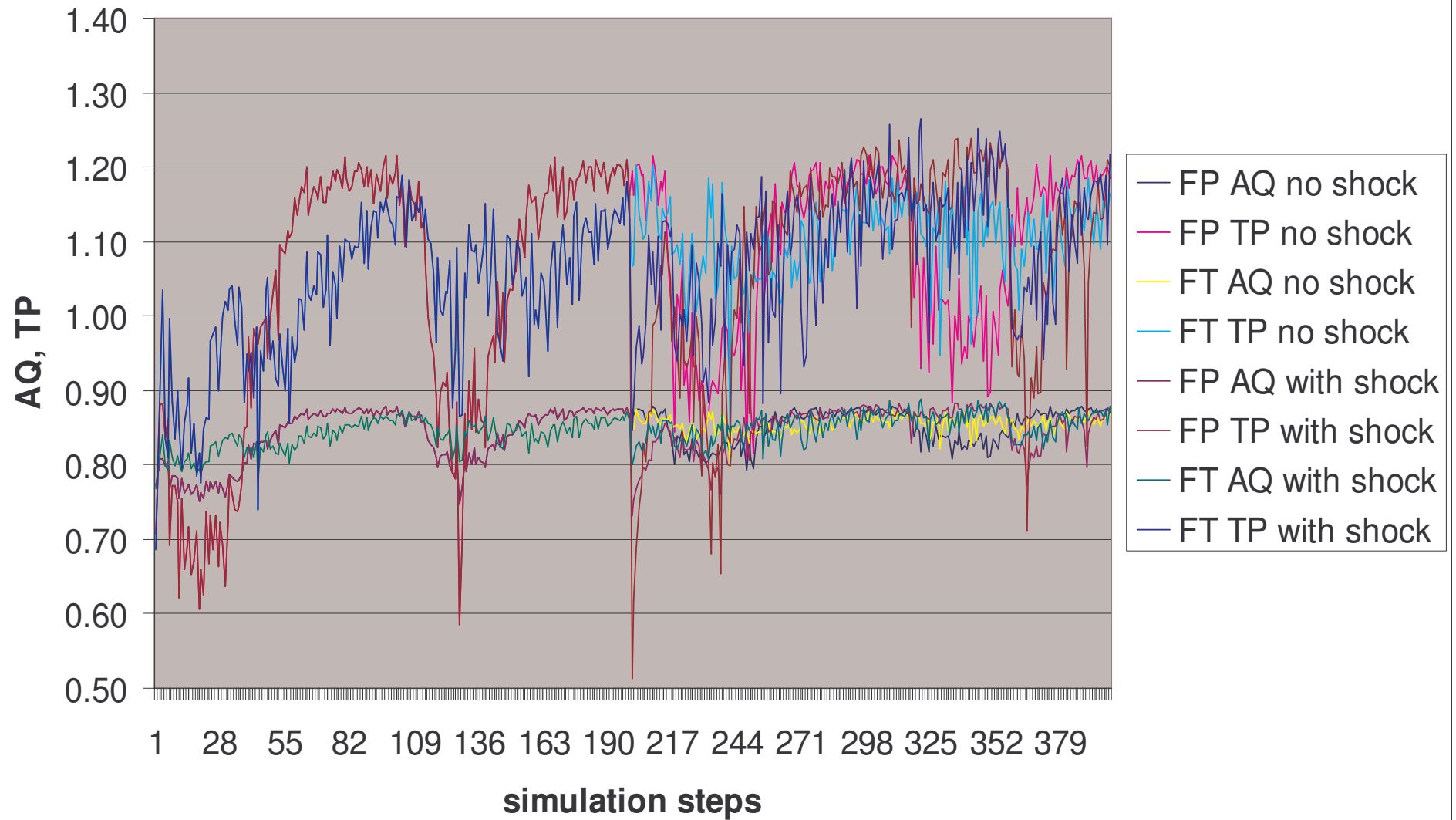
# Performance with DEBT DMP



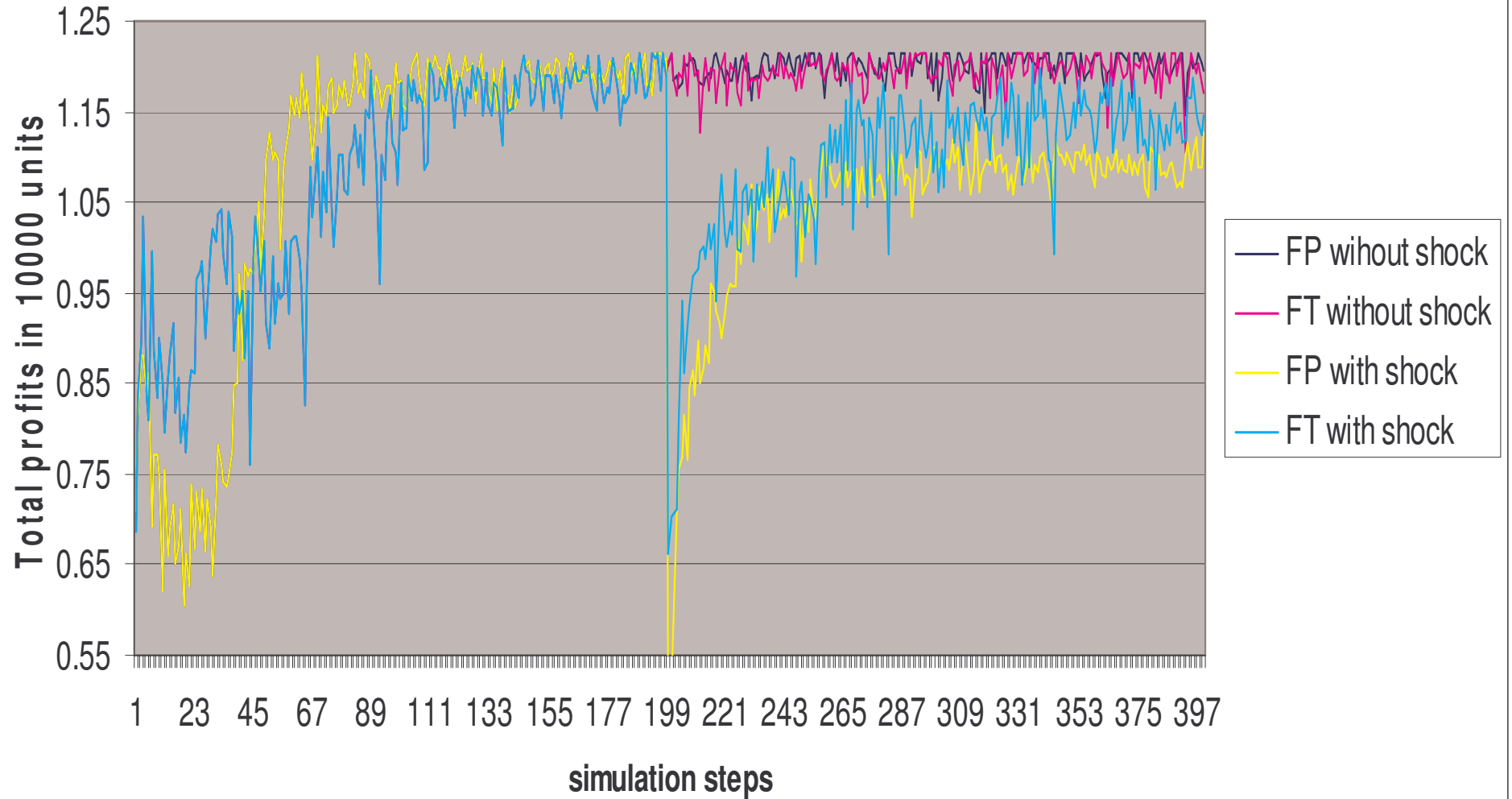
## Performance with INDEBT DMP of honest agents



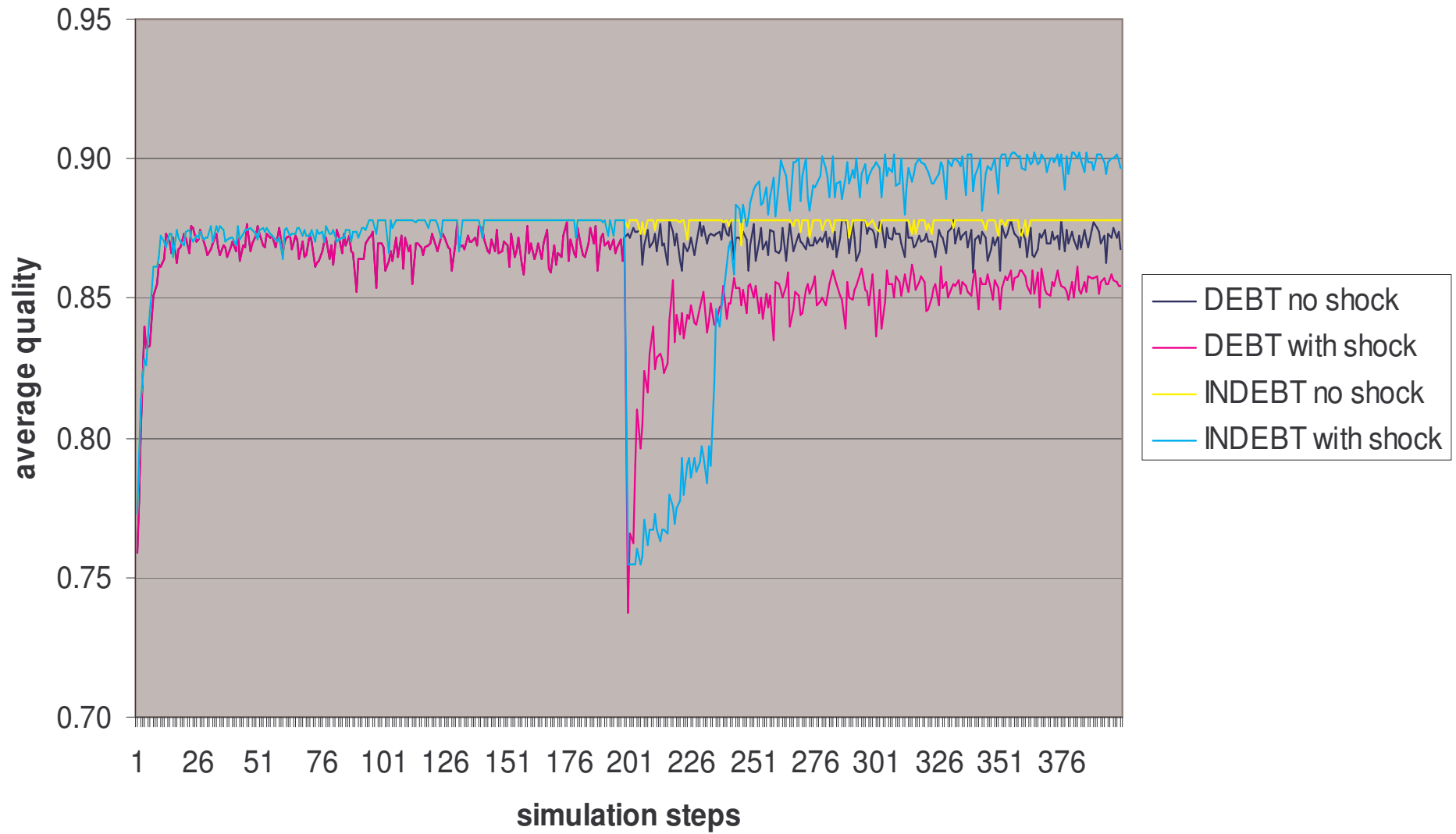
## Performance with INDEBT DMP of cheating agents



## Dishonest FP & FT without forgetfulness effects



# Honest FP performance with DEBT and INDEBT DMP



# Conclusions (1)

- When firms exchange information its competitiveness increases
- Opportunism brings competitiveness under the level of knowledge transfer absence
- With knowledge transfer firms reduce the negative impact of environmental shocks
- Knowledge redundancy increases with knowledge transfer and opportunism, but neutralization time and cumulated profits do increase

# Conclusions (2)

- *In highly uncertain environments knowledge redundancy is a competitive advantage*
- With full dishonest agents Total Profits have a chaotic behavior
- Forgetfulness mechanisms impact heavily with dishonest agents
- Its effects are similar to those of environmental shocks

# 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

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