DISTRIBUTION NETWORKS IN THE RUSSIAN CHEMICAL INDUSTRY

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Russian Environment

- Instability / unpredictability of markets
- Lack of information on potential partners
- High propensity to opportunistic behavior

Distribution networks

- Shift in distribution channels' structure
- Cutting number of distributors in many industries
- Internationalization
- Instable relationships

PVC market

The chosen market segment is polymerized vinyl chloride (PVC) market

An impressive dynamics during the decade:

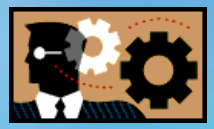
- 2000-2007 2.4 times growth
- 2008-2009 the dynamics became slower, in 2009 there was a remarkable reduction of PVC consumption in Russia due to crisis
- Still, some companies managed further growth


ЗАО Русхимсеть
Operates in Russia since 2000
Provides wide range of chemicals, mainly for small and medium producers
Annual turnover 50 Mn USD
МЕНЕДЖМЕНТ

Distribution Network

Actors in the network

- **Producers of chemicals (domestic and foreign)**



- **Customers**

- **Transport Cos (international and domestic)**

- **Finance Agents (banks, insurance companies)**

- **Local Authorities (tax administration, customs, etc)**


Domestic flow
European flow
Asian flow
Arctic Ocean
Greenland (Denmark)
Iceland
Canada
Alaska (USA)
North Pacific Ocean
United States of America
North Atlantic Ocean
South Pacific Ocean
Brazil
South Atlantic Ocean
Russia
Mongolia
India
Indian Ocean
Australia
New Zealand
Southern Ocean
Antarctica
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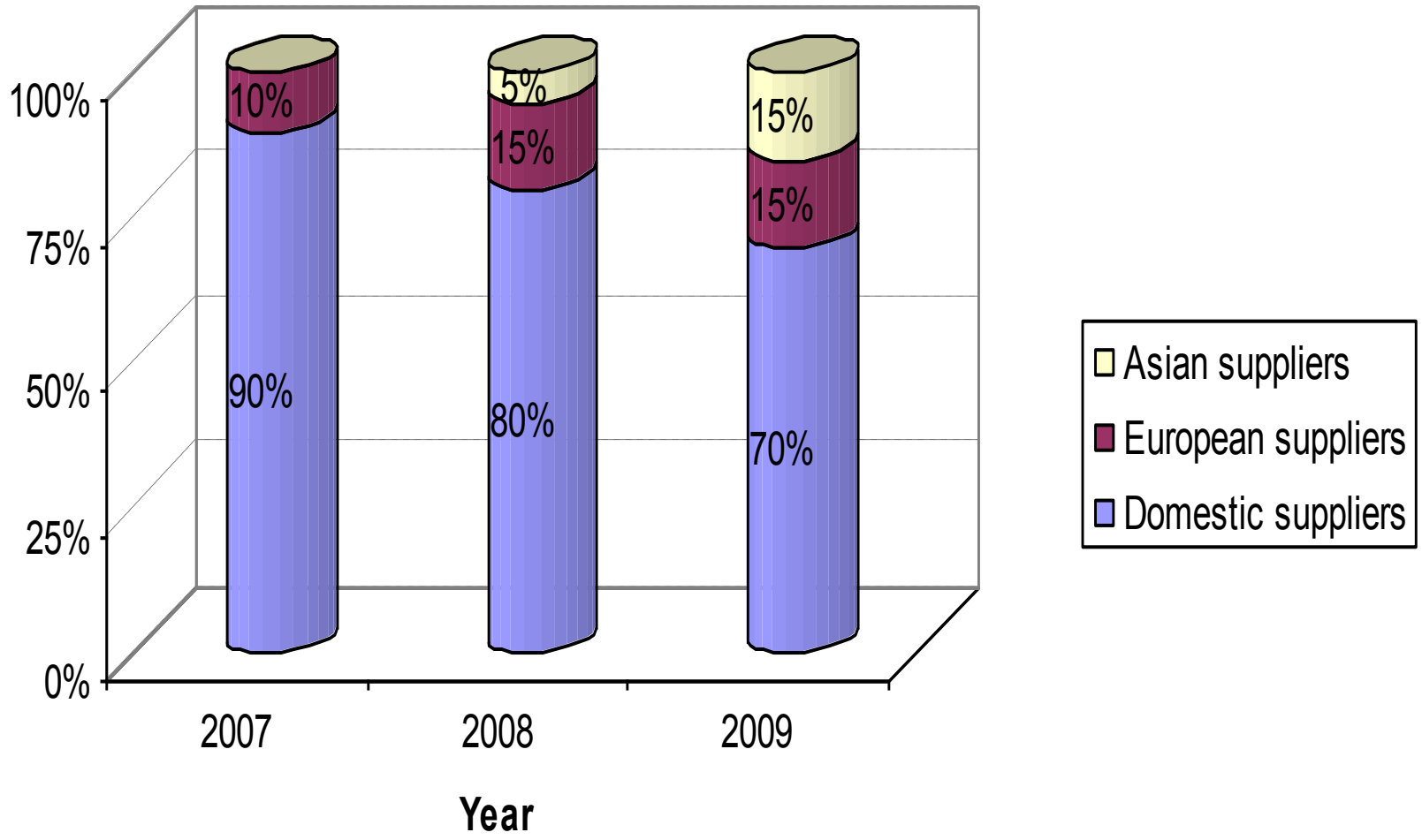
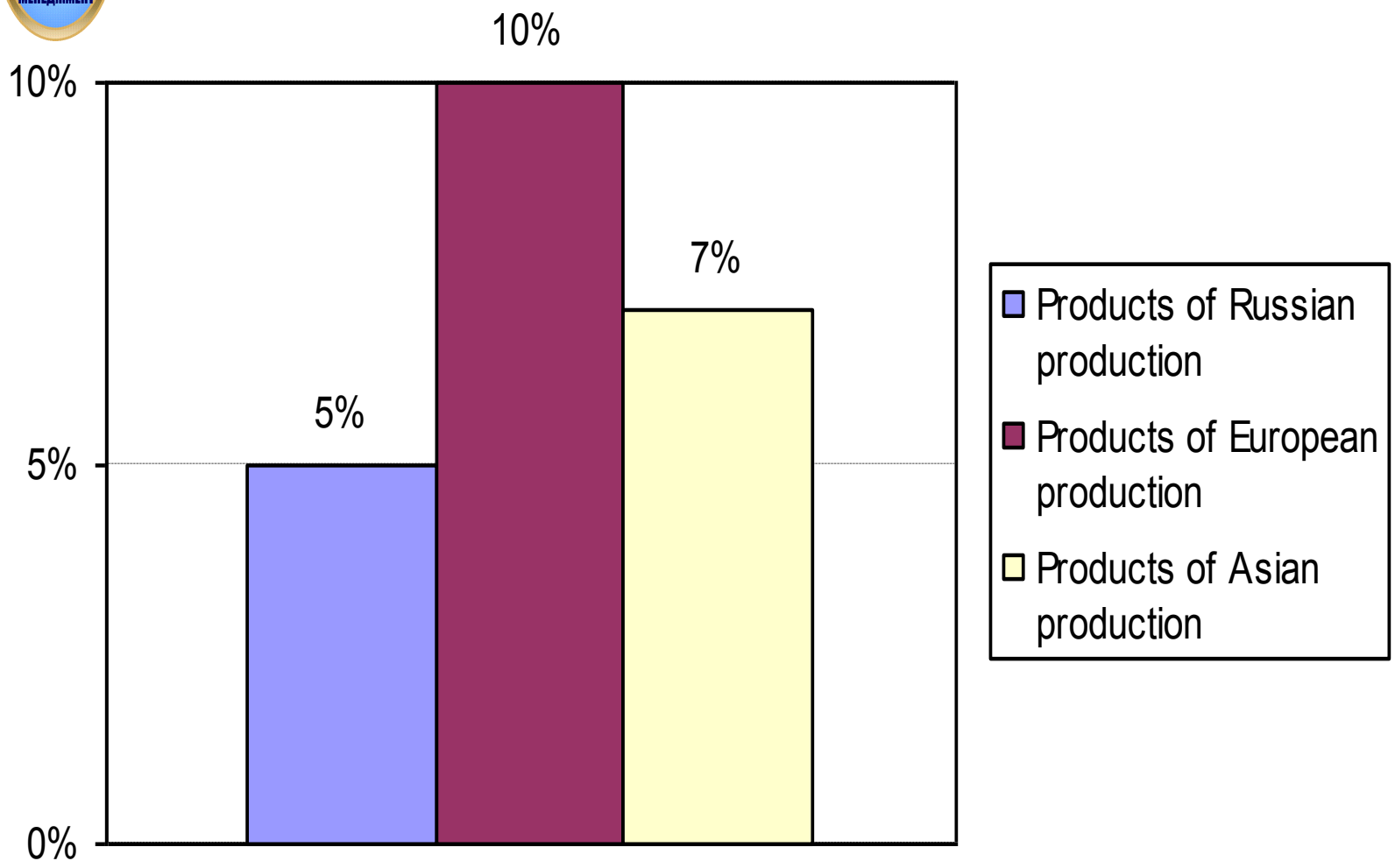
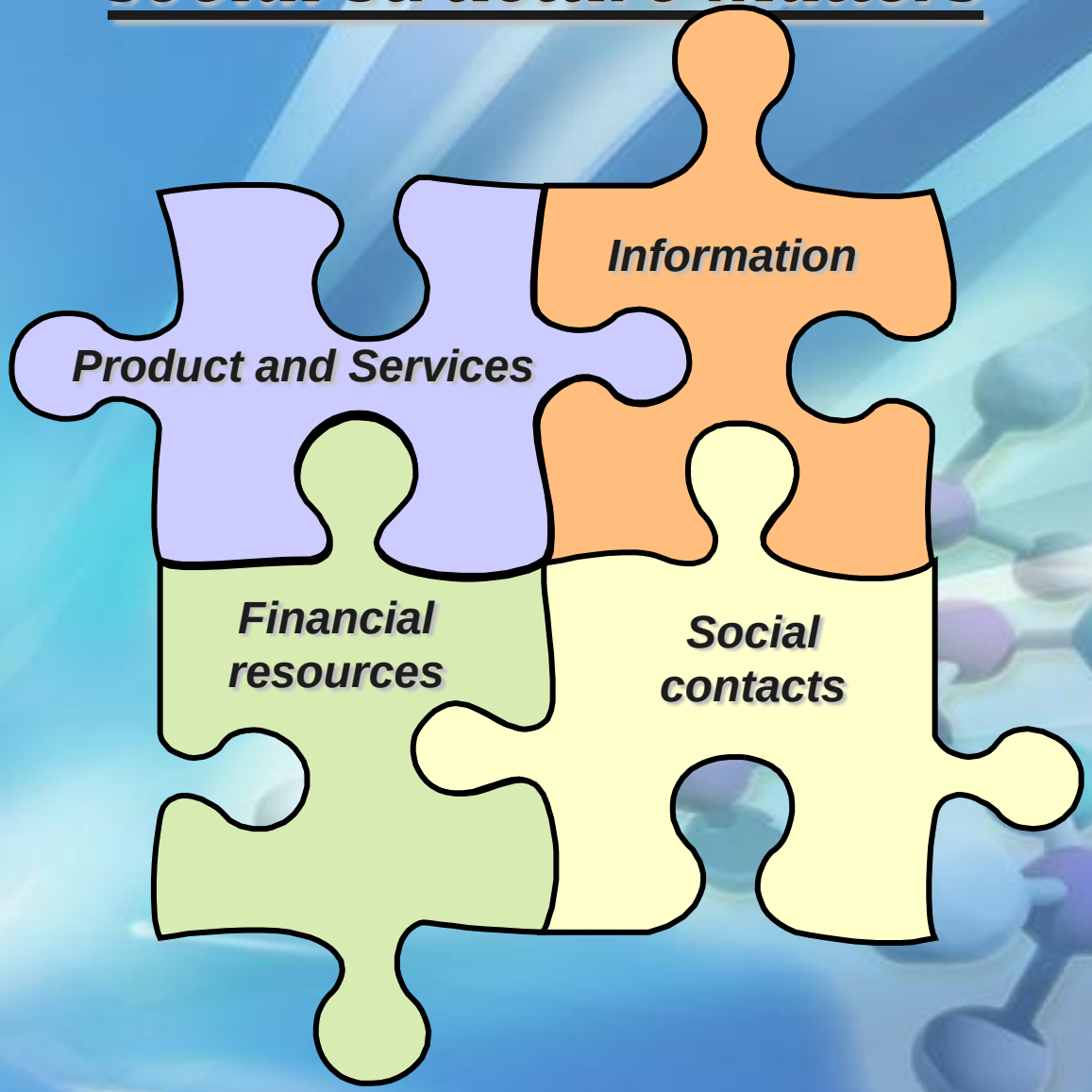
Product structure dynamics



Average profitability of product sales



Distribution network formation: social structure matters



Network Formation Models

Two main types:

1. Using game theory tools examining actors (persons, organizations) as exercising discretion in forming relationships
2. Based on random graph theory considering economic or social relationship as a random variable

   Advanced random-based models of networks take into consideration the most basic network property that the presence of links tends to be correlated. On an intuitive level, models of network formation where links are formed independently tend to look too much like ‘trees’, while observed social and economic networks tend to exhibit substantial clustering, with many more cycles than would be generated at random (Watts, 1999).

Markov graphs

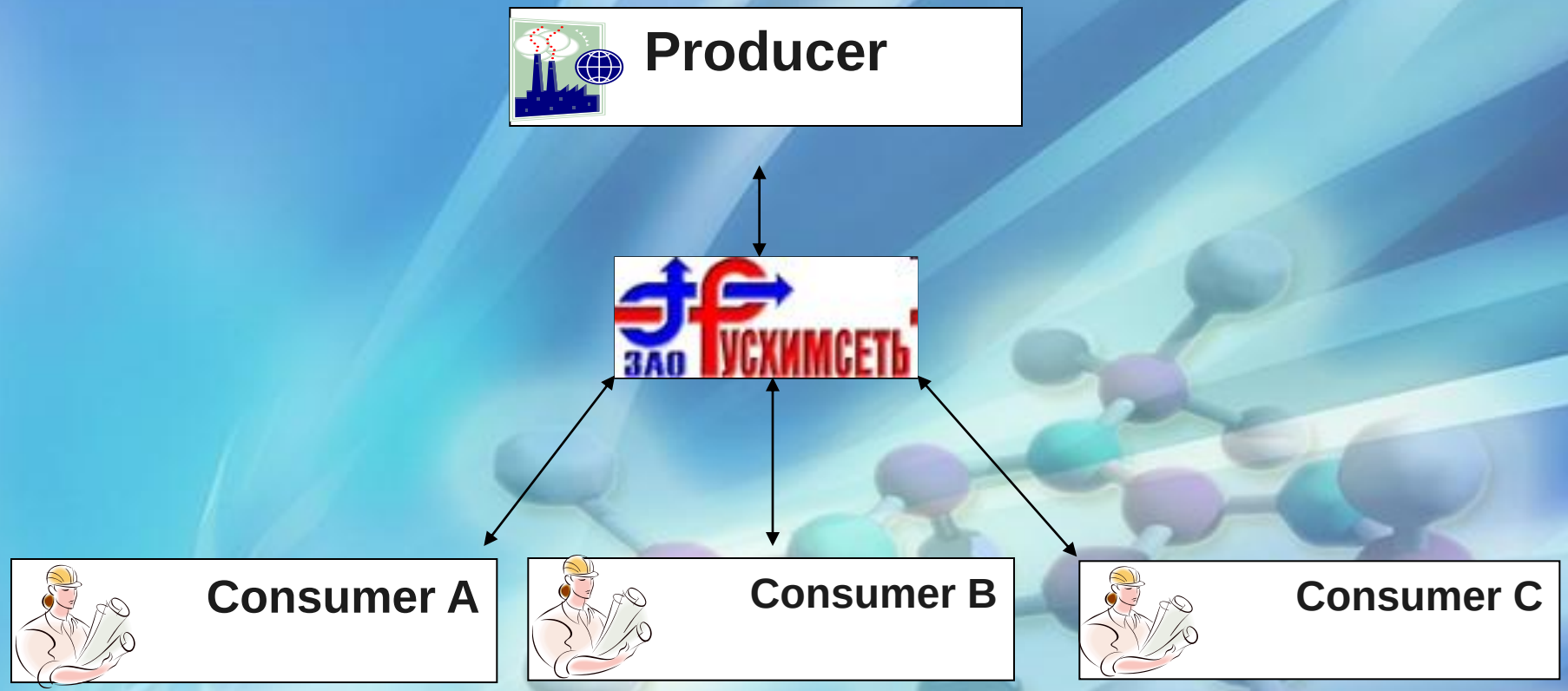
Frank and Strauss (1986) identified a class of random graphs which they called ‘Markov graphs’.

Their idea is as follows: a link forms to be dependent on whether or not neighboring links are formed.

Specific interdependencies require special structures, because, for instance, making one link dependent on a second, and the second on the third, can imply some interdependencies between the first and third.

These sorts of dependencies are difficult to analyze but some special versions of such models have been useful in statistical estimation of networks (Jackson, 2008)

'Domestic' supply chain



'European' supply chain

Producer

Sales office

Storehouse

Third party logistic supplier

Representative office in Russia

ЗАО «Русхимсеть»

Financial provider

Consumer A

Consumer B

Consumer C

'Asian' supply chain

Producer

Third party logistic supplier

ЗАО Русхимсеть

Financial provider

Consumer A

Consumer B

Consumer C

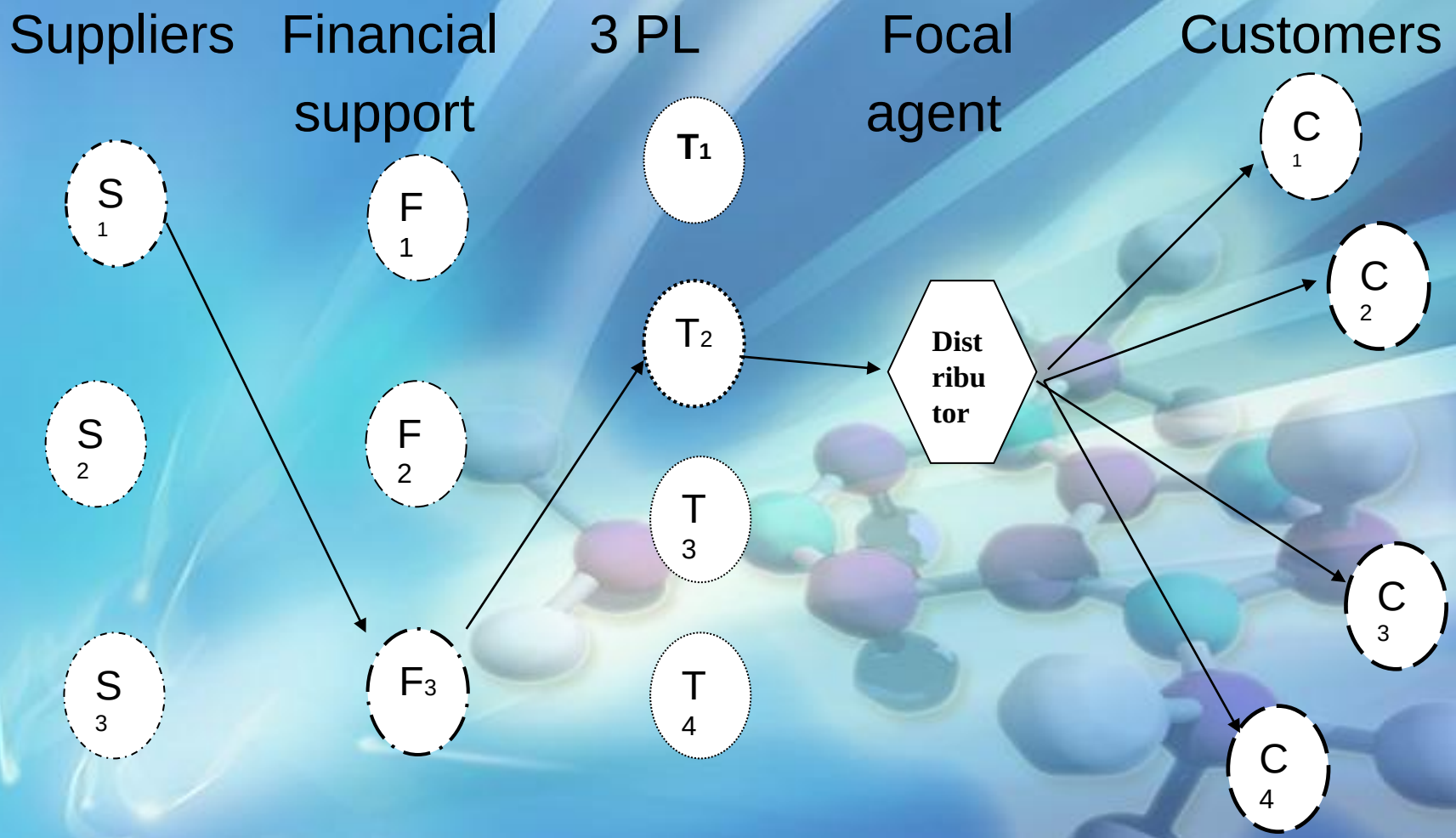
Sustainability in unstable environment

Distribution chain stability and flexibility gained through networking helped the company to survive the crisis. Long term cooperation served as a base for trust within the network and thus made it possible to get some agent's payments postponed.

In 2009 some competitors had to leave the market while the «Ruskhimset» company's profit increased rapidly

So, the main conclusion is: network approach to distribution of chemical products is helpful in terms of sustainability. Networking does matter – moreover, it is of great importance in unstable environment.

Distributor choose actors for supply chain to gain profitability



Formula for transition probabilities

$$\pi^{(0)} = (p(\xi = i_1), \ldots, p(\xi = i_N))$$

$$\Pr(\xi_{n+1} = j / \xi_n = i) = p_{ij} = I(a_j \le a_i) \cdot \left(\frac{(a_j)^{-1}}{\sum_{(k:a_k \le a_i)} (a_k)^{-1}} \right)$$

Then one-step transition matrix is given by

P =

$$\begin{pmatrix} P_{11} & P_{12} & P_{1m} \\ P_{21} & P_{22} & P_{2m} \\ \ldots & \ldots & \ldots \\ P_{m1} & P_{m2} & P_{mm} \end{pmatrix}$$

Example

We consider a sequence of transportation services rates from our 3PL suppliers (m=3) given by:

$$\{3500, 3650, 3700\}$$

$$\pi^{(0)} = \begin{pmatrix} 0.323 & 0.335 & 0.341 \end{pmatrix}$$

- The matrix of transition probabilities (P ij) will be the following

$$\begin{pmatrix} 1 & 0 & 0 \\ 0,51773 & 0,48227 & 0 \\ 0,350825 & 0,326796 & 0,32238 \end{pmatrix}$$

Forecast of a partner in n steps

$$\pi^{(5)} = \pi^{(0)} \cdot (P_{ij})^5 = \begin{pmatrix} 0.323 & 0.335 & 0.341 \end{pmatrix} \cdot \begin{pmatrix} 1 & 0 & 0 \\ 0.97 & 0.03 & 0 \\ 0.95 & 0.05 & 0 \end{pmatrix} \approx \begin{pmatrix} 1 & 0 & 0 \end{pmatrix}$$

Opportunistic behavior – choice of partner with cheapest rates

Conclusions

Distribution networks of chemicals in Russia:

- instable relationships
- headed by focal firm ("chain captain")
- obvious search for partners providing fair prices
- many small and medium producers of PVC in Russia filling mainly special orders concerning rather small quantities
- social contacts as a main base of business relations within “domestic" chains
- reputation as a main concern while choosing foreign partners, still “fair price” concern is also in place
- distribution networks including European partners usually emerge “within” existing European distribution chain
- cooperation with Asian partners not well developed yet

Conclusions

Markov chain theory can benefit to the network management:

once we have calculated probabilities according to prices we can compare them with ***empirical probabilities***. The difference between transition and empirical probabilities could help us to evaluate implicit benefits which we get from the relations with partner in terms of probability theory.

Further research is needed to aprove preliminary findings and find more adequate and simple way of comparing two models of behavior using the Markov chain theory tools

Thank you for your attention!

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