Dynamic analysis of bankruptcy and economic waves

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1. Intoduction

For a long time the relation between production of goods and credits allotted to firms was analysed at macroeconomic aggregated level (Varga (1937), Trakhtenberg (1939), Mendelson (1959-1964), Minsky (1963), Anikine et Entov (1978), Kindleberger (1996), Aglietta et Rebérioux (2004)). The se studies show that a correlation between them is very strong, but the its' intensity varieties and causal link modifies accordingly to phases of business cycle. More recently the analyses were performed at the level of individual firm or at the level of a portfolio that shares credit among different firms. For example, Yiu (2004) indicates that the investments in risky assets reduce whenever the V@R (maximum expected loss over a given horizon period at a given level of confidence in economic growth) constraint becomes binding.

The subject of my analysis is a partially aggregated agent, which represents a group of firms homogenous from some judgment about their probability to be bankrupt. Each representative firm keeps the signs of multiple attributes of firms that compose its' group. The groups of firms are not formed into some network through cooperation or for some reasons of labour division. Such spontaneous emergence of groups (or classes) among the individuals of any population, humans or virtual persons, in the realistic context of interests and of environmental conditions, is largely analysed in social sciences (for example, Axtell et ali (2000), Axtell (2002)). A multitude of latent characteristics that determine the entry of an individual into a group explains why such representative agent, being an abstraction, can act in response to different stimuli.[1] In this work, the classes of firms are constructed using the rating of some of their observable and quantifiable qualitative characteristics. The intensity of impact of each characteristic into a general one-dimensional rating of a firm reflects an importance that researcher attributes to this characteristic in his analysis of phenomenon.

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[1] Note, that it is not the case for aggregates of national computability.

This one-dimensional score represents the temporal quality of firm (in a sense, it's a fundamental for hedonic price). Finally, the researcher reveals into the set of firms' scores some homogenous classes by descretizing the quantitative scores. For that she/he determines the thresholds, which disjoin firms in function of their score.

Now the firms are scored and classified by different institutions and for different reasons and purposes. For example, the French agency VIGEO scores 500 000 firms around the world accordingly to social criterion of "responsible investment" (Notat (2004)). In this paper the classes are created accordingly to default probability of firms. The average values of characteristics of firms in each class express the characteristic of representative agent.

Since, creditor accords credits to firms in function of their score and the performance of a firm depends, among other thinks, on condition of financial equilibrium of enterprise, I analyse here the credit policy which would avoid the representative firms serial default, except some eventual situations, when restructuring is necessary and selective bankruptcy must be realised.

Along these lines, the dynamic of solvency, insolvency and risk transition is analysed. New rules are currently introduced in many countries to control the risk taken by the firms; in particular, to define the capital required to hedge a risky credit portfolio. It becomes possible to analyse the firm default risk and its expected evolution. The agencies report regularly summary statistics of the rating histories under the form of transition matrices providing the migration probabilities between given rating classes for different years and sectors of economic activity. The aim is to verify if the observed migration probabilities can be used as leading indicators for business cycles, recession and growth trends in place of other standard leading indicators as unemployment or inflation.

The bankruptcy principles and the financial regulation are presented in section 2. Then, in section 3, the data sets are discussed and some typical evolution of risk probabilities is reported. The data of firms' migration through the classes of risk are often analysed in the literature by means of an ordered qualitative model with observable or unobservable factors. This model is reviewed in section 4, and especially its dynamic properties, when some factors represent the cycles. In section 5 the dynamics of up-grade and down-grade migration probabilities data are compared with the evolution of the GNP. Some results of causality analysis of links between risk of default and some financial variables are described. Finally, in section 6 examples of control methodology are agreed. The goal of the control is the selection of a policy for avoiding systemic risk.

2. The bankruptcy laws and the financial regulation

Operating firm must be solvent. According to accounting principles it signifies that it can serve and refund all its debt's becoming due. Insolvency is the situation when the firm's debt is greater than its asset value including: stocks, accorded credits, real estates, machines and other assets. In a situation of insolvency bankruptcy occurs. It is the pattern for resolving disbursement problems of firm owners.

Moreover, bankruptcy, as an institution of regulation, implicates some general economic issues of capitalism such as the production of wealth (analysing by whom the wealth has been produced, in conformity with which objectives) and the outcome sharing. For example, the bankruptcy regulation is needed in Russia since the economic liberalisation and the massive privatisation in 1992. Before, the unique owner - the State - was not faced with the problem of firms' insolvency, because he valorised them throughout the criteria of national usefulness and the mechanism of equalization of assets among firms. The restructuring, moving or dismantling occurred without unemployment and without revenue losses for individuals (I will not discuss the overall economic efficiency of Soviet mechanism of reproduction and accumulation.)

Historically, bankruptcy consists in three stages:
1) to withdraw publicly the bankrupt from operating;
2) to gather all information about creditors and to estimate assets;
3) to settle the investors' failure (they lose for this reason their property rights), to sale assets in order to indemnify the creditors, to quash the marginal debts and to arrange the firm's liquidation.

The entrepreneur observing insolvency can seek at short run to realise some very risky activity. Therefore bankruptcy legislation traditionally (since 17 century) seeks to regulate the enter/exit rules of operating in order to protect the public interest (or total efficiency) from excessively risky firms.

For several reasons firms face debts, and are unable to repay them in some circumstances. The bankruptcy procedure is required to explain and to resolve the problems rising in such situations. The most important goals of the bankruptcy can be enumerated: It should provide a not wasteful outcome that is the maximal sum available to be shared between debtors, creditors and other concerned participants, such us, employees. It should preserve the bonding role of debt by penalising the

managers and shareholders according their faults. The bankruptcy and non-bankruptcy states must be treated with similar attention concerning the contractual obligations within the firm.

Two principal forms of bankruptcy procedures exist: an asset sale and a structural bargaining. The sale of the firm's assets is usually supervised by a trustee, or a receiver. Such procedures and supervision are not as evident as it seems from the old capitalist world. For example, the Russian government postponed decisions of restructuring the industrial sector after the privatisations in earlier 1990. It did not force insolvent firms into bankruptcy, even when it was their largest creditor. The government, particularly at the regional level, often interferes in bankruptcy proceedings to prevent job-losses. After all, the lack of a credible threat of bankruptcy has meant that managers did not seek to avoid insolvency. As a result the country was facing an increase of firm insolvency with a huge accumulation of unpaid debts. Recognising that large-scale initiation of legal proceedings of bankruptcy as asset sale is impossible; one seeks other means and ways.

In the case of structured bargaining the claimants are encouraged to bargain about the future of the firm. Indeed it can be liquidated or restructured, and in both cases the rules should be negotiated and determined. For example, the bankruptcy law in France give to the court, through an administrator, the power to accept a restructuring plan without the approval of creditors (or workers) if it guarantees the maintenance of employment and the repayments of creditors.

Some problems arise in connection with structured bargaining procedure, since it follows two objectives at the same time that are: the task to decide for the firm future and who should get what in the event of a restructuring of claims. The bankruptcy reforms are in progress in many countries in order to make the procedures more transparent and efficient (see Hart, 1999). Thus, the goal of an appropriate bankruptcy law is to reduce the systemic risk and overall financial instability. But the regulation of financial system, with the prudential rules is another way.

Bankruptcy of an individual financial institution or micro-prudential accident is a consequence of disruption of one or more indicators of the institution's health, such as: capital adequacy, asset quality, management soundness, earnings, liquidity, and sensitivity to risk. The widespread financial distress may come from the failure of individual institutions and the spread trough different contagion mechanisms to the financial system in general (Gourieroux & Peaucelle (1996)). The objective of a macro-prudential approach to regulation is to limit the risk of financial distress with its significant losses in terms of GDP. The strengthening of the macro-prudential mechanism needs a closer cooperation between supervisory authorities and central banks, that why new rules of macro-prudential regulation have been elaborated by Basle Capital Accord.

3. Available data for default analysis

The objective of the New Basle Capital Accord II (2003-2004) is to allow banks to manage their risks with a dynamic approach of capital adequacy. The first internationally accepted standard was

developed in 1988. These and following rules are introduced by the regulator (Central bank governors and the heads of bank supervisory authorities in the Group of Ten countries G10) to control the risk, in particular to define the capital required to hedge a risky credit portfolio [the so-called Value-at-Risk (V@R) that is the maximum expected loss over a given horizon period at a given level of confidence]. The implementation of this regulation requires a careful analysis of firm default risk and of its expected evolution. As a by product the rating agencies as Standard & Poor's (S&P), Moody's, Fitch, or some central banks, as the Banque de France (BdF), have been led to improve the quality of their proprietary rating data bases[2]. Typically, they make public summary statistics of the rating histories under the form of transition matrices providing the migration probabilities between given rating classes for different years and economic sectors. These statistics are the dynamic measure of degrees of creditworthiness among operating firms.

The definition of the rating and the population of firms differ according to the rating agencies.

For instance the main rating agencies obtain information about the situation of the firms, generally when they are issuing bonds. This explains why their data bases concern large firms, mainly US companies, even if the proportion of European and Japanese firms represented in the bases has grown rapidly at the end of the eighties. The number of rated firms is around 10 000, with a proportion of missing data (alternative NR : not rated) between 10 and 20 %. These data are reliable since 1985 approximately, providing 17 years of observed transitions matrices. They use a rating with ten classes from the highest rating [AAA for S&P for instance] to the worst one D corresponding to default.

The data collected by the French Central Bank are of another type. They include the balance sheets of French firms, with sales larger than 762 000 Euros, or those with debts 5 times beyond the threshold of registration at Central of banking risks (the threshold since 1997 is 76 224 Euros). Consequently, the data are covering about 185 000 firms per year, 85% of workforces and 90% of distributed bank credits. In the French Central Bank case, the contribution of economic ratios on financial situation of a firm depends on the sector. For example, for Industry there are eight economic ratios that contribute to the score value. The score indicates the health of firms in report with the management ratios, such as: provider deadline, tax and social security creditor; rate of return and return on sales: rate of added value; solvency: burden of financial charges; debt: leasing liabilities, capital-debt ratio; and current liabilities: liquidity, bad or doubtful debt. Then the information included in the balance sheet is transformed into a quantitative score representing the risk level of defaulting.[3]. After that the score is discretized to get a qualitative rating with ten classes of risk (average probability of default at the

[2] See e.g. Brady et alii (2003) for a description of S&P data base, Carty (1997) for the Moody's data base, Foulcher et alii (2003), Bardos (2004), for a description of the Banque de France data base.

horizon of three years), noted D, 1, ..., 10. The alternative "D" corresponds to default and the alternative "10" indicates a perfect financial situation (analogue of the AAA of the rating agencies). The default in the French Central Bank rating signifies that the enterprise is under bankruptcy procedure. For example, in 2001 among industrial firms in France 20.4% of firms had a high probability of default in the future, 8.4% of firms were neutral, and 71.2% were healthy firms. The risk of default changes in time, and the score of any firm can maintain it in the same class of risk or switch into another class. The structure of migrations among the classes allows us to analyse the risk dynamics. In France the data have been collected since 1992, which provides 11 years of transition matrices.

Example of transition matrix reported by the Banque de France is given in the table below.

Table 1. Migration probabilities "Industry", between 1999 and 2000 (in %)

	10	9	8	7	6	5	4	3	2	1	D	NS
10	72,38	15,91	1,34	1,51	0,46	0,17	0,41	0,24	0,05	0	0,05	7,49
9	12,47	57,58	13,56	5,75	0,92	0,59	0,72	0,98	0,1	0,06	0,09	7,17
8	1,28	26,67	35,74	23,35	1,77	0,66	1,12	2,04	0,43	0,05	0,17	6,72
7	0,39	4,88	16,16	50,57	8,71	2,94	2,13	4,21	1,21	0,54	0,48	7,79
6	0,26	1,9	3,01	33,61	23,3	10	6,96	6,76	2,24	1,42	1,45	9,09
5	0,26	1,94	2,51	17,21	20,92	16,16	14,07	9,94	3,71	1,94	1,78	9,57
4	0,25	2,04	3,05	12,98	12,53	12,83	17,52	14,56	4,68	4,18	2,85	12,53
3	0,08	1,62	3,05	13,64	9,3	5,89	11,61	21,11	7,11	6,21	4,34	16,04
2	0,11	0,78	1,56	8,16	8,6	5,81	10,61	16,54	12,74	9,5	7,37	18,21
1	0	0,24	0,82	2,83	4,59	3,53	6,48	12,96	8,48	24,5	15,31	20,26

A lot of migration probabilities are rather small. The significant values are mainly around the main diagonals, which represents the proportions of firms keeping their previous rating class (the class of default probability), and for default as arrival state (absorbing state). These matrices can be summarized by considering the probabilities of a down-grade [resp. an up-grade]. For instance for a firm rated "6" at the beginning of the year, the probability of an up-grade is the probability to migrate to one of the state 7,8,9 or 10.[4]

In order to analyse the systemic default risk, it is important to consider the simultaneous rating migrations of firms with different indicators of risk in the same direction. Such migration is called migration correlation. The stochastic transition matrix, which assumes a common multivariate factor across firms, represents the migration correlation between different classes of risk.

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[3] For example, in the article by Bardos & ali (2004) the risk level of default is revealed by a discriminant analysis technique.

[4] As usual, in empirical studies it is important here to be careful with interpretation of estimation results. For example, the study of Moody's ratings of U.S. corporates shows that the number of down-grades in corporate bond has exceeded the number of up-grades, leading to think that the credit quality of U.S. corporate debt has declined. The article by Blume and alii (1998) suggests however that a

4. Analysis of default dynamic: the ordered qualitative model with factor

The ordered qualitative model with factor is usually considered in the literature (see e.g. Albanese, Chen (2003), Bangia et alii (2002), Gupton et alii (1997), Crouhy et alii (2000)) as a convenient specification for stochastic transition matrices. Indeed it allows reducing the number of factors, which are driving the different migration probabilities, while keeping the model tractable with a reasonable number of parameters.

As usual the specification is based on a latent variable $S_{i,t,}$, which can be interpreted as an underlying quantitative score, directly related to an expected probability of default at some horizon. Typically the horizon is 3 years for the BdF score. Thus $S_{i,t}$ is the value of the score for firm i at date t. It is assumed that the conditional distribution of variable $S_{i,t}$ given the information available at the beginning of period t depends on some factor Z_t and on the most recent rating $Y_{i,t-1}$. It is such that:

Latent model for the score

$$S_{i,t} = \alpha_k + \beta_k Z_t + \sigma_k u_{i,t},$$

(1)

$$\text{if } Y_{i,t-1} = k, \quad k = 0, ..., K-1,$$

where α_k, β_k, σ_k are scalar parameters and $u_{i,t}$ are independent error terms, identically distributed with common distribution function G. Thus three parameters are introduced for each rating class: α_k measures a level effect, β_k is the risk sensitivity with respect to the factor[5], whereas σ_k is the idiosyncratic (firm specific) standard error.

Latent model for the factor

The factor has to be assumed non observable, to allow for migration correlation [see the discussion in Gagliardini, Gourieroux (2003)]. Loosely speaking, if the different sensitivity coefficients are nonnegative, a positive movement on Z_t will imply a joint increase of the individual risks whatever the rating class of the ferms. Thus we will get a positive migration or up-grade correlation, if the future of the factor is not a priori known. It will be assumed that the evolution of the factor is independent of the values of the shocks $u_{i,t}$, that they depend on the past by means of the most recent factor value (which is the Markov assumption), and that the transition factor density can be parameterized. This density

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major part of down-grades trend in ratings is the result of changing standards of scoring and rating by this agency

[5] We have implicitly consided a one factor model for expository purpose.

will be denoted by:

$$\frac{1}{dz} P[Z_t \in (z_t, z_t + dz) | Z_{t-1} = z_{t-1}] \cong f(z_t | z_{t-1} \boldsymbol{q}),$$ (2)

for small dz.

Link between latent and observable variables

Finally the rating of period t is defined by discretizing the quantitative score:

$$Y_{i,t} = \ell, \text{ if and only if } a_\ell < S_{it} < a_{\ell+1},$$ (3)

where: $a_0 = -\infty < a_1 < ... < a_{K-1} < a_K = +\infty$ are fixed (unknown) thresholds.

Under the specification above it is easy to derive the migration probabilities given the factor value. Since the factor is indexed by time only, these quantities are closed to the observed sample transition matrices, computed per year. We get:

$$p_{k,\ell,t} = P[Y_{i,t} = \ell | Y_{i,t-1} = k, Z_t]$$

$$= P[a_\ell < S_{i,t} < a_{\ell+1} | Y_{i,t-1} = k, Z_t]$$

$$= P[a_\ell < \alpha_k + \beta_k Z_t + \sigma_k u_{i,t} < a_{\ell+1} | Z_t]$$

$$= P\left[\frac{a_\ell - \alpha_k - \beta_k Z_t}{\sigma_k} < u_{i,t} < \frac{a_{\ell-1} - \alpha_k - \beta_k Z_t}{\sigma_k} \Big| Z_t\right]$$

$$= G\left(\frac{a_{\ell+1} - \boldsymbol{a}_k - \boldsymbol{b}_k Z_t}{\boldsymbol{s}_k}\right) - G\left(\frac{a_\ell - \boldsymbol{a}_k - \boldsymbol{b}_k Z_t}{\boldsymbol{s}_k}\right)$$

The model reduces to an ordered probit model with factor, if the common distribution G corresponds to the standard Gaussian distribution, and to a Cox model with stochastic intensity if exp $u_{i,t}$ follows an exponential distribution [see e.g. Lando (1998)]. The beta model assumes independent transition matrices, with independent rows, following beta distribution (the beta distribution is the basic specification used in probability and statistics for the law of a stochastic

discrete distribution).

Different specifications of the factor dynamics can be retained in practice. Feng et alii (2003) assume a Gaussian vector autoregressive factor. When business cycle is specified by means of a hidden Markov chain, it seems natural to consider a factor with discrete state space {0, 1}, where "0" represents "recession" and "1" represents "expansion". The factor dynamics is summarized in this case by a (2,2) transitions matrix $P = \begin{pmatrix} p_{oo} & p_{01} \\ p_{10} & p_{11} \end{pmatrix}$. For this model the joint process (Y_{1t}, ..., Y_{nt}, Z_t) defines a Markov chain, with some recursivity in the joint transition matrix (Gagliardini-Gourieroux (2003)).

5. Credit migration and economic growth

The relationship between firm default and general economic dynamic has been advocated since a long time in the economic literature. During a recession period, the firms have more difficulty to sell their productions, which can deteriorate their balance sheet, their probability of failure increases, as well as the credit rate, offered by their lender. Conversely, if the probability of failure of a firm increases, it has more difficulty to find credit at a small rate, which can increase the amount of regular reimbursement and reacts negatively on its situation. This creates an accelerated movement towards default, with the usual consequences on employment, growth, deflation… The new existing databases on credit histories allow for a better understanding of the relationship between the business cycle and the factors influencing credit risk and credit migration. A few number of studies have already been done on this topic [see Nickell, Perraudin, Varotto (2000), Bangia et alii (2002)], and especially with proxies of the business cycle, such as the NBER indicator. They essentially concern the US business cycle at a general level, and do not take into account the effect specific of a sector structure of economy. Gagliardini and Gourieroux (2004), Boussyguine and Peaucelle (2004) analyse the French rate of GDP evolution, and its impact on risk migration in some sectors of French economy.

The evaluation of migration probabilities of firms in France shows clearly some common feature, with at most two underlying patterns: 1) the evolutions for up-grade are in the inverse directions of the evolutions for down-grade, the up-grades have an ascending trend in each class of risk on the period between 1992-2001, and the down-grades feature has inverse declining general trend (except the class 1 of high default risk); 2) the evolutions for three sectors (industry, wholesale and retail trade) are very similar. This pattern is compared with the French growth rate, and the comparison shows the strong link between migration probabilities and growth rate. The dynamic linear link between the down-grade series and the GDP, using a causality analysis, indicates for analysed sectors that, on one hand, for the classes of low risk the GDP is a leading indicator of the down-grade risk migration, but on other hand, the ordering between both measures is reversed in the very risky classes, where the down-grade

probabilities can be considered as leading indicator of the economic growth with a lead of two and three years. Besides, the down-grade tendency is more reactive than the up-grade one to GNP modification.

Such are recent empirical investigations concerning the dynamic analysis of default risk in some sectors of French economy and of economic growth of this country.

The firms' scoring determines the class of risk to which it belongs and consequently the condition of credit (amount and term) it can count on. In any case the "health" of operating firm depends on quality of credit it gets.

In Boussyguine and Peaucelle (2004) the causal relation between the trends of upgrade and downgrade in French industrial sector and the spread evolution, as well as with evolution of treasury bonds are analysed. It is shown that the rate of bonds remuneration is an advanced indicator for downgrade movement in one risky class (2 class) and in no risky classes (6,7,8,9). It is also leading indicator for upgrade movement in relatively neutral to risk classes (4,5,6 and 7). The causal impact of spread is observed only for two classes of risk (5 and 7) and it is statistically significant for upgrade trend as well as for downgrades.

6. Risk management or economic growth control

Some interesting works have been done recently in the domain of risk management and control. The majority concern idiosyncratic shocks that provoke the defaults. In such case the optimisation programme has to solve either the creditor problem, or the borrower portfolio problem looking for the optimal allocation of investment between liquidity, stocks or credit subject to an exogenously specified V@R control condition. In the recent article by Yiu (2004) the V@R is imposed as a dynamic constraint in the optimisation of portfolios problem. Thus, at each period the V@R is estimated and it has an effect on the investment decision. The author finds that in such model the investments in risky assets are reduced whenever the V@R constraint becomes binding. Besides, when V@R is the risk control, consumption and expected utility are not considerably affected for certain choices of parameters. This result confirms more general statement that system safety could not be a very strong constraint and certainly not the goal. Indeed, any system with some degree of probability at some instant reaches the attractive position of "catastrophe", like bankruptcy in the case of financial institution. If one hypothesises that safety is the aim of an operating system than the solution is obvious and consists in breaking off the system. If an existing system is considered as useful, than the problem of its safety must be analysed in the context of some incentives to operate it.

My fields of interest are the investigation in the systemic risk prevention and the adaptive control of interconnections that exist between business cycle and heterogeneous risk aversion of the firms. In particular I want to consider the stabilisation of complex chaotic systems through feedback

management. The aim is not to come across the most effective means to achieve the goal, but rather to explore the principal possibilities of its' achievement and to analyse the class of potential movements of the system under control. For example, the migration matrices characterise the "health" of financial and real economy (as a system), and they can be used to feedback impulses (regulation) on it. The regulation consists in credit policy addressed to firms regarding the general rate of economic growth. In general the realistic model of complex system cannot be solved analytically, and researchers combine simulation with optimisation tools for control and optimal design. Typically our problem of interest leads to complex optimisation problems whose criterion function admits no analytically tractable form. In such cases the estimation of the values of criterion function by simulation and the search for an optimal solution by genetic algorithms (Köchel & Reaucelle (2003)) or evolution strategies can be performed.

Instead of conclusion, I prefer to describe the methodological scheme for future development of control analysis (prescriptive proposal) of the dynamic relation between risk evolutions and economic growth using the results of empirical investigations (descriptive proposal) reported in previous sections[6].

To formulate a control problem signify to design an interested subject, who has some concerns vis-à-vis the system, and such subject may be Basle Capital Accord of G10 or Central Bank, called *CB*. The object of concern can be systemic risk avoiding (prevention of generalised down-grading) and sustaining of economic growth. Such aim is interesting to study since till now one frequent criticism of the current Basel Capital Adequacy frame (determining the following risk components: default probability, loss given default, exposure at default, effective maturity) is that it increases procyclicity with a negative consequence on firm's operating.

Then it is necessary to describe the relationships between *CB* and the object that is the structure of interests, the dynamic properties of the object (revealed for the moment for three sectors of French firms by empirical analysis), and the possibilities and methods of concerns' achievement. The problem can be formalised by introducing a system of axioms that circumscribes a class of utility-oriented systems, which have the unique subject, *CB*, of concerns, but this subject has the concerns of multi-perspective types. The object of interests is passive[7], dynamic and stochastic system. Its structure is not determined precisely and the decision maker, *CB*, can construct it. The control aim is not postulated a priori, and the control motivation is in relation with the set of concerns (interests).

It is postulated that dynamic is described through a Markovian process. Three types of interests are provided concerning: a) the control of system evolution, b) the choice of its structure, c) the diagnosis

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[6] I acknowledge V. Baranov (2004) who suggested me to consider the problem in this way.
[7] Regulator admits the hypothesis of passivity of migration matrix, but the researcher has to remember that each matrix is an aggregation of operating firms and an abstract of decision making of thousands of firms.

of situations, in which the process of interests' realisation can be situated. The axioms are used to formulate the premises of decision making oriented to control the process of interests achievement in the course of operating and avoiding the systemic default.

The premises of decision making are the following:

1. The unplanned evolution of the states of the elements of risk migration matrix (object of concerns) is described by a Markovian process. The set of states S encloses the attractor D (default). $\beta(S)$ is an a priori distribution of probabilities on the set S.

2. X is a finite set of situations. The situations require diagnosis, which consists in the selection of situation in function of the state. Let $X_s \subseteq X$ the constraints, which determine the acceptance of situations as alternatives for diagnosis, depending on the stats $s \in S$.

3. Let C a set of control signals, which are chosen depending on situation $x \in X$. The constraints $C_x \subseteq C$ are given concerning the acceptance of control alternatives in function on situation $x \in X$. The set C contains the control signals which pull the system out of attractor state D. In our problem, on one side, the new entries in different classes of risk, for example in share proportional to the population of each class, can be interpreted as such signals, on other side, spreads are usual price signals in controlling economic systems.

4. The structure of the object is not fixed and can be "selected" among the structural alternatives G (since a residual heterogeneity exists in any class of risk, see equation (1)). The structural alternative is selected dependently on states and situations (scoring and rating); and especially on their common parameter (factor Z_t). If structural alternative is chosen consequently in any moment it is called tactical option, if it is constant at all horizon of interests existence it is called strategic option.

5. The utilisation of control impulses generates a discrete Markovian control process with values belonging to the set S of states. The transition function of this process is given by: $q^g(S \mid S \times C)$, where parameter $g \in G$ is a structural alternative.

6. Then it is necessary to introduce the utility function $w^g(C \times S \times X) \to \Re^1$, which determines the a priori preferences on the set of alternatives control signals C, where $c' > c \Leftrightarrow w^g(c',s,x) > w^g(c,s,x)$. (For example, supervisory review of banks' internal assessments of their overall risks must ensure that bank management is exercising good judgement of situation for crediting).

7. The control is performed according to the scheme of situational control: at discrete moments one observes the state, depending on this state a diagnosis of situation is selected, and accordingly to the result of diagnosis one makes a decision about the control impulses.

The postulates of decision making (1-7) determine the bearer of information a priori about the condition of decision making, generating the "information structure" of basic data a priori:

$$I=\{S, \beta(S), X, [X_s \hat{I} X, s \hat{I} S], C, [C_x \hat{I} C, x \hat{I} X], G, q^g(S/S\,\acute{}C), w^g(C\,\acute{}S\,\acute{}X), g \hat{I} G\}.$$

Accordingly to the information structure *I*, one develops the methodology of control formalisation based on the principles of: a) splitting of concerns (interests), b) equilibrium solutions, c) structural transformation. The following methodological positions describe the content of these principles:

1. The multi-perspective concerns are decomposed into some components. Each aspect is confronted to "virtual concerned segment" (class of risk) and corresponding set of alternatives. It is supposed that for each segment one criterion of quality among alternatives can be determined; at the same time criterions are independent, but not given a priori explicitly.

2. Each segment (firms of each class of risk) has the possibility to make a choice individually, but it is constrained by the necessity to respect the common interests of the subject, *CB*. Because of constrains the interests of different segments are consistent under these conditions, more, they are of cooperative type.

3. The problem has game theory content with latent cooperative concerns (interests).

4. The solution of the problem consists in researching of a stable compromise which cannot be improved. Such compromise is a cooperatively efficient equilibrium.

5. The criterions of alternatives' quality of virtual segments must be elaborated using the structural transformations of initial information structure *I*, into the necessary information structure.

The model of decision making describes:
- the initial hypotheses;
- the strategies of: control, diagnosis and structural choice;
- the criterions of: strategic control quality, structural choice quality, and quality of strategic diagnosis, which can be an average "risk";
- the dynamic equilibriums.

Than, it is necessary to explain the way to achieve the dynamic equilibrium: the necessary and sufficient conditions, as well as local equilibriums. The model of dynamic equilibriums presupposes that they are asymptotically stationary, and for this the estimates of closeness (operator of compression) to stationary equilibrium have to be demonstrated.

The computational construction of dynamic equilibrium by V.Baranov (2004) consists in the algorithm of dynamic equilibrium approximation and in the algorithm of local equilibrium. The last one needs the formulation of information structures concerning the "utility" and the "risk". Finally, the algorithms of configuration of information structures respectively for "utility" and for "risk" are described.

The procedures presented previously provide a dynamic apparatus of decision making in

organisational operating systems with the assignment to conserve their safety and soundness, consolidate the stability of the financial system, and improve its ability to serve as a source for sustainable growth for economy.

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