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Operational risks and their management in the public financial system with especial regard to budgets of local governments

Abstract for doctoral dissertation

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Contents:

1. Reasons for topic

The importance of the topic is explained by the change in role-taking of the state in the 21th century. The topicality of the question is given by the more and more severe problems of financeability of the individual state activities and groups of tasks, including those of local governments and municipalities, emerging at both international and national levels. The problem of financing affects both developing countries of peripheral positions and the developed economies of the world. The specificity and novelty of choosing this topic is the fact that the present dissertation, instead of the relatively well-definable financial risks, it makes an attempt to introduce operational risk into state household defined by the credit institutional sector on the basis of practical points of view; it also describes its theoretical aspects, the selection of the applicable methodology and also provides the verification of its practical applicability by means of statistics.

The United States of America, China, the Mediterranean countries of Europe and Russia each face problems of financing subnational governmental levels, and these countries are only the most striking examples in the world. In the United States, the imbalanced management of pension funds at the member states' level (the infamous case of New Jersey and the investigation of its Securities and Exchange Commission), some cities declaring bankruptcy (the example of Detroit) pose problems. In China, the development of infrastructure, carried out at the local level in order to compensate the economic crisis, caused an immense local debt stock. The insolvency of Spanish provincial governments, the problems of financial imbalance of some Russian regions, along with the phenomena described above, indicate that a large number of operational decisions of subnational (local) governments carry considerable risk, evaluable in its total effects at the macro level as well.

> *The choice of topic is directed to such a range of problems on the surface of which the various state-financial imbalances appear. In the background of the problem, we can identify the peculiarities of the state's decision-making mechanisms, the environmental factors influencing decision-makers.*

Raising the problem with regard to the divergent functioning of the state requires linking and evaluating extremely distant fields of topics – both theoretically and methodologically. To

formulate the answerable research questions, we had to identify a field of topic narrowed down considerably and an essentially simplified problem. This problem is operational disequilibrium. We were able to assign the distinct elements of the complicated theoretical background to the simplified problem. A further condition of this was that the responses should be given to clearly put questions to be decided by measurements, and the statements related to the limited topic should be falsifiable.

In the interest of this, instead of the role-taking of the state and its operational risk at the macro level, we directed our research to the mezo level, to the system of subnational governments. By using this approach, we restricted the field of problem to the investigation of phenomena appearing at the micro level and generalisable to the mezo level.

Creation of harmony of local taxation and local programs of public expenditures, the principle of fiscal equivalence, manifests itself in local budget as financial compulsion. We could study the functioning of regularity in the operational budgets of local governments on a considerable universe, which can be taken homogeneous in the framework of the given co-untry, by statistical methods. The relatively large number of universe and the homogeneity of the local governments of the given state involved great advantage versus the descriptive comparative study of the state households of countries with different political systems. The analysis of the subnational level allowed us to support the statements formally deduced from the theoretical framework.

A wide range of detailed secondary data was available of the Hungarian local governments. The data can be made suitable for arranging them into groups of data according to the theoretical approach and for defining suitable statistical variables (Sándorné 2009, 2014). Therefore, we carried out the empirical research on the Hungarian universe.

2. The objective of research and its theoretical bases

In the course of determining the system of objectives of research and shaping the theoretical reference framework, we could select from a wide range of the results of economics. To process the diverse research topic, we used an approach and methodological-logical framework, in which the literature can be shaped uniformly, with a consistent train of thought, into theses carrying novelty in regard to state household and the operational risks of local governments.

We had to take into account the achievements of finances, financial theory, economics, the economics of the public sector and state-finances, had to review the related most important works (Allen-Tommasi 2001, Báger 2006, Báger et al 2012, Barr 2009, Botos 2014, Feldstein 1995, Musgrave-Musgrave 1989, Sivák-Vigvári 2012, Stiglitz 2001, Vigvári 2005, 2008, 2009, 2010).

The theoretical treatment of risk demonstrated significant, almost explosion-like development in the 1980s and 1990s. The theoretical demands of modern finance and the practical demands of money economy developing at an extraordinary speed brought the unexpected utilization of the achievements of mathematics of the 20th century, for which the greatest thinkers of economics provided the theoretical background. F. A. von Hayek and E. Fama's assumption of incidentally, accidentally, still perfectly determined prices had a great effect on the theoretical and methodological works concerned with risk (Fama 1965, 1970, Fama-French 2012).

Risk-aversion is interpreted by both neoclassical and behavioural economic schools. The neoclassical school, remaining within the analytical framework of utility functions, models and explains the phenomena of risk-avoidance and risk-preference by the parameters of derived utility function. A most important prerequisite of the model is the strong, non-influenceable preference system of the decision-maker. Possible preferences of the decision-maker are expressed by the location of the indifference curve regiment, based on which his / her behaviour can be consistently risk-preferring, risk-indifferent or risk-avoiding. The shape of utility function determined on the basis of preferences (being convex and concave) also expresses relationship to risk with mathematical precision. Such an alternatingly convex and concave utility function can also be constructed, which, with the continual increase in the level of income, is suitable for the explanation for the risk attitude, changing continuously to stay in the neoclassical frameworks. Basically, mainstream economics puts the analysis of usefulness related to changes in property in the centre. Although these were approaches deviating from this, but they never went beyond possibilities offered by utility functions (Arrow 1976, Friedman-Savage 1948, Markowitz 1952, Samuelson 1963).

In the behavioural economic school established by A. Tversky and D. Kahneman the concept of utility is replaced by the notion of psychological value. The key to the risk interpretation of behavioural economics is the value function of prospect theory, which, contrary to utility

function related to income, can take on negative values as well. For it does not study the change in property and the established state, but the relative change perceivable by the decision-maker: profit and loss. The decision-maker regularly ignores the financial status, therefore this phenomenon is very complex. Even if we possess large property, a long, unpleasant series of loss may make us risk-preferring. The value function of prospect theory in the range of loss is convex from above, we are inclined to risk more in order to get out of the bad process. However, profits can as well make us risk-avoiding, the value function of prospect theory is concave from above. The phenomenon is independent of the financial status or income and the decision-maker's stance as well, we do not assume his / her strong and uninfluenceable preferences. Basically, it is the decisional environment that counts, the direction of events taking place at a time and its value content. A given series of events offers reference points: where we have come – e. g. to a maximal income – will become a reference point further on. We do not determine profit and loss compared to a status of ours that can be looked at as objective, e. g. to property accumulated in the long term, but to short-term-course events (Benartzi-Thaler 1995, Hámori-Komáromi 2005, Kahneman-Tversky 1979, Kahneman-Thaler 2006, Kahneman 2013, Kőszegi-Rabin 2007, Rabin-Thaler 2001, Thaler et al 1997).

In the dissertation, we gave preference to the framework of analysis offered by behavioural economics for the following reasons:

- In the course of analysing operational risks, we did not see the necessity of the analysis of property as the chance of occurrence of operational risk events, its possible effect is independent of the financial size of property, but it decisively depends on the changes in the operational environment, for the description of which the value function of prospect theory provides a suitable analytical framework (Benartzi-Thaler 1995, Chernobai et al 2007, p.16, Kahneman-Tversky 1979, McNeil et al 2005, pp.468-470, Thaler et al 1997).

- We did not take the risk community of the modern state as an entity based on property, therefore the concepts of profit and loss related to the reference points of outer and inner environments are more suitable for the description of state-financial decision-making processes (Benartzi-Thaler 1995, Kahneman-Tversky 2006, Post et al 2008, Thaler et al 1997).

- The risk community of the state is not voluntary and, consequently, taking some losses is an inevitable, certain event. The value function of prospect theory offered a discernible and suitable framework, for the explanation of situations involves certain losses as well (Kahneman-Tversky 1979, Post et al 2008).

In the course of the interpretation of concepts, apart from opportunities offered by behavioural economics, we always took into account the explanations consequential from the concept of neoclassical usefulness as well (Arrow 1976, Friedman-Savage 1948, Markowitz 1952, Samuelson 1963).

Despite the divergent axiomatic bases, loss avoidance explained by the utility concept of economics and the decisional models analysed with the value function of behavioural economics are not far from each other concerning empirical possibilities of application. Applying these models parallelly, we obtain similar results, however, according to some experiments, the ability of prospect theory to give forecasts is significantly better (Post et al 2008).

We applied the theoretical results connected with loss avoidance for state-household decisions. For the theoretically exact restriction of the studied field of topic, we applied two of the economics of the public sector and of the theoretical theses of state finances.

- The first one is Wagner's law, which, based on historical data series, determines the gradual growth of the state's role-taking, essentially the role of the modern welfare state. There was a heated scientific and financial-professional debate about this thesis. Sharp criticisms indicate that, both in theory and practice, the state's role-taking and the boundaries of market mechanisms are created with overlaps and off-chance decisions (Barr 2009, Erős 2008, Hetényi 2006, Stiglitz 2001).

- The second one is the concept of fiscal decentralisation, which is directed to the off-chance boundary area carrying uncertainty concerning distribution of tasks and financing – between the central government taking the macro position on the one hand, and the subnational, regional and local governments acting at the mezo and micro levels on the other (Allen-Tommasi 2001, Sivák-Vigvári 2012, Vigvári 2005, 2008a, Musgrave-Musgrave 1989).

Distribution of tasks between the market and the state and also the central and local levels results in a specific, matrix-like formation. Two constantly-changing border-lines appoint four domains: these domains divide the essential operational mechanisms of the society and economy, their boundaries are fields of well-describable conflicts of interests.

One of the restrictable domains is local governing, which establishes a special relationship with the local market, with the central government and, last but not least, with the local community voters. We should like to get an answer to the following questions:

> *What is the attitude of the local governmental level to its uncertain operational environment and to the central government mediating regulatory conditions? How does it make decisions affecting its functioning under the circumstances of taking financial budgetary risks?*

We asked three questions at the same time, which were directed to some "interfaces" of the local governmental domain of the drafted matrix-like formation. The components of the question are detailed below:

- We examined state-household operational decisions under the circumstances of taking financial risks. A state-household management decision, complying with the budgetary regulations, is about the utilisation of a given estimate (in case of expenditures) and its replenishment (in case of incomes). We answered the question by the help of interpreting some general concepts; we had to define the concepts of risk, financial risk and operational risk in connection with state household. It was a very essential criterion in the course of introducing the theoretical frameworks that we give a theoretically clear definition of operational risk which can be consistently used in the whole of the state household.

- The subnational (local) government does its activity in a complex, local financial, economic, social and natural environment. Its activity is directed to organising and influencing this environment; its system of objectives is attached to the given locality. To achieve its goals, it collects, evaluates the pieces of information from its local operational environment and makes its decisions in this local medium. Therefore, during our research, we concentrated on the direct operational conditions of the given local governing entity, for this is what logically came from the definition of the

concept of operational risk. Because of this, from the scope of our investigation, we excluded those environmental elements that were not directly connected with operational conditions and those to which the local governmental decision-maker, as representative of a higher administrative unit (territorial, regional organisational levels) could relate. This is why we did not consider the items of local governmental activity directed to development, accumulation, investments and the control of the wider environment and also the allocation of local and central resources and its coordination as part of the operational environment. From the budgetary and financial point of view it simply meant that the research was exclusively directed to operational budgets. In the course of the research, because of conceptual exclusions, we were not allowed to study the risks of accumulative incomes and expenditures, the various developmental and investment programs and those of financial supports.

- A very touchy and critical restrictive surface is the relationship of local governments with the other levels of state household. In Hungary, it is a particularly complex system of relations because of the normative operational support from the central budget on the one hand and the financing of hospitals being in the management of local governments until June 2012, from the social insurance on the other. We had to use very strong abstraction to separate the mechanism of action of financing operations, which is a pure financial risk, from the phenomena interpreted as operational risk. Therefore, we interpreted the influence of the central government as an informational medium, mediating normativity, part of which is both legislation and informal control and also the intention of the government in power manifesting itself hidden in the normative financing. Because of this, we had to exclude financing operations from the field of research topic; these are not included in the operational budget formally either. However, we completely studied the effects of consequences of governmental intention – hidden in financing – on operational risk, which appear in the shortage of part of the current operational budget of the actual budget (in the negative difference of income and expenditure estimates).

The theoretical questions consisted of extremely many further components. The questions implicitly contained a great many relations and theoretical linkages as well that we had to touch upon and interpret during exposition. By the help of a consistent logical deduction, we

selected those items that really took us closer to the answer (in the interest of which we applied formal logical deduction) and then, in the framework of an empirical study, we checked the force of those possible answers, which, by our assumption, characterised the best the relation of local governing to risk and their decisional mechanisms.

3. Structure of dissertation and applied methods

The exposition of the topic is divided into two major parts: the introduction of the theoretical framework and the description of the results of the empirical research conducted on local governments in Hungary.

We divided parts of dissertation into ten chapters each. In the first part, chapters follow the order of steps of logical exposition while in the second part, they follow the logical order of the correlations between the empirically studied variables. The second part of the dissertation is concluded with an outlook, which summarises the possible fields of application based on the examples of Hungarian local governments. The dissertation is concluded with a short summary, at the end of which we give a review of the further possible directions of theoretical and empirical research.

In the first part of the dissertation, we generalise the concept of operational risk from the credit institutions' applications, utilising the theoretical results of modern financial science and then, from the generalised definitions, we deduce the state-household and, within this, the possible fields of application at local governments in a consistent logical system. The dissertation follows the following stream of thought: we first review the risk management of credit institutions and then the related theoretical and methodological solutions of modern corporate finances. We interpret the conceptual differences between risk and operational risk in credit-institutional environment and then generalise operational risk in a sector-neutral manner (chapters 2.1-2.2). Following this, we apply the generalised concept to the public sector (chapter 2.3) and provide the financial interpretation of risk related to state household (chapter 2.4). We place the interpretation in the conceptual framework of state-financial decision-making: we introduce the concepts of discretional and normative state-financial decisions and determine their risk contents (chapter 2.5). We put conditions of equilibrium, by the help of which we interpret operational risk and distinguish it from the financial risk-taking of the state (chapter 2.6). We interpret state-financial decisions by the help of decision-theoretical models

of neoclassical and behavioural economics (chapters 2.7-2.8), then complete the variables testable in the framework of the empirical study based on the results of the previous chapters (chapter 2.9). Prior to the description of the results of the empirical study, completing the logical deduction, we give a review of relevant theoretical economics approaches related to local governing (chapter 2.10).

In the second part of the dissertation, we test the final conclusions of the theoretical deduction on the virtually total universe of 3166 items of the local governments in Hungary based on the survey data of a longitudinal study for a period of ten years. We introduce the questions and methodology of the empirical research in chapters 3.1-3.3, the sources of data and the result of the process of data cleansing and the zero hypothesis necessary for statistical analytical procedures. Chapters 3.4-3.8 contain the detailed test results of statistical analysis of the zero hypotheses. The results of statistical analysis are evaluated on the basis of research questions in a summarising manner in chapter 3.9. Chapter 3.10 contains the above-mentioned outlook about the fields of application of the introduced variables and risk indicators.

Zero hypotheses, necessary for the statistical analytical procedures, were created in the following logical system:

1. *In the course of presenting, we introduced variables suitable for statistical measures, in connection with which we put testable statements in the frameworks of the empirical study.*

2. *For each variable of the universe and their rates, we put it as a general hypothesis that their quantitative moves, measured for the given period, are accidental.*

3. *If the hypothesis in relation to accidental change can be refuted, we have put the deterministic correlation based on a priori knowledge and parallel research results as financial-professional assumption.*

4. *In the course of the empirical study, we processed the data of the total local governmental universe for ten years (3166 observations per variable) by the help of computer programs. The procedure was of deductive character, we related the theoretical conclusions to the characteristics of the universe measurable in the total universe. The deterministic changes, identified in the course of testing the methodology of operational risk, and, apart from financial-professional assumptions, we also identified the templates of series of data which can be related to the known macro-economic, financial and transformational processes at the mezo level for the period studied. Because of the explorable identities, we gave a short outlook on the introduction of the possible practical application of the methodology.*

The table systematises the zero hypotheses, where g = operational expenditures, T = operational incomes, mg = material expenses, mT = local taxes, OR = absolute operational risk, mOR = discretional absolute operational risk, ROR = relative operational risk, mROR = discretional relative operational risk:

	Null Hypothesis of Empirical Research	*Presuppositions on Impact Factors of Normativity (a)*		*Presuppositions on Impact Factors of Discretionality (b)*	
		H0	H1	H0	H1
I.	**Presuppositions on Universal Variables**				
1.	The General Impact of Processes Describable by Operational Expenditures has Random Character	*g* random variable	*g* deterministic	*mg* random variable	*mg* deterministic
2.	The General Impact of Processes Describable by Operational Revenues has Random Character	*T* random variable	*T* deterministic	*mT* random variable	*mT* deterministic
II.	**Presuppositions on Universal Ratios of Impact Factors of Normativity and Discretionality**				
3.	The Tangible Part of Operational Expenditures has Random Character	*mg/g* random variable	*mg/g* deterministic		
4.	The Local Tax Part of Operational Revenues has Random Character	*mT/T* random variable	*mT/T* deterministic		
III.	**Presuppositions on Operational Risk Indicators**				
5.	Occurence of Risk Events has Random Character	*n(OR)* random variable	*n(OR)* deterministic	*n(mOR)* random variable	*n(mOR)* deterministic
6.	Absolute Operational Risk has a Random Character in Connection With the General Impact of Environmental Factors and in Complience with Theoretical Assumptions	*OR* random variable	*OR* deterministic	*mOR* random variable	*mOR* deterministic
7.	Relative Operational Risk has a Random Character in Connection With the General Impact of Environmental Factors and in Complience with Theoretical Assumptions	*ROR* random variable	*ROR* deterministic	*mROR* random variable	*mROR* deterministic
IV.	**Presuppositions on Universal Ratios of Operational Risk Indicators Derivable from Normative and Discretional Decision Making**				
8.	Universal Ratio of Absolute Operational Risk by Normativity vs Discretionality has Random Character	*mOR/OR* random variable	*mOR/OR* deterministic		
9.	Universal Ratio of Relative Operational Risk by Normativity vs Discretionality has Random Character	*ROR/mROR* random variable	*ROR/mROR* deterministic		
V.	**Presuppositions on Inherent Risk**				
10.	Relative Operational Risk in Connection with Discretional Decisions is on or above the Level of Theoretical Assumptions	*ROR<IR*	*ROR>=IR*	*mROR >= IR*	*mROR<IR*

Comments:

1. Null hypothesis were defined on universal averages except in the case of Occurence of Risk Events indicators (No. 5 and 12 null hypothesis)
2. Universal ratios are the ratios of universal averages.
3. Null hypothesis were tested by mathematical-statistical computer programmes. The methodology of tests was ATC, which based on the application of the phenomenon of autocorrelation. During the process we compared the theoretical correlation cofficient to the experiential values between the successive years. In the framework of this methodology, if the experiential value does not leave the confidence interval of theoretical limits the assumption of randomness (white noise) will be underpinned. The ten years examined consisted of eight time lags to test. If the presupposition of randomness is falsifiable the variable will be considered as deterministic. The detailed results of the calculations of applied computer programme will be shown in tables in the sections of testing the individual variables.

4. Major results of the dissertation

The methodological analytical framework of operational risk established at credit institutions differs from models developed for studying business risks in several points. Profit maximalisation and the intention of increasing property are not exclusively in the centre of effects analysis, for, to interpret operational risk, we need not presume a business strategy aiming at increasing property, which, step by step, again and again takes outcomes weightable with various probabilities. In the course of evaluating operational risk, irrespective of the business process to take place, we search for such loss-causing-factors, which occur perfectly accidentally. In the course of evaluation, the value of the initial property is not important, the extent of the possible loss is in the centre, which in a given case can many times exceed the initial property.

The aspects of operational risk management by credit institutions can be translated into the analysis of financial management decisions of the state household.

We identified credit institutions as property-based risk communities, where the credit institution as a private enterprise, apart from its essential business activities (investment, crediting) takes significant social responsibility for the availability of certain groups of property, e.g. for undisturbed operation of payment systems or payment of bank deposits. Taking this responsibility towards the economic environment can be so big that it can put some credit institutions in a special situation establishing a risk community extended beyond those directly affected within the credit institutional enterprise. In a given case, credit institutions represent too large size in the economy to cause lasting operational disturbances in their basic activities (“too big to fail”), therefore there is a wide range of social interest to save them.

A similar situation can be identified at some institutions of the state, at companies owned by the state, especially in the case of natural monopolies and, after all, in the whole of the operation of the state.

Further on, we apply the above generalisation of operational risk to the state and then to the local level of the operation of the state, which, similarly to credit institutions, does its activity in a special operational risk environment.

Thesis 1: The theoretical and methodological approach to the operational risk of credit institutions can be well applied to the analysis of responsibilities and obligations of the modern state taken towards its environment. This general responsibility includes a large number of complex and concrete obligations: the stabilisation of social, economic, financial and natural environmental processes and also, towards these, the production of certain groups of goods and maintenance of public services.

We presumed that each single operational estimate of expenditure perfectly expresses the state of the institutions and environment of a given field of target and its information contents can be divided according to the effect factors of the given field of issue.

With this assumption, both the estimate of operational expenditure as a planned amount (original estimate) and as actual expenditure (realised data) carries the total of the environmental information. The data of the plan reflects the information-contents of the interest-balance created at the beginning of the period (t-1 time), the completion data (at t time) carries the whole of the environmental information that explains deviation from the plan and derives from the change in the positions of those affected. Based on the assumptions above, the same statement can be put for operational incomes. It follows from the statements put for operational incomes and operational expenditures that:

Thesis 2: the effects of the operational environment are reflected together in the state- financial processes, in the operational budget. This approach provides suitable information for a top-down evaluation of the operational risks of the financial-economic decisions of the state household.

The key to evaluation is the balance of capacities maintained by the state and required by the society. Capacity balances can be described with value functions deducible from the environment and value functions containing identical variables of institutional capacities. We expressed capacity balances by conditional expected value formulas. Looking together at the capacity balances of the sides of incomes and expenditures, on the expenditure side significant social, economic and natural environmental problems may remain unattended if the state adjusts its expenditures to incomes controlled from tax bases of optimal sizes and optimal extents of taxes. If this is the case, the state has utilised all the information when making decisions concerning incomes, however, on the expenditure side, it has ignored a number of de-

mands. Conversely, having utilised all the information, i.e. approximating institutional size of capacity to the possible demands, the overburdening of the possible tax bases and the overtaxation of the adjusted tax bases appear as societal and economic drawbacks.

Thesis 3: Under the condition of budget balance, environmental-institutional capacity balances will not be in equilibrium. Equilibrium would results from the equality of the capacity balance on the income and expenditure sides, which are, as a consequence of the above assumptions, perfectly random variables, therefore their difference is also an random variable, so operational balance can occur accidentally.

According to statements in theses 2 and 3, the financial risk-taking of the modern state arises from its general risk-taking towards the environment and also its wide range obligations and operational risk is the consequence of this.

Therefore, we distinguished the financial risk-taking of the modern state from its operational risk-taking; operational risk is the consequence of the financial risk-taking of the environmental obligations burdening state household.

Operational risk expresses the internal balance of the state's institutional system and the sustainable state of its institutions proportional to the demands of the environment. Operational balance exists between resources tapped from the environment and the goods produced for the environment. The presence of operational risk, its statistical fluctuation, surprise-like accidental change involves special operational conditions, constant force of accommodation for state household. The modern state, therefore, maintains an internal regulatory system, by which it ensures the sustainability of its operation. Regulation-based operation, normativity curbs the influence of external effect affecting the system.

External environmental effect resulting from financial responsibilities appears in discretional, while the internal mechanism of action ensuring operational balance manifests itself in normative state-financial decisions.

We substituted the items of budgetary funds equation, endowed with perfect information contents, the income and expenditure estimates in the value function of prospect theory. By this, we achieved that the research results of behavioural economics related to loss avoidance and risk avoidance could be applied in the analysis of state-financial decisions as well. By this

approach, we determined the theoretical value of the operational risk of discretional decisions, which we called inherent risk (IR) and in the course of an empirical study we made it correspond to experiential values.

Thesis 4: Discretional decisions can be placed in distinct reference frameworks on the income and expenditure sides. Decisions made in risky situations can be analysed both with utility axioms and in the conceptual framework of psychological value. Because of the properties of the operational system of the modern state, we gave preference to the psychological approach of behavioural economics.

Thesis 5: In the course of the empirical study, we identified operational risks exceeding, at the same time approximating the theoretical IR value resulting from discretional decisions at the total universe of Hungarian local governments for a period of ten years.

During the theoretical deduction we defined variables for the empirical study. From the variables, we deduced operational risk indicators.

Thesis 6: Absolute (overall) operational risk indicator (OR) – the difference between operational incomes and expenditures – is a money unit-based random variable. It is suitable for the expression of the value-at-risk (VaR) of the universe.

Thesis 7: Relative operational risk indicator (ROR) – the rate index of the difference between operational incomes and expenditures – a pure relative number, is also a random variable. It is suitable for the expression of risk exposure.

We supported the accidental nature and applicability of OR and ROR with empirical study on a Hungarian universe, for a period of ten years (2003-2012).

The determined risk indicators can be further divided. In the course of the empirical study, we distinguished the subsets applicable for discretional decisions and also the risk indicators determinable for these.

However, we took the *tangible expenditures* planned and accounted for in the framework of operational budgets and *local taxes* freely imposable in the framework of regulations as parts of local governmental operational budgets, controllable by discretional decisions:

1. *Tangible expenditures in the Hungarian treasury accounting system are essentially created on residual principle. In the data series of treasury statements of the individual sectoral expenditures non-personal and non-accumulative items were piled up. The specific composition of tangible expenditures offered a planning and accounting-technical scope for action for Hungarian local governments. Because of all these, we treated the tangible expenditure, estimated and accounted for, as an item of the system of operational expenditure assumed to be preceded by discretional decisions, i.e. as independent statistical variables.*

2. *The discretional character of the system of local taxes is evident in the practice of settlements, therefore, in the course of analysis, we also took local tax incomes, planned and accounted for, as independent statistical variables.*

We tested the *zero hypothesis of accidentality* for each variable and indicator of operational risk.

> *Thesis 8: The result of the statistical analysis shows that Hungarian local governments made their financial-expenditure-related decisions taking considerable financial risk towards the environment. The attitude of the local governmental level to its uncertain operational environment was risk-preferring, the established risk level studied on the Hungarian universe concerning discretional decisions came above the theoretical value (IR) between 2003 and 2012. The effect of the decisions of the central government mediating the regulatory conditions reduced the relative operational risk level.*

The results of the evaluation of zero hypotheses supporting the comprehensive statements are contained in the Table on the next page. Based on the evaluation of the test results of zero hypotheses 3, 4, 8 and 9, we put some financial-professional assumptions. In the series of data we identified patterns, based on which, looking out of the analytical framework formulated by the zero hypotheses, with the help of the introduced operational risk indicators we conducted an analytical study. At the end of the dissertation, we provide a short review of the processes of the operational risk of the universe of Hungarian local governments. We considered it very important to choose the reference framework of operational risk carefully, for risk analysis is an aim-dependent deductive procedure. By the help of the introduced methodological framework, with "rule of reason" and "per se" approach, we analysed the distribution of incidence and sum of the values of the absolute operational risk of Hungarian local government for the period between 2003 and 2012. The practical outlook also demonstrated the contradiction which was established between the efforts of the local governmental level made in the interest

of their environments and their operational balance and financial sustainability. The following table summarises the evaluation of zero hypotheses:

	Evaluated Null Hypothesis of Empirical Research	*Evaluations of Impact Factors of Normativity (a)*		*Evaluations of Impact Factors of Discretionality (b)*	
		H0	H1	H0	H1
I.	**Evaluations of Universal Variables**				
1.	The General Impact of Processes Describable by Operational Expenditures **did not have** Random Character	*g* random variable	*g* deterministic ✓	*mg* random variable	*mg* has a trend ✓
2.	The General Impact of Processes Describable by Operational Revenues has Random Character, on the Contrary the Part of Local Taxes has a Trend	*T* random variable ✓	*T* deterministic	*mT* random variable	*mT* has a trend ✓
II.	**Evaluations of Universal Ratios of Impact Factors of Normativity and Discretionality**				
3.	The Tangible Part of Operational Expenditures has Random Character	*mg/g* random variable ✓	*mg/g* deterministic		
4.	The Local Tax Part of Operational Revenues **did not have** Random Character	*mT/T* random variable	*mT/T* deterministic ✓		
III.	**Evaluations of Operational Risk Indicators**				
5.	Occurence of Risk Events has Random Character, on the Contrary the Discretional Part was Deterministic	*n(OR)* random variable ✓	*n(OR)* deterministic	*n(mOR)* random variable	*n(mOR)* deterministic ✓
6.	Absolute Operational Risk has a Random Character in Connection with the General Impact of Environmental Factors and in Complience with Theoretical Assumptions	*OR* random variable ✓	*OR* deterministic	*mOR* random variable ✓	*mOR* deterministic
7.	Relative Operational Risk has a Random Character in Connection with the General Impact of Environmental Factors and in Complience with Theoretical Assumptions, on the Contrary the Discretional Part was Deterministic	*ROR* random variable ✓	*ROR* deterministic	*mROR* random variable	*mROR* has a trend ✓
IV.	**Evaluations of Universal Ratios of Operational Risk Indicators Derivable from Normative and Discretional Decision Making**				
8.	Universal Ratio of Absolute Operational Risk by Normativity vs Discretionality has Random Character	*mOR/OR* random variable ✓	*mOR/OR* deterministic		
9.	Universal Ratio of Relative Operational Risk by Normativity vs Discretionality has Random Character	*ROR/mROR* random variable ✓	*ROR/mROR* deterministic		
V.	**Evaluations of Inherent Risk**				
10.	Relative Operational Risk in Connection with Discretional Decisions was on or above the Level of Theoretical Assumptions, in Connection with Normativity was below of It	*ROR<IR* ✓	*ROR>=IR*	*mROR >= IR* ✓	*mROR<IR*

Comments:

1. Null hypothesis were defined on universal averages except in the case of Occurence of Risk Events indicators (No. 5 and 12 null hypothesis)
2. Universal ratios are the ratios of universal averages.
3. Null hypothesis were tested by mathematical-statistical computer programmes. The methodology of tests was ATC, which based on the application of the phenomenon of autocorrelation. During the process we compared the theoretical correlation cofficient to the experiential values between the successive years. In the framework of this methodology, if the experiential value does not leave the confidence interval of theoretical limits the assumption of randomness (white noise) will be underpinned. The ten years examined consisted of eight time lags to test. If the presupposition of randomness is falsifiable the variable will be considered as deterministic. The detailed results of the calculations of applied computer programme will be shown in tables in the sections of testing the individual variables.

The results of the practical outlook in relation to the possibilities of practical application were as follows:

On the analogy of the Tiebout-hypothesis, we used such an approach to the analysis of the operational risk of Hungarian local governments at the mezo level which borrowed the possible analytical aspects from the competitive economy.

Our pattern to be followed was the regulation of competition, which, in its system of objectives and means, can use two kinds of regulational and controlling approach, the "per se" and the "rules of reason" types of regulation and controlling methodology.

- The "per se" type evaluation of operational risk introduces a disproportionate distribution of operational risk according to the plant size categories of operational expenditures. The financial and public administrational literature dealing with local governments has processed the plant size problems of the system in detail for the last few decades. The extreme distributional picture of local governments has also indicated to us that the local governmental system hides asymmetries in itself. According to the conducted "per se" type of risk evaluation, the 64-80% of the sum of value of the absolute operational risk (OR) was concentrated in 7-13% of local governments.

- For the universe, we also carried out a "rule of reason" type risk evaluation. The distribution of the sum of values of absolute operational risk (OR) according to categories showed considerable structural rearrangement on the "rule of reason" type of approach. We experienced a move of local governments having absolute operational risks of larger sums of value (value-at-risk) in the direction of larger relative operational risks (risk exposure). The risk indicators introduced on the basis of the theoretical framework sensitively, in several dimensions, mediated the moves of the universe to us. Analytically, the process can be further detailed and we can arrive at the individual risk evaluation of each local government.

In practice the "per se" and the "rule of reason" types of approaches can be applied parallelly. The "per se" approach can be applied in the course of central governmental interventions for the reduction of operational risks, central financing decisions and the selection of target fields of controlling programs. The "rule of reason" type of approach is suitable for the fine tuning

of local governmental tasks, the differentiation according to the individual risk groups, the impact assessment of sectoral regulations and it is also an adequate approach of control in the selection of scenes of assessment.

Apart from the possible practical application, research can be continued both theoretically and empirically.

- Theoretical research possibilities emerge on the "interfaces" of the local governmental sector first of all in relation to modelling institutional capacities becoming necessary in the direction of the local market, local society and also local natural values. What kind of quantitative and qualitative characteristics does the optimally created local governmental institutional system possess which generates the lowest possible absolute operational risk at the mezo level? The other interface is the regulational, controlling and financing system maintained with the central government. Basically, we can put the same question as before: is there such a normative financing model which created the lowest possible absolute operational risk at the mezo level among local governments? The problem can be approached from many kinds of direction. In my opinion, a regulational and institutional and institution-constructing approach supported theoretically, treating information with a "rule of reason" view in combination with the transformation of the financing system highlighting the elements of stability and being bound to rules, can significantly reduce the absolute and relative operational risk of the system of local governments. The exploration and processing of information – and system – theoretical relations of capacity balances already introduced in the dissertation may yield further theoretical results providing a utilisable reference framework for the theoretical basis of the suggested transformations.

- Apart from the further development of the theoretical frameworks, it is reasonable to intensify research towards methodology as well. The established operational risk indicators can be further divided. Based on the system of index figures accepted in financial analyses, indicators subdivided in detail, can be constructed, with which we can explore the detailed characteristics of operational risk processes. On the Hungarian universe, we can further divide tangible expenditures and can study the distribution of their components together with the internal and external variables.

Similar possibilities of analysis are offered by statistical variables creatable by the subdivision of local taxes. As an external variable, we can study local tax bases, in the framework of comparative analytical procedures.

- Considering the fact that no decrease in the level of operational risks can be expected, the scope of progressive empirical research can be extended by the application of a new methodological toolbar in future. For this purpose, Monte-Carlo simulation could be a useful methodology. The suggested methodology is a procedure developed in the scope of natural sciences, which is suitable for modelling and testing future courses of stochastic processes (scenario analysis). The method of simulation in modern economics places the deterministic approach to trend analysis into the framework of probability theory and applied methodology. Structured Monte-Carlo simulation of scenarios (SMC) is now an accepted procedure in the risk management of credit institutions. Concerning the trend analysis-related introduction of this methodology in Hungary at the macro level, substantial advances have also been made in relation to the state household (Báger at al 2012). Research at the mezo and macro levels can be connected to the latter methodological direction of development.

- Apart from the use of statistical tools built on the processing of large and significant number of data (big data), completing these tools, operational risk forecasts can be made with the theoretical distributional picture as well, also generated in a large number. For instance, the credit institutional methodology of VaR (value-at-risk) calculation, by the use of the SMC tool, can be applied to state-household relations as well. The clarification of theoretical relations, making the methodology applicable to state household, the experimental testing of the possibilities of practical use involve further research tasks in the forthcoming years.

- The methodology presented in the dissertation can also be used in a complex way, for the empirical analysis of the local governmental system of the individual states. The selection of data sources, getting to know the regulational system of the given state, the identification and testing of statistical variables, necessary for the application of the methodology, all involve serious challenges. The analytical methodological framework suitable for the international comparison of the operational risks of state households can be made up by the utilisation of the experience of a large number of

assessments at the sectoral level. This direction of development, on the one hand, extends the practical possibilities of the application of the methodology and, on the other hand, it can yield theoretical and methodological results unplannable in advance. Carrying out the international comparisons requires the cooperation of theoretical and practical experts. It is an expensive but very promising direction of research.

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