Assessment of structural changes of concessions in the water and sewerage sector

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Abstract. The goal of this scientific paper is, based upon the research of the structural changes of projects and investments for concessions of existing assets and in general for public-private partnerships (PPP) in the water and sewerage sector, to assess the redistribution of concession practices and flow of investments, by regions of the world. The research encompasses the period of 1991-2018, based upon the data of the World Bank, for countries with a low or medium income. The study used the statistical analysis methods of comparative analysis and the analysis of structural changes.

The practical significance of the research will be expressed in the creation and testing of a method for conducting structural analysis of data sets in the area, for example, of PPPs in the sector of water and sewerage.

Use of the integral coefficient of structural changes proved to be the suitable instrument for uncovering structural differences, including in depth ones, by doing a step-by-step decomposition of the individual sub-levels of the researched aggregates or databases.

It is believed that this applied structural approach and the results received from the study will serve as an additional instrument for analyzing and tracking the behavior of certain market counter-agents. Structural analysis results will help in the creation of situational models for pre-crisis, crisis or post-crisis situations that will assist public authorities and local communities in making decisions concerning the restructuring of their water services (partially or fully privatized or nationalized, leasing or subcontracting of concessions, changes to the use of types of PPP), as well as helping potential or active water entrepreneur concessionaires by providing precise parameters for their investment intentions and/or business plans.

As a result of the research of structural changes of *concession projects* and *concession investments* of existing assets for the period 2008-2011, it is discovered that the world financial and economic crisis had a stronger influence upon the structural changes of *concession investments than on the concession projects*.

The significantly increasing structural changes reported during this global crisis period in five of the six surveys, by individual regions of the world, practically bring to the fore the effect of the results of the decisions, taken in response to the fears, doubts, demands and expectations, by management teams from the public and private sectors.

Key words: concessions, water utilities, water and sewerage, structural changes, PPP projects, investments.

1. Introduction

Over the last few years, countries of the world have been facing the challenge of maintaining and developing their water infrastructure, as well as restructuring water utilities and their offered services. Quite often this happens by increasing the participation of the private sector. Given the limitations of government budgets for financing the growing infrastructure projects, authorities are seeking ways of sharing part of the burden for new investments in infrastructures with the private sector. Furthermore, the participation of the private sector could increase the effectiveness of investments, management, operation and maintenance of public utilities. The restructuring of the water sector in different countries has been shown to attract businesses in that sector which have brought about increased benefits such as an improvement in the quality of the provided water utilities due to an increase in competition within the sector.

For this reason, *the entities being researched* are concessions such as the basic public-private partnership (PPP) in the water and sewerage sector from around the world.

The object of the research is the structural changes regarding the number of projects and the size of investments in concessions of existing assets, viewed through the prism of public-private partnerships in countries with a low or middle income in the water and sewerage sector.

The goal which we have in this paper is, primarily the study of structural changes in projects and the investments of concessions and overall for the public-private partnerships in the water and sewerage sector in order to evaluate the redistribution of concession practices and related investment flows by regions of the world.

The fulfillment of the stated goal will be achieved by solving the following *main problems*:

1. The systematization of methodological bases and the creation of a methodology for researching data sets in the sphere of public-private partnerships in the water and sewerage sector based upon structural analysis.

2. The approbation of a methodology for the conducting of structural analysis for data sets for the private sector’s involvement in the development of the technical infrastructure of the water and sewerage sector.

3. Analysis and evaluation of structural changes of the studied aggregates related to the number of PPP projects, concession projects and the size of PPP investments as well as concession investments in the water and sewerage sector by region of the world.

The study of structural changes as related to the number of projects and the size of investments of concessions through the prism of all PPP projects in the water and sewerage sector in the regions of East Asia and Pacific, Europe and Central Asia, Latin America and the Caribbean, the Middle East and North Africa, South Asia and the sub-Saharan Africa covers the period of 1991-2018.

In order to establish structural features of the use of concession practices for existing assets in the water and sewerage sector, specialized data sets of the World Bank for the participation of the private sector in the development of the infrastructure of different regions are used for analysis. (Bank, 2017a).

The databases include infrastructure projects (meeting certain criteria) in countries with low or middle incomes (Bank, 2017b).

It is believed that the applied structure method and the obtained results from the study will serve as an additional tool for the analysis and tracking of the behavior of certain market counteragents (in this case, operators of water concessions). For example, the results of the structural analysis could assist government authorities and local communities in making decisions concerning the redistribution of their water utilities (whether the sector is partially or fully privatized or nationalized, leasing or subcontracting of the concession, changes to the type of PPP used) by creating a situational model for pre-crisis, crisis or post-crisis situations. The results will also help potential or active entrepreneur water concessionaires regarding the specifications of the parameters of their investment intentions and/or business plans.

2. Nature and content characteristics of the concessions

The development of the water and sewerage sector as a part of the whole infrastructure of a country is among one of the key factors influencing an increase in the living standard of that country’s population. The chronic lack of financial funding over the long term by public authorities for the maintenance of the water and sewerage infrastructure is among the primary reasons why public-private partnerships had to be formed as an innovative investment model.

By providing infrastructure utilities in the water sector, opportunities exist for the participation of the private sector. In addition to the forms of privatization and contracted services, a significant number of the utilities can be set up as management contracts in the form of concession agreements or concessions depending upon the specific responsibilities and the distribution of the risk between the public and private partners.

„Concessions“ are understood as giving the rights to a private company to provide a specific infrastructure service and to receive the income that it produces. Often that assumes that the concessionaire will pay taxes to the body who offered the concession, make certain investments, as well as collect direct payments from consumers throughout the period of the concession. When the concession period ends, it is possible that compensation on the investment may not be fully recovered (OECD, 2007, p. 19).

In practice, as it concerns water providers and sanitation systems and their equipment, they can be provided by works concessions or services concessions. The definition of „works concessions“ and „services concessions“ are partially given in Article 5 of Directive 2014/23/EC of the European Parliament and Council on the award of concession contracts (EP, 2014, L 94/20). The article states that „‘works concession’ means a contract for pecuniary interest concluded in writing by means of which one or more contracting authorities or contracting entities entrust the execution of works to one or more economic operators the consideration for which consists either solely in the right to exploit the works that are the subject of the contract or in that right together with payment“.

Service concessions are defined as „means a contract for pecuniary interest concluded in writing by means of which one or more contracting authorities or contracting entities entrust the provision and the management of services other than the execution of works … to one or more economic operators, the consideration of which consists either solely in the right to exploit the services that are the subject of the contract or in that right together with payment".

Works and service concessions presuppose that the concessionaire (operator) will assume operational risk associated with the exploitation of the construction or utility including the risk of demand and supply. It is accepted that the concessionaire will accept operational risk, when under normal conditions of exploitation, he is not guaranteed that he will see a return on his investments or expenses associated with the exploitation of the work or service concession. In practice, the risk assumed by the concessionaire presupposes being exposed to market fluctuations and an eventual estimated loss, which may not be negligible in size.

At the time of the adoption of the directive, the European Commission produced an „Informational Paper", which stated that the Commission's opinion did not include the risk, connected with poor management, breach of contract or force majeure (European Council, 2011).

Ameyaw, E. and Chan, A. (Ameyaw & Chan, 2015) point out that effective assessment of risk, which the government assumes, when leaving the development of their water infrastructure in the hands of a public-private partnership is inexact. For this reason, the authors have conducted a study of water projects (Fuzzy Synthetic Evaluation – FSE) using a questionnaire survey. After surveying the entire industry with engaged sectors, they created a list of 40 factors. These factors were further categorized into three main categories – financial/commercial, legal and socio-political and technical. Additional analysis highlighted the category „Financial/Commercial Risk" as the most critical factor, followed by legal and socio-political factors and technical factors. The study shows that the overall level of risk for PPPs in the water sector in developing countries is high, which suggests that these projects are risky for governments as well as for private interests.

Some authors (Milenković, Rašić, & Vojković, 2017) considered the role of the local government in public-private partnership projects, which is namely to evaluate and approve detailed plans for implementation by the concessionaire, while the role of the private partner is to design, build and operate the facility. According to these authors, implementation of the PPP model provided more effective long-term investment possibilities. The PPP model in combination with training, adaptation and innovation are the future for the development of Croatian cities.

Other authors (Mouraviev & Kakabadse, 2017) analyzed the efforts of the Russian and Kazakh governments in establishing a legal, institutional and financial framework for implementing partnerships in different sectors. According to them, PPPs, without a doubt, can be regarded as an instrument for economic reform for the purpose of achieving faster economic growth, providing a larger volume of public services and replacing the government in a number of sectors, such as water supply.

Concession contracts are usually defined by the following characteristics (Guasch, 2004, pp. 27-28):

1. The relationship between the body awarding the concession and the private concessionaire shall be regulated by a contract. The body awarding the concession can be the government, an interdepartmental commission, and sometimes the regulatory agency, which is not a very suitable option.

2. The concession shall be granted for a limited period. Under certain conditions, there are opportunities for its renewal. The concessionaire has the right not only to use the existing public facilities, but also to build new ones. The concession contract sets out the conditions and prices at which the concessionaire provides public services and uses these facilities.

3. The concessionaire shall be responsible for the investments regulated in the contract, under the supervision of the state or the regulatory body, and for the construction of the new facilities. He exercises control and his rights over the new assets until their transfer at the expiration of the contract. Usually in the contract there are clauses defining or indicating: the payment of certain compensation for investments that are not fully depreciated at the end of the concession period; the reasons and the means for legal protection in case of early termination of the contract; various penalties and fines for non-compliance with the agreements.

4. The concessionaire is entitled to remuneration collected directly from the users of the provided service on the basis of the tariffs set in the contract. In general, the tariffs are accompanied by appropriate guidelines for review and adjustment. The prices are most often regulated with the help of set mechanisms for determining the rate of return received by the concessionaire and a fixed price ceiling. Through the principle of effective financial balance set in the mechanisms, the concessionaire has the opportunity to realize a good rate of return on investment. In cases where the operating income may not cover the costs, deliberately provided compensatory mechanisms are applied.

In another aspect, the characteristics of concession contracts can be studied from the point of view of public-private partnership. In this regard, according to some authors (Marques, 2016), the results of infrastructure and water resources management from public-private partnerships, for example in Brazil, differ from those expected and there are discrepancies in the price of services to be paid. Recommendations have been made to improve public procurement of this type - preliminary studies and documents are rarely well prepared, there is low competition and the risk matrix is unbalanced. This implies that the quality of contract management is not very good.

Other authors (Porcher, 2017) consider the price ratio of water services / debt from directly managed services. These analyzes highlight the hidden costs that are borne by consumers. Porcher concludes that if public services - water supply or sewerage - are outsourced to a private operator, the price is significantly higher than the price of the same services supplied by a municipal council. This difference disappears when the „hidden costs“of water are taken into account, i.e. the price that takes into account the recovery of the public service debt. In fact, private management is characterized by higher tariffs, but a lower level of debt, so that the price ensures the recovery of full costs, while in public administration, prices are lower than in private management, but with higher public service debt.

However, given the wide range of situations in which they apply, concessions are often much more complex than these basic characteristics suggest. Concession agreements also usually contain other obligations and rights that require regular regulatory oversight of compliance monitoring, harmonization of interpretations, change of tariffs, periodic revisions (usually every 5 years) of tariffs and renegotiation of incentives and conditions when appropriate conditions occur. In this case, the role of the government is to set the rules for competition at the stage of bidding and to enforce the terms of the agreements and compliance with the regulations.

Some authors, including Nakhla (Nakhla, 2016), discuss the effectiveness of the contract in the absence of financially guaranteed investments in public-private partnerships. According to them, national reforms to the foundational law can lead to innovations in approaches to regulation. Such a reform is the hybrid model, combining commission regulation and franchise bidding. The model is cost-effective while integrating the objectives of tariffs for solidarity and social connections for access to water.

According to Jensen, O. and Wu, X., hybrid regulation of public-private partnerships for the provision of water and sewerage services, combining contractual regulation and agency regulation, is both persuasive and possible. The challenges of such a model are significant when institutions are relatively weak and the main tensions between the two approaches can undermine the resilience of PPPs. Water concessions in Manila from 1997 to 2015 categorically prove this regulatory model as successful (Jensen & Wu, 2017).

Concession as a form of realization of public-private partnership is characterized by a large number of advantages. We will emphasize only the most important ones:

1) „Concessions should be used in areas where they are most likely to aid development“ (Kerf, et al. 1998, p. 12). They are most likely to support development when used to regulate natural monopolies, such as the water sector, where services can generally be provided cheaper by one company than by two or more.

2) Conducted on the basis of a competitive tender, concessions stimulate competition for the market, as opposed to competition within the market, which would lead to the elimination of monopoly rents, with the object of obtaining the most efficient operator and providing support for regulatory supervision (Guasch, J. Luis, 2004, p. 31).

3) „Concessions can encourage cost efficiency, particularly when granted under price-cap regulation or rate of-return regulation if cost referential benchmarks are used. Under price-cap regulation, concession contracts specify maximum prices for set quantities of goods or services, permitting cost savings to accrue to the concessionaire, at least between tariff reviews“ (Guasch, J. Luis, 2004, p. 31).

4) A concession can both stimulate competition and foster profitability. If it is well organized, for example a water concession won by the tenderer offering to provide the water utility to consumers at the lowest cost, acts as an incentive to improve efficiency in the following two aspects, accompanied by the effect of competition in the market.

First, the concession requires companies to offer the water service at a price that covers their costs, but only that much. The latent effect that the concession mechanism has can be identified with the normal competitive pressure predetermining market behavior aimed at maintaining low prices and limited profits. Additional benefits also stem from the fact that the state does not need to calculate the lowest profitable price of the water service and then regulate it in order to prevent the monopoly provider from setting a higher price. Based on the competitive start in the competitive auction, the companies find this price themselves. It is probably the best available estimate at the right price, because companies usually have better information than regulators.

Second, the concession encourages companies to extract water cheaply. There is no way for an inefficient company to win the tender and remain profitable in offering the service. In principle, in order to win, companies have to offer a price for water that is not much higher than their cost of supplying it (Kerf, M. et al., 1998, p. 11).

5) „Concessions generally have a limited term, at the end of which they are put out to bid again. When the incumbent concessionaire has the opportunity to compete in the rebidding, it has an extra incentive to perform well during the term of the original concession, since by performing well, it improves its chances of being awarded the concession again“ (Kerf, M. et al. 1998, p. 14).

6) „If one firm competes for many concessions, it has a further incentive to perform well in order to qualify as a bidder for other concessions. Governments can therefore better harness the benefits of reputation by awarding several concessions in a single industry, each for a different region, and permitting international firms to compete for local concessions, since these companies have valuable reputations they want to protect" (Kerf, M. et al. 1998, p. 14).

7) Granting a concession for the management of state property is one of the main tools for the implementation of projects in various sectors, including in the field of water and sewerage services.

8) Investments in infrastructure projects are an important means of maintaining economic activity and can help a country quickly return to sustainable economic growth. Concessions can provide effective ways to implement infrastructure projects, provide services and more broadly innovate in the context of recovery efforts, including in the field of water and sewerage services. At the same time, they are tools for the long-term structural development of infrastructure and services, which bring clear advantages for both the private and public sectors.

9) The granting of a concession should create guarantees for the protection of public assets for the effective management of a service of public interest at the risk of the concessionaire while promoting the efficiency of public activities and services through the use of private sector expertise.

10) „Concessions are an effective way to attract private finance required to fund new construction or rehabilitate existing facilities. A key advantage of the concession arrangement is that it provides incentives to the operator to achieve improved levels of efficiency and effectiveness since gains in efficiency translate into increased profits and return to the concessionaire. The transfer of the full package of operating and financing responsibilities enables the concessionaire to prioritize and innovate as it deems most effective" (Asian Development Bank, 2008, p. 36).

11) „Concessions are important because they are the only actually tried and tested model of PPP. … France has been using concessions for more than 100 years to supply municipal water" (Grimsey, D., M. Lewis, 2007, p. 225).

12) „Public transport, water supply and electrical facilities can operate several concessions simultaneously, which allows a comparison to be made between the prices of concessionaires, the quality of services and investments in meeting public needs" (Grimsey, D., M. Lewis, 2007, p. 225).

13) „... concession models are useful in countries where the institutional, legal, regulatory and financial structures are not sufficiently developed to ensure full privatization with independent regulation or where its implementation is politically unacceptable" (Grimsey, D., M. Lewis, 2007, p. 225).

14) „The private sector concession model is most likely to achieve the greatest benefits for the community and the economy as a whole. The government continues to own the network while the private operators lease the long-term right to use the assets and collect revenue from service delivery. The benefits accrue due to strong financial incentives to reduce water losses and expand service" (Asian Development Bank, 2000, p. 12).

15) „Concessions ... can provide incentives to expand the customer base, increase investment, maintain existing assets and reduce technical and non-technical losses within water distribution networks" (Asian Development Bank, 2000, p. 83).

These content characteristics of the concession, in the role of practical tools for the implementation of PPPs, reveal its potential as a flexible investment model for the development of public infrastructure in the absence of opportunities for public funding at national and/or local level.

3. Methodological bases for data analysis by measuring and evaluating structural changes in concessions based on the example of public-private partnerships in the water and sewerage sector

The study of foreign experience shows that the diversity of investment intentions and ways of their implementation and financing have led to the emergence and imposition of many innovative forms of public-private partnership related to the specific scheme for the implementation of the individual concession activity. For example, a concession contract can be realized as a model agreement in the form of: franchising, „pure" concession or „specialized" concession (Guasch, J. Luis, 2004, p. 24; O'Connor, Terrence M. 2018; Asian Development Bank, 2008, p. 37). The broad-spectrum range and poly-variance of these potential forms, differentiated by groups, are summarized and presented by (Stoyanov, S., Raichev, T. 2011, pp. 254-260). Each of the varieties differs in terms of the levels of involvement of government or local authorities, the distribution of risk between the public and private sectors, „methods for mitigating threats and minimizing risk" (Antonova, V., 2012, pp. 432-437), responsibilities related to investments, operational requirements and incentives for operators.

The study of the foreign experience regarding the methods used for the analysis of the concessions in the water and sewerage sector show that at the moment the system. Recent research (Medema et al. 2020) focuses on the precesnece of corona virus in sewage. Similar starting point have other researchers (Mallapaty, 2020). Other researchers (Khan et. al. 2020) focus on soil contamination. Structural change index is a common indicator, used in economics (Price, 2020). Structural change index is used (Vasilev, J. and Kaneva, M. 2016) to find variations in structures. Structural changes in water and sewage sector may be studied by: (1) number of projects and (2) amount of investments in adjacent years.

The assessment of structural changes in the present study is based on an analysis of World Bank data on private sector participation in infrastructure construction, in low- and middle-income countries (Bank, 2017b).

One of the main indicators that the World Bank monitors in measuring the participation of the private sector in the construction of infrastructure is the number of projects.

According to the World Bank methodology, the database includes infrastructure projects that meet the following two main criteria:

- They are owned or operated by private companies in low- and middle-income countries. Private partners should have at least a 20% stake in the project contract, except in the case of a waiver, which includes those with at least a 5% stake in equity;
- They service directly or indirectly facilities for public use, where a significant share of production (20%) is sold to service the public under a contract with a utility company.

The countries are reviewed every 5 years to maintain data continuity. The countries are divided into six regions – East Asia and Pacific, Europe and Central Asia, Latin America and the Caribbean, the Middle East and North Africa, South Asia and sub-Saharan Africa.

The private participation projects contained in the World Bank's water and sewerage database are brownfield or contracts for concessions for existing assets, management contracts or leasing contracts, greenfield, and for the acquisition of public property.

Brownfield projects are implemented in one of the following forms of public-private partnership – Rehabilitate, Operate, and Transfer (ROT), Rehabilitate and Lease or Rent and Transfer (RL / RT) and Build, Rehabilitate, Operate, and Transfer (BROT).

The projects under management or leasing contracts are divided into two groups – management contracts and lease contracts.

Greenfield projects are represented only by the following PPP forms – Build, Operate, and Transfer (BOT) and Build, Own, and Operate (BOO).

Projects for acquisition of public property (Divestitures) are divided into partially or fully transferred (Partial and Full) public property.

The database covers projects in a very wide range in terms of their current status. It can be registered as Active, Concluded, Cancelled and Distressed.

The projects in the water and sewerage sector are divided into two subsectors – treatment plants and utilities.

The distribution of projects in the subsector wastewater treatment plants is covered by the segments: potable and wastewater treatment plant; potable treatment plant; wastewater treatment plants.

The distribution of projects in the subsector „Utilities“ by individual segments is as follows: for wastewater collection; for wastewater collection and treatment; for water supply with sewerage; for water supply without sewerage; and others.

Another main indicator, which the World Bank tracks, in order to measure the participation of the private sector in the development of infrastructure, is the amount invested in individual PPP projects, including concessions. The methodology of the World Bank specifies that investment reports for individual projects are for projects which have been done or have to be done by the project company in agreement with the contract for PPI. Database values are recorded by year of investment or by year of the financial closure of the project in millions US dollars. When a change in the investment agreement happens due to a renegotiation of the contract, the database is updated whenever publicly accessible information is available.

If all the projects in the dedicated World Bank database were commensurate in value, it would help the scientific research to produce more accurate results. For example, investments should be presented with comparable prices, or related to the number of serviced households, the number of consumers of utility services or the size of the serviced territory in square kilometers.

Investments in the water and sewerage sector are distributed respectively into two subsectors – treatment stations and utilities.

The distribution of investments for the improvement (rehabilitation) and/or the expansion of treatment plants are segmented in the following ways: for treatment plants for potable water or wastewater; for treatment plants for potable water; for treatment plants for wastewater.

The distribution of investments for the improvement (rehabilitation) and/or expansion of utility services are segmented in the following ways: for collection of wastewater; for collection and treatment of wastewater; for water supply with sewerage; for water supply without sewerage; and others.

In order to have a clearer and more exact understanding of the development of concessions in the water and sewerage sector for the research period, in the six regions of the world, our analysis used the so-called integral coefficient for structural changes of Professor K. Gatev (Gatev, 2007, pp. 44-52).

With the help of the integral coefficient for structural changes, one is able to ascertain the level of structural changes of the aggregates studied, by researching the changes in the relative shares of the aggregates in individual regions in relation to their total size (number or size, respectively) for the examined year in relation to the previous year.

The current study’s analysis and evaluation encompasses structural changes in the water and sewerage sector by region of the world for the following aggregates – „number of PPP projects“ (see Table 1), „size of the investment in the PPP project“ (see Table 2), „number of projects for concessions“ (see Table 3) and „size of investments for concessions“ (see Table 4), „number of projects for concessions in relation to the total number of PPP projects“ (derived from the data in Tables 3 and 1) and „size of investments of concessions in relation to the total amount of PPP investments“ (derived from the data in Tables 4 and 2).

Table 1.

The number of projects in the water and sewerage sector by region and year of financial closure for the period of 1991-2018

Financial Closure Year	*East Asia and Pacific*	*Europe and Central Asia*	*Latin America and the Caribbean*	*Middle East and North Africa*	*South Asia*	*Sub-Saharan Africa*	***Total Projects***
1991	0	0	1	0	0	1	**2**
1992	1	0	6	1	0	4	**12**
1993	7	1	5	0	0	2	**15**
1994	5	0	11	0	0	0	**16**
1995	5	1	10	0	0	1	**17**
1996	5	4	15	1	0	6	**31**
1997	19	0	30	0	0	2	**51**
1998	25	1	27	0	0	1	**54**
1999	7	1	17	2	0	6	**33**
2000	20	10	21	0	1	1	**53**
2001	14	3	21	0	1	4	**43**
2002	21	3	23	1	0	2	**50**
2003	30	11	9	1	0	1	**52**
2004	32	11	19	0	1	0	**63**
2005	46	9	6	4	1	1	**67**
2006	46	5	5	0	0	2	**58**
2007	62	2	11	3	5	2	**85**
2008	48	1	11	5	2	2	**69**
2009	32	0	8	3	1	0	**44**
2010	14	0	8	2	1	0	**25**
2011	27	0	7	2	0	0	**36**
2012	21	2	15	1	1	1	**41**

2013	19	0	10	0	1	1	**31**
2014	23	0	13	0	0	0	**36**
2015	25	1	20	2	2	1	**51**
2016	24	1	8	0	0	0	**33**
2017	25	1	2	0	2	1	**31**
2018	21	0	5	1	3	0	**30**
Total Number	**624**	**68**	**344**	**29**	**22**	**42**	**1129**

Sources: World Bank data and author's calculations

The advantage of the integral coefficient, as such, is twofold – on one hand it displays the relative changes, but on the other hand, it is also at the same time able to capture the absolute changes of the studied aggregate. The influence of their one-way changes (towards increase or decrease) in relation to the final value of the integral coefficient is usually difficult

Table 2.

Investments in PPP projects (in USD million) in the water and sewerage sector by regions and year of investment for the period 1991-2018

Year of Investment	*East Asia and Pacific*	*Europe and Central Asia*	*Latin America and the Caribbean*	*Middle East and North Africa*	*South Asia*	*Sub-Saharan Africa*	***Total Amount***
1991	0	0	75	0	0	0	**75**
1992	284	0	0	0	0	0	**284**
1993	2558	0	4023	0	0	0	**6581**
1994	821	0	525	0	0	0	**1346**
1995	520	0	1263	0	0	0	**1783**
1996	149	942	148	0	0	20	**1259**
1997	8032	0	1869	0	0	294	**10195**
1998	943	108	1202	0	0	0	**2253**
1999	270	0	2007	0	0	82	**2359**
2000	4066	268	2043	0	0	31	**6408**
2001	673	0	906	0	2	3	**1584**
2002	934	8	470	0	0	0	**1412**
2003	704	324	104	169	0	9	**1310**
2004	3132	241	773	0	111	0	**4257**
2005	1341	440	120	510	0	0	**2411**
2006	1147	740	741	0	0	0	**2628**
2007	1902	609	447	230	142	121	**3451**
2008	974	102	874	874	76	0	**2900**
2009	539	0	304	1419	24	0	**2286**
2010	640	0	1143	570	0	0	**2353**
2011	592	0	545	0	0	0	**1137**
2012	467	133	4720	223	116	126	**5785**

2013	309	0	3217	0	135	0	**3661**
2014	353	0	3548	0	0	0	**3901**
2015	774	1200	3155	114	19	33	**5295**
2016	1527	200	323	0	0	0	**2050**
2017	1583	25	219	0	51	60	**1938**
2018	1961	0	687	240	910	0	**3798**
Total Amount	**37195**	**5340**	**35451**	**4349**	**1586**	**779**	**84700**

Sources: World Bank data and author's calculations

to predict and quite often they can, for example, influence the direction of its increase, followed by a decrease and then again another increase. So, by covering the registered absolutes and relative changes, and the strength of relationship between them, in practice one is able to achieve the measurement of manifested complex structural changes in observed aggregates or databases.

Table 3.

Number of concession projects in the water and sewerage sector by regions and year of financial closure for the period 1991-2018

Year of Financial Closure	*East Asia and Pacific*	*Europe and Central Asia*	*Latin America and the Caribbean*	*Middle East and North Africa*	*South Asia*	*Sub-Saharan Africa*	***Total Projects***
1991	0	0	1	0	0	0	**1**
1992	1	0	2	0	0	0	**3**
1993	5	0	3	0	0	0	**8**
1994	4	0	5	0	0	0	**9**
1995	3	0	5	0	0	0	**8**
1996	1	0	7	0	0	0	**8**
1997	11	0	10	0	0	2	**23**
1998	19	0	16	0	0	0	**35**
1999	2	0	9	0	0	1	**12**
2000	14	9	19	0	0	1	**43**
2001	5	0	13	0	0	0	**18**
2002	11	2	18	0	0	0	**31**
2003	7	0	8	0	0	0	**15**
2004	17	0	13	0	0	0	**30**
2005	15	0	4	0	0	0	**19**
2006	14	2	2	0	0	0	**18**
2007	20	0	8	0	1	0	**29**
2008	9	1	8	0	1	0	**19**
2009	5	0	2	0	1	0	**8**
2010	3	0	6	0	0	0	**9**
2011	8	0	2	0	0	0	**10**
2012	9	1	13	1	1	0	**25**

2013	5	0	6	0	1	0	**12**
2014	2	0	8	0	0	0	**10**
2015	7	0	17	0	0	0	**24**
2016	2	0	7	0	0	0	**9**
2017	1	1	2	0	0	0	**4**
2018	3	0	0	0	0	0	**3**
Total Number	**203**	**16**	**214**	**1**	**5**	**4**	**443**

Sources: World Bank data and author's calculations

By comparing the values of the integral coefficient in different sub-periods of the studied period, one is able to perform an actual measurement of the intensity of structural changes in a dynamic plan.

Table 4.

Investments in concession projects (in USD million) in the water and sewerage sector by regions and year of investment for the period 1991-2018

Year of Investment	*East Asia and Pacific*	*Europe and Central Asia*	*Latin America and the Caribbean*	*Middle East and North Africa*	*South Asia*	*sub-Saharan Africa*	***Total Amount***
1991	0	0	75	0	0	0	**75**
1992	284	0	0	0	0	0	**284**
1993	2417	0	4000	0	0	0	**6417**
1994	801	0	165	0	0	0	**966**
1995	360	0	1193	0	0	0	**1553**
1996	35	0	86	0	0	0	**121**
1997	7771	0	1363	0	0	294	**9428**
1998	748	0	927	0	0	0	**1675**
1999	48	0	1589	0	0	45	**1682**
2000	3442	268	2043	0	0	31	**5784**
2001	85	0	795	0	0	0	**880**
2002	735	8	218	0	0	0	**961**
2003	509	0	102	0	0	0	**611**
2004	2844	0	137	0	0	0	**2981**
2005	594	0	87	0	0	0	**681**
2006	665	253	305	0	0	0	**1223**
2007	1193	0	141	0	9	0	**1343**
2008	100	102	548	0	76	0	**826**
2009	114	0	15	0	24	0	**153**
2010	39	0	230	0	0	0	**269**
2011	234	0	128	0	0	0	**362**
2012	238	100	4573	223	116	0	**5250**
2013	59	0	3076	0	135	0	**3270**
2014	51	0	675	0	0	0	**726**
2015	186	0	3086	0	0	0	**3272**

2016	70	0	223	0	0	0	**293**
2017	16	25	219	0	0	0	**260**
2018	302	0	0	0	0	0	**302**
Total Amount	**23940**	**756**	**25999**	**223**	**360**	**370**	**51648**

Sources: World Bank data and author's calculations

The coefficient of structural changes, proposed by K. Gatev, is calculated with the help of formula (1):

$$K_{sg} = \sqrt{\frac{\sum_{i=1}^{k}(v_t - v_{t-1})^2}{\sum_{i=1}^{k} v_t^{\,2} + \sum_{i=1}^{k} v_{t-1}^{\,2}}}, \quad (1)$$

which for the goals of this study, the formula elements will be designated as follows:

i=1,2,…k – the number *sub-aggregates* – assume the values of 1 to 6, corresponding to the number of regions in the world, in whose territory there have been registered elements of the observed aggregate in the period of the examined year;

v_t – relative shares of the sub-aggregates are calculated based on the registered elements of individually observed aggregates in their territory (number of PPP projects, size of investments in PPP projects, number of projects for concessions or size of investments of concessions) in relation to the total number in the examined year;

v_{t-1} – relative shares of sub-aggregates are calculated on the basis of registered elements of individual observed aggregates in their territory (respective number of PPP projects, size of investments in PPP projects, number of projects for concessions or size of investments for concessions) in relation to the total number for the previous year.

When structural changes are determined through the calculation of the number of projects for concessions in relation to the total number of PPP projects or the size of investments for concessions in relation to the total number of PPP investments in the water and sewerage sector then:

v_t – the relative shares of the sub-aggregates are calculated on the basis of the registered elements of individually observed aggregates in their territory, in this case the number of projects for concession or the size of the investments for concessions, but determined respectively in relation to the total number of PPP projects or total size of the PPP investments for the examined year;

v_{t-1} – the relative shares of the sub-aggregates are calculated on the basis of the registered elements of individually observed aggregates in their territory, in this case the number of projects for concessions or size of the investments of concessions, but determined respectively in relation to the total number of PPP projects or total size of PPP investments for the previous year.

Usually, the coefficient of structural changes is normalized in the range from 0 to 1. For a more exact interpretation of the results, the scale for normalization and interpretation of structural changes (see Table 5) proposed by T. Todorov (Todorov, 2010, p. 23) has been used.

In the practical use of the integral coefficient, when covering a longer period of time, such as that in our study, the unweighted arithmetic mean of the coefficients by sub-periods (years) should not be used in determining its mean value (Gatev, 2007, pp. 51-52). Using this method for this study would lead to inaccuracies because changes in structures throughout a whole period are not guaranteed to be smooth and uniform. To more accurately

Table 5.

Scale for the Normalization and Interpretation of Coefficients of Structural Changes

Value of the coefficient of structural changes	**Economic Interpretation**
Zero	No structural changes
From 0.01 to 0.05	Very weak, negligibly low structural changes
From 0.06 to 0.10	Weak structural changes
From 0.11 to 0.20	Moderate structural changes
From 0.21 to 0.40	Significant structural changes
From 0.41 to 0.60	Strong structural changes
From 0.61 to 0.99	Very strong, intensive structural changes
1.0	Total, diametrically opposed structural changes

determine the average value for the whole period, one should use the calculated average geometric mean. Thus, if the corresponding coefficients for the sub-period are K_{si}, and the sub-periods are n, the average or average annual integral coefficient ($\overline{K}_s$) will be calculated using the formula:

(2) $$\overline{K}_s = \sqrt[n]{\prod K_{si}} \quad ,$$

where: $\prod$ – the sign of the work;
i=1,2,…n – number of *sub-periods* – assume the values of 1 to 27.

Another peculiarity is that a multiplicative relationship does not exist between the integral coefficient calculated for individual sub-periods (years) and the total coefficient for the whole period, i.e. the product of the coefficients for individual sub-periods is not equal to the coefficient for the last year of the period compared to the first year.

It is important to keep in mind that the integral coefficient of structural changes is dependent on the number of structural elements (parts of the aggregates), i.e. it would not be correct to compare coefficients calculated for structures with a different number of elements.

A number of features influence the accuracy of the structural analysis results, for example, the PPI includes data for the expected size of investment upon the signing of a contract. This value is helpful in that it provides an assessment of the total capital for the duration of the project, and at the same time it is not dependent upon the stage of its life cycle. When using this measure, there are known disadvantages. One of the disadvantages is connected to the size of the common investment information, which is declared by the participating parties and is often not announced publicly making it difficult to verify, thus there are missing values and mistakes in the values of the database registration. Apart from this, the size of the capital investments may be considerably different from the actual investments (Jensen, 2017, p. 9).

A negative influence on the accuracy of the structural analysis comes from the incomplete databases for some of the years and regions especially the missing investment size for the many mostly smaller PPP projects. For this study, from the 1129 PPP projects registered in the database (up to 17.02.2020) in the water and sewerage sector for the period of 1991-2018, approximately 23,56% of them are missing data for investment commitments. For the concession projects, approximately 20,99% of them are missing data for the expected investments. With appropriate subsequent calculations such as for the decrease in the notional amount of investments on average per project, projects with missing investment data will have to be excluded in order to limit statistical errors.

Regardless of the incomplete and/or inaccurate data, the World Bank database with reference to PPP projects in the sphere of technical infrastructure still offers access to a serious volume of „detailed and summarized data, which can serve as the basis for the evaluation and analysis of private participation in infrastructure and its trends by country, region and sector“ (Bank, 2017b).

In the subsequent analysis, it must be understood that it is conditional, because the evaluation has not been completed at the time of the value of the investment of PPP projects for individual years. As a rule, the highest average value of the size of investments in one project in the water and sewerage sector for the period of 1991-2018 is characterized by relatively equal values, of approximately 150 million USD, for *public transferred projects (partially and fully)* and concession projects. It should be taken into account that public transferred projects are characterized for having the lowest relative share, about 2,9% of the total number of PPP projects in the water sector, and these *concessions* – are in second place, after the *projects for new sites*, with a relative share of 39,2%.

The following is the *average value* for *concession projects*. It exceeds 1,52 times the analogous *average value for the size of investments of one PPP project* in the water and sewerage sector.

Then, in descending order, follow the *average values* for the size of investments for one project: *for a management contract* (about 1,96 times smaller than that of the concessions, but here the error can be significant, since only 16 of 112 projects registered in the database have data for planned investments); *for a leasing contract* (about 2,07 times less than that of the concessions); *for a new site* (about 2,50 times smaller than that of the concessions).

Consequently, it can be conditionally accepted that the *concessions* are characterized, on average for project, with a significantly larger volume of necessary (planned) investments analogous to the remaining types of PPP, with exception to the *partially and fully public transferred projects*, which, however, are characterized by much lower frequency.

We would like to suggest that *structural analysis* using the so-called *integral coefficient of structural changes adapted* for data sets in the sphere of PPP in the water and sewerage sector be completed in the following order:

1. Formulation of a scientific research objective and main sub-objectives (main tasks), whose solutions are based on structural analysis.
2. Systemization of specific *methodological instructions* including a choice of statistical tools which include an evaluation scale and steps (algorithms) for completing a structured analysis of data sets.
3. Application of the *methodological instructions* for conducting a structured analysis with selected statistical tools and applied steps *adapted* for observed aggregates of data in the sphere of public-private partnerships in the water and sewerage sector, with the goal of fulfilling the set research objective.
4. Preparation of a comparative assessment between structural changes in *PPP projects* and *concession projects* in the water and sewerage sector, by region, for the period of 1991-2018, including the calculation of the *average value* of the integral coefficient for structural changes ($\overline{K}_s$) of *PPP projects and concession projects.*
5. Research and evaluation of structured changes in relation to the *number of concession projects* calculated relative to the *total number of PPP projects* in the water and sewerage sector, by region of the world, for the period of 1991-2018, including determining the *average value* of the integral coefficient for structural changes ($\overline{K}_s$).
6. Analysis and evaluation of structural changes in *investments of PPP projects* and in *investments of concessions* in the water and sewerage sector, by region, for the period of the study, including the calculation of the *average value* of the integral coefficient of structural changes ($\overline{K}_s$) of *investments in PPP projects* and *investments in concessions*.
7. Analysis and evaluation of the structural changes in relation to the *size of investments for concessions* calculated relative to the *total size of PPP investments* in the water and sewerage sector, by region of the world, through the research period of 1991-2018, including discovering the *average value* of the integral coefficient of structural changes ($\overline{K}_s$).
8. Derivation of the peculiarities between structural changes, compared to the previous year, of *PPP projects* and the *investments in them* in the water and sewerage sector, by region, for the period studied, including a *comparison of the strength of changes between average values* of the integral coefficient of structural changes ($\overline{K}_s$) for *PPP projects* and the *PPP investments*.
9. Disclosure of specifics of the structural changes between *concession projects* and *concession investments* in the water and sewerage sector, by region, for the period studied, including the *comparison of the strength of changes between average values* of the integral coefficient of structural changes ($\overline{K}_s$) for *concession projects* and for *concession investments*.
10. Deducing the main conclusions, summaries and/or recommendations as a result of the research conducted using the described *methodological steps (algorithms)*.

In our opinion, when conducting research, it is important to reveal the various, most common causes, factors, conditions and/or factual situations of the business environment, which in one or another predetermine the relative and absolute changes of observed aggregates (variable).

It is essential to establish the mechanism of manifestation of a given structural change, and whether it is decreasing or increasing and to what extent, due to the relevant absolute and/or the relative changes, by individual regions of observed aggregates of data, and the strength of the relationship between them.

In this way, it will be possible to measure the complex structural changes in the observed data set, in the field of PPP, due to which, as a rule, *very strong, intensive structural changes cannot* be caused in relation to *PPP projects and concession projects*, respectively for *PPP investments* made and *the investments made by concessions*, during the current year compared to the previous year, in the water supply and sewerage sector, by separate regions of the world.

4. Analysis and assessment of the structural changes in the number of projects for concessions in the water and sewerage sector

The distribution of projects in the water and sewerage sector by region is *uneven*. This is determined by the difference in socio-economic development and investment possibilities in the countries of a region as observed during the period of the study (Raichev, 2018, pp. 83-84).

The results of the completed analysis using the integral coefficient for structural changes for the *number of PPP projects* in the water and sewerage sector for the period of 1991-2018 (see Table 6) show that:

- *strong structural changes in the integral coefficient* for PPP projects were observed in relation to the previous year only for 1993 and 1994, with the values – 0,558 and 0,431. Those values from 1993 are due to significant growth in the number of PPP projects in the region of East Asia and Pacific – from 8,3% relative weight in 1992 to 46,7% for 1993 (with a difference of 38,4%), whereas, a decrease was reported in both the Latin America and Caribbean and sub-Saharan Africa regions, the changes in relative shares went from 50,0% to 33,3% (with a difference of 16,7%) and from 33,3% to 13,3% (with a difference of 20,0%) respectively. Concerning the strength of changes for PPP locations in the Middle East and North Africa, they were to a small extent divergent, but equivalent in weight in their decline – with changes in relative shares from 8,3% to 0,0%. While at the same time, a manifestation of PPP projects was registered in a new region – Europe and Central Asia with changes of relative shares from 0,0% to 6,7%.

The *strong changes* in the *structure* of *PPP projects* in 1993 are due to the relatively larger role of growth in the degree of structural differences of the expansion of PPP practices with the newly registered concession projects with the existing assets (*Brownfield*) and the Greenfield project in the region of East Asia and Pacific. Malaysia stands out because of the following PPP: Indah Wastewater Urban Sewerage Rehabilitation – Indah Region (Kuala Lumpur, Penang, Labuan, Langkawi); Sandakan and Tawau Water Supply – Sandakan and Tawau areas, Sabah state; Sewerage collection and treatment – Indah Region (Kuala Lumpur, Penang Labuan, Langkawi); Kota Kinabalu Water Supply Project – Kota Kinabalu, Borneo.

The *strong structural changes of PPP projects* for 1994 as compared to the previous year are mostly due to the significant growth in the number of PPP projects in Latin America and the Caribbean – from 33,3% relative weight in 1993 to 68,8% for 1994 (with a difference of 35,5%), followed by an equal reduction by two projects in two of the regions – East Asia and Pacific and sub-Saharan Africa, with structural changes from 46,7% to 31,3% (with a difference of 15,4%) and from 13,3% to 0,0%, respectively. The absence of the Europe and Central Asia region, recognized as a territorial zone for PPP projects, has had little impact with a relative impact of structural change ranging from 6,7% in 1993 to 0,0% for 1994.

With the lack of projects in the regions of *Europe and Central Asia and sub-Saharan Africa* in 1994, *ongoing processes of strong concentrations of PPP projects in the water sector can be found in the territory of the countries of the regions of East Asia and Pacific and Latin America and the Caribbean*. The opinion of this study is that the degree of attraction of investment interest is due to the clearly existing, long-term accumulated significant problems in the water sector of the countries of the East Asia and Pacific region and a strong reliance on the innovation of PPP tools as an appropriate solution. The countries have been gradually gaining confidence in foreign investors and in their own legislative and regulatory experience, take for example, the leading role of Latin America and the Caribbean with very high activity for the first 12 years and continuing thereafter. As support for this opinion, there are two significant trends in PPP practice in the water and sewerage sector for the period of study, 1991-2018, namely a significant yearly increase in the total number of PPP projects in the East Asia and Pacific region[28] for the period of 2003-2018 in comparison to the region of Latin America and Caribbean[29]. While for the period of 1991-2002, there was a discontinuance of a reverse trend with significant increase in PPP projects in Latin America and Caribbean region in comparison to the East Asia and Pacific region, including.

- *significant restructuring of the number of PPP projects among individual regions* in comparison to the previous year can be observed in 2003. The value of 0,403 of the *integral coefficient* (second largest for the period of study) is mostly due to the increase in relative shares of PPP projects in the region of East Asia and Pacific with 15,7 points (to 57,7%) and Europe and Central Asia with 15,2 points (to 21,2%), at the expense of decreasing the relative shares in the region of Latin America and the Caribbean with 28,7 points (to 17,3%) and sub-Saharan Africa with 2,8 points (to 1,9%), whereas the region of the Middle East and North Africa were comparatively able to maintain their shares with a ratio of 2,0% in 2002 to 1,9% in 2003.

[28] One must take into account the significant opening to the outside world of China, including allowing more foreign investors and its increasing economic power, whose PPP projects are 46,77% of the total number of PPP projects in countries with a low- or middle-income, in the water and sewerage sector in the world.
[29] The total number of projects in the two regions comprise approximately 85,74% of the total number of registered and observed PPP projects in the water and sewerage sector by the World Bank.

Table 6.

Integral Coefficient of Structural Changes, as related to the previous year, of the number PPP projects and the number of concession projects in the water and sewerage sector, by region, for the period of 1991-2018

Sub-period	**K_{si} of the number of PPP projects**	**K_{si} of the number of concession projects**
1992 - 1991	0,218	0,378
1993 - 1992	0,558	0,396
1994 - 1993	0,431	0,251
1995 - 1994	0,130	0,096
1996 - 1995	0,264	0,309
1997 - 1996	0,348	0,520
1998 - 1997	0,133	0,115
1999 - 1998	0,339	0,461
2000 - 1999	0,377	0,422
2001 - 2000	0,211	0,364
2002 - 2001	0,134	0,168
2003 - 2002	0,403	0,140
2004 - 2003	0,173	0,141
2005 - 2004	0,306	0,291
2006 - 2005	0,125	0,131
2007 - 2006	0,111	0,202
2008 - 2007	0,064	0,272
2009 - 2008	0,049	0,262
2010 - 2009	0,219	0,517
2011 - 2010	0,229	0,594
2012 - 2011	0,300	0,527
2013 - 2012	0,131	0,102
2014 - 2013	0,064	0,360
2015 - 2014	0,170	0,115
2016 - 2015	0,289	0,088
2017 - 2016	0,186	0,369
2018 - 2017	0,148	0,798

Source: Author’s calculations

Specifically, this is expressed in the relatively greater role of the increase in the level of structural differences due to the redistribution of investor interest with a decrease of 14 PPP projects in 2003 in Latin America and the Caribbean while at the same time there was an increase of 9 PPP projects in East Asia and Pacific and 8 in Europe and Central Asia. Interest in the region of the Middle East and North Africa was confirmed with one new PPP project;

- 2008 stands out with *weak changes of structure in PPP projects, in number and by region*, respectively, and with a value of 0,064 of the *integral coefficient*, in comparison to the previous year. This is due to the almost identical structure of distribution of relative shares of PPP projects in each of the 6 regions in 2008 in comparison to 2007. In 2008 the initial negative impact of the world financial and economic crisis, which started that year, was felt in the following way – total number of PPP projects started to decrease annually for the period of 2008-2010 to a total of 25, i.e. to numbers seen before 1996, in comparison to the number of projects in 2007. The collapse of PPP activity in the water and sewerage sector reveals the anticipatory behavior of the private investors of the world when the conditions for medium-term and probably for long-term plans are insecure and unpredictable in the business environment;

The lowest values for the 28 years of the period studied were recorded in 2009 – *very weak, negligible low structural changes* with a value of 0,049, which is due to the almost identical structure of distribution of relative shares of PPP projects in 2009 in comparison to 2008, with predominant margins of between the order of 3-4%.

- *identical, weak changes of the structure of PPP projects* in comparison to the previous year are recorded in 2014. During 2013 projects were localized in 4 regions, while in 2014, they were located in only two of the four regions. Two regions – South Asia and sub-Saharan Africa in 2013 recorded one project each. Because of these low values, it has a negligible effect (with relative changes of 3,2%) in measuring the level of structural changes in PPP projects in the water and sewerage sector in 2014.

Based upon the results and the above findings, it is possible to make a *summary*, that in the period studied from 1991 to 2018 *no very strong (intensive) or total (diametrically opposed) changes have been registered in the structure of PPP changes in the water and sewerage sector, by region of the world*. This might be explained on the side of supply by the relatively smooth growth of investors in PPP interests upon discovering an appropriate (profitable) territorial location, with enough security in business demographics, social, economic and/or technological advantages, and *on the demand side* of households (populated communities) – with the vital provision and guarantee of access to quality water for potable-household needs.

During the researched period 12 sub-periods with significant structural changes and 10 sub-periods with moderate changes of structures of PPP projects are predominate. One can observe only two sub-periods with strong structural changes and two with weak and one with very weak structural changes of PPP projects. From the resulting analysis, one can make the following summary that all of them are most often determined by the level of one way and/or opposing actions of the main predetermined values of the integral coefficient for the following factual situations:

- predominately one-way increase or decrease of the *absolute changes of the number of PPP projects* in the two leading regions of East Asia and Pacific, and Latin America and the Caribbean, *presupposes less significant structural changes*;

- the great number of sub-periods characterized by regions with predominately close or approximately equal relative shares of PPP practices for individual years in a relevant sub-period, *lead to an elimination of the appearance of a more substantial structural change*;

- as well as due to the temporary drop in subsequently registered new projects (but characterized by small absolute changes) and „new" regions, respectively, for example Europe and Central Asia, Middle East and North Africa and South Asia, *lead to the elimination of the appearance of more substantial structural changes*.

The *average* of the integral coefficient of structural changes ($\overline{K}_s$) *of PPP projects* in comparison with the previous year, by region, for the period of 1991-2018 is 0,193. It is identified as a level with *moderate changes in structure* according to the adopted scale of measurement.

The results of the completed analysis based upon the integral coefficient of structural changes in comparison to the previous year of *the number of concession projects* in the water and sewerage sector for the period of 1991-2018 (see table 6 again) show that:

- *the strongest changes of structure of concession projects* (with K_{si} = 0,798) were observed in 2018. They are not due to an increase in the number of concession projects in the region of East Asia and Pacific. Since only in that region are localized the new concession projects with existing assets, the relative share of the region in comparison with the other regions amounts to 100%. On the other hand, a greater number of the concession projects in 2017 were distributed among three different regions whereas only one project was registered in East Asia and Pacific. For this reason, there is a greater difference in the changes of relative shares in 2018 in comparison to 2017 for this region, predominately very strong structural changes, coming to exactly 75,0%.

- *strong changes in the structure of concession projects* (with K_{si} = 0,594) are observed in 2011. They are due to the divergent changes in the relative shares between East Asia and Pacific and Latin America and the Caribbean, from 33,3% and 66,7% in 2010 and 80,0% to 20,0% in 2011, relatively;

- predominately in 10 of the sub-periods, there are *significant structural changes*. For example, in the first sub-period 1992-1991, one can observe an *integral coefficient* of concession *projects* of 0,378. These significant structural changes are due to a substantial change in the relative shares in two regions, as a result of the localization of concession projects in those regions. In 1991 in Latin America and the Caribbean was registered the beginning of the realization of the first concession project in the water sector, in countries with low- or middle-income, in Argentina, under the name of Aguas de Corrientes, in the Corrientes Province. In 1992, three new concession projects began with one of them in a new region – East Asia and Pacific, in Malaysia, under the name of Johor Bahru Water Treatment Plant, located in Sunghai Layan/Johor State, while the other two projects were in Latin America and the Caribbean, in Argentina, under the name Sudamericana de Aguas located in the

Municipality of Pilar, Buenos Aires Province. Therefore, the changes to the structure of concession projects is due to the overflow of the 100% relative share in Latin America and the Caribbean in 1991 with a 33,3% relative share for this new region, and a difference of 66,7% was reserved for the leading region in 1992;

- with *weak changes of structure in concession projects* and with respectively the lowest values of the *integral coefficient*, in comparison to the previous year, from 0,096 and 0,102, respectively, differ 1995 and 2013. This is mostly due to the almost identical distribution of relative shares of concession shares in the regions of East Asia and Pacific and Latin America and the Caribbean, from 44,4% to 37,5% and from 55,6% to 62,5% in 1995 and from 36,0% to 41,7% and from 52,0% to 50,0% in 2013, respectively.

On the basis of the results and the main findings, one can *summarize*, that during the period of 1991-2018 no concession projects in the water and sewerage sector, by region of the world, registered as total (diametrically opposed), as well as very weak, with negligibly low changes of structure. This can partially be explained by the simultaneous influence of several important factors such as:

- the need for *research, development and acceptance of relative legislation and regulation* by the countries using the PPP tools and in particular concessions;
- *a more cautious and gradual use by public authorities of the innovative (for them) PPP model* for the resolution of problems in the area of water infrastructure and services;
- *the delicate nature of concession projects for communities* in providing public water and sewerage services taking into account the number of existing foreign examples of the premature termination of concession contracts because of unscrupulous practices or inability of concessionaires to fulfill their obligations.

The *average* integral coefficient of structural changes ($\overline{K}_s$) for *concession projects* in comparison to the previous year, by regions, for the period of research, is 0,260. It is identified as a level with significant changes of structure on the adopted scale.

In comparing the results of the structural changes of *PPP projects* and in particular of *concession projects*, it is possible to come to the following *main findings and conclusions*:

✓ *Concession projects* in the water and sewerage sector in the world during the period of research, 1991-2018, can be characterized as *significant (10 sub-periods), moderate (7 sub-periods), strong (6 sub-periods), weak (3 sub-periods) and one sub-period has very strong* structural changes.

✓ Structural changes are most often due to an expansion in PPP practices in countries from new regions or from a strong increase in the number of PPP projects in individual countries characterized with significant long-term problems in providing the local population with water and/or sewerage services and corresponding treatment plants.

✓ The *average* of the integral coefficient for structural changes, in comparison to the previous year, for the period of study, for *PPP projects* is 0,193 which is about 1,3 times smaller than the analogous *average* for *concession projects* which is 0,260. *This shows that due to various factors concession projects are given to greater structural changes than to the aggregate of PPP projects.* Based on this, one could draw out the following two dependencies:

1. As to the survival, existence and/or prosperity (development) of a business (in this cases as a type of PPP), it is dependent upon and sensitive to the effect of various factors of micro-, meso- and macro-environment being greatly affected by its susceptibility to quick, abrupt changes (for example, in terms of their size, location, type and choice of activity, production nomenclature and range) and of course by their ability to take timely preventive measures to decrease, limit, or share potential risks, i.e. toward higher structural changes.

2. On the other side, the more a business is unaffected by various factors in the business environment, i.e. the business is characterized as having greater flexibility and could comparatively more easily adapt to new conditions, without having to make serious changes in relation to the production environment, the factors of production and the product and/or services offered, it is more likely to not be susceptible to higher structural changes.

In our opinion, *the main group of factors*, *to which are due or which generated specific structure changes*, seen through the studied relative shares of sub-aggregates, calculated on the basis of registered in their territory elements of individually observed aggregates (the number of PPP projects, size of investments in PPP projects, number of concession projects or size of concession investments, respectively) in the water and sewerage sector, *can be generally classified as*:

a) *Technical or still a model* – the factors, which are based on known positions (specific configurations of elements of researched aggregates) of the mechanism, initiating stronger changes of structure in the researched market (economic) aggregates or inducing for example their own significant limitation, resting on the mathematical-statistical logic built into the set computational model. At first glance, one could accept that they have an objective and somewhat incidental character, because they are predetermined by the facts as they are. But even if they appear post-factum – whatever the sub-aggregates being observed either „in place“ or in a specific case – region by years, essentially, these are a direct reflection of previously taken business management decisions, under the influence of the following factors below, regarding the implementation or non-implementation of specific business projects:

b) *financial-economic* – a factor, which especially influences the decision of a business to transition to the implementation or non-implementation of a given business project (what – for example, in which water and sewerage subsector /treatment plant or utilities/, in which segment /treatment stations for potable water and wastewater, treatment stations for potable water, treatment stations for wastewater and/or for collection of wastewater, collection and treatment of wastewater, water supply with sewerage, water supply without sewerage; how – under what PPP form /ROT, BROT, RL/RT, BOT, BOO, management or leasing contract, partially or fully transferred, acquisition of property, and etc./; how much – with what financial and investment commitments; where – in what region of the world; and when – which year, for how long), including on the basis of participation in a tender for a PPP project or in a procedure for awarding a public procurement contract for construction and/or for the provision of a service. It is mainly preventative and largely subjective in character;

c) *organizational-managerial* – a factor, which because of its nature, either offers encouragement or acts as a deterrent for the investment intentions of an entrepreneur. This factor is analogous with the financial-economic factors because it also stands out, but to a relatively lesser extent, with its preventative and largely subjective character;

d) *of a public-legal character* – a factor, which directly and immediately effects the decision of a business. It is distinguished by its objective nature, but also exhibit a significant preventative influence during the research of the potential investment project – the presence of national political will and/or at the local level for the real support of business, stable legislature and etc.;

e) *natural-geographic* – in this case literally the terrain. This factor is of an objective nature and directly influences the decision to implement an investment idea or project;

f) *demographic* – this factor has an objective influence. Entrepreneurs comply with it, taking into account the assurance of the demand of the service in the long-term, as is usually the case with concessions and which would be a difficult task in a region with declining activity;

g) *employment and income* – this factor objectively influences the decision of businesses. It takes into account on one hand to what extent future payments for the provided public service (public good) will be able to be collected, and on the other, what margin and volume of profit can be expected in the short and long term plan, based upon the amount household budgets can afford for the public service in a specific territory, from eventual systematic increase of prices for the offered public service;

h) *inflation and exchange rate of the national currency* – this factor has an objective influence. Entrepreneurs assess the potential size of their actual income, of profit or eventual loss, respectively.

This study proposes that the reason for the difference found in the results, specifically for the above case, can be found by applying one of following two methods.

First, one can perform and in-depth review of the processes of changes of structures effected and each of the other types of PPPs. Therefore, if analogous values of their *average integral coefficient* are almost identical, it would mean that every PPP in the water sector would react in a similar way to problematic situations or in ascending sustainable development in an otherwise dynamic socio-economic environment, i.e. the public institutions and market counteragents directly involved with them will have an almost identical behavior regardless of the heterogeneous specifics of different types of PPPs. In this case, one should be able to receive almost identical values of their *averages* of *integral coefficients* both between them and also among each of the different types of PPPs and for the total number of PPP projects. If however, one accepts that one part of them, for example concessions, have significantly higher values of average of the *integral coefficient* from the rest, because they are, for example, more susceptible, especially to territorial restructuring (in contrast, for example, to projects for new sites /*greenfield projects/* and to a greater degree to management and lease contracts), because long-term commitment to public authorities and to investment programs, brings some discomfort for entrepreneurs when there is an abrupt, unforeseen change in the economic situation (business environment). Then this difference of 1,3 times could be explained precisely by the preventative measures taken to avoid or eliminate certain problems before the successful implementation of the business, which are a generator of significant structural changes, caused, for example, by redirecting the implementation of the business model to another region.

In our opinion, this approach is indicative of how *with the help of structural analysis* the next sub-level (by individual types of PPP) can easily, quickly and reliably support the research in a more general way by revealing the reasons to take into account certain factual circumstances.

Among the *main reasons*, according to us, with the help of which the tools could be additionally enhanced in order to have a more accurate and reliable analysis concerning the discovery of mechanisms for the initiation of relatively stronger structural changes, is that each type of PPP should have the following characteristics:

- to be *more susceptible to territorial displacement in their establishment*, which is a prerequisite for a business to act extremely cautiously and preventively with final decisions;

- to be *less flexible in the event of unforeseen, abrupt changes in the economic situation*, which has a potential deterrent effect on the investment intentions of the entrepreneur and is again a prerequisite for business to act preventively with final decisions – for refusal to implement the investment project or to change the place and/or time of its implementation;

- to be *much more characterized by a more uneven territorial distribution*;

- to have a *higher frequency of ongoing counter-processes in the direction of increase to decrease and vice versa in the same regions (territorial zones)* than those of other types of PPP, respective aggregates.

The possession of each of the indicated quality characteristics by the concession projects can be explained. For example, more difficult susceptibility would mean that concessions are more burdened by territorial dependence, and this is because the study covers concessions of existing water assets (*brownfield*) with a relative share of 39,2%, compared to 41,5% relative share of *greenfield projects*, 16,3% relative share of *management and leasing contracts* and only 2,9% of *divestiture (transfer, i.e. acquisition of property*) of the total number of PPP projects in the water supply and sewerage sector.

This ensures a limitation to a change in their location, but also the inability to show flexibility in financial and economic crises, such as changing or closing down quickly, due to long-term contractual obligations with public authorities and individual households (local communities), especially when it comes to providing a vital necessity such as water.

Of course, this is not the case with concessions in a pre-start position. When identifying a potential hazard with a high degree of risk, they can understandably change their target location very quickly or move to a waiting position. Indicative in this respect are the two observed trends in the water and sewerage sector. When analyzing the structural changes in the total number of PPP projects, it is noteworthy that the number of projects in the four-year period preceding the global financial and economic crisis is 273. During the global crisis it was reduced 1,6 times to 174, and in the subsequent four-year period we have a decline again, i.e. an increase in the downward trend to 159 projects. However, this is not the trend in concession projects. Their number in the four years preceding the global financial and economic crisis amounted to 96. During the global crisis they were reduced by more than 2 times to 46. During the next four-year period, there is a turnaround – there is a growth of concession projects of 1,5 times, reaching 71 units.

Our assumption that they are relatively more unevenly distributed among the different regions of the other types of PPP projects, as well as the presence of more frequent counter-processes of dislocation (territorial displacement) on the same territorial zones (regions) than other types of PPPs, within a given sub-period, are based on the achieved experience in the analysis of structural changes to reveal in whole or in part the mechanism of their generation and respective limitation.

From table 7, it is clear that concession projects have an extremely low representation in three of the regions, on the other hand they occupy an extremely high relative share of the number of PPP projects in Latin America and the Caribbean region – 62,21%. In support of the thesis of the existing greater unevenness in the territorial distribution, respectively of the higher degree of concentration, in the case of concessions is the fact that the relative shares of the number of concession projects and the number of PPP projects of the two leading regions by number of projects – East Asia and the Pacific and Latin America and the Caribbean combined, in comparison to their respective total numbers, amount to 94,13% and 85,74%.

At the same time, the difference is significantly less in the number of concession projects than the total number of PPP projects in the two leading regions (by number of projects), respectively 3,1 for East Asia and the Pacific and 1,6 for Latin America and the Caribbean , undoubtedly this also has an impact, but in the direction of a certain reduction (blurring) of the degree of impact of the structural changes of concession projects in the general plan of the structural changes of all PPP projects.

Table 7.

Number of PPP projects and in particular concessions in the water and sewerage sector by region for the period of 1991-2018

Region / *Indicators*	*East Asia and Pacific*	*Europe and Central Asia*	*Latin America and the Caribbean*	*Middle East and North Africa*	*South Asia*	*Sub-Saharan Africa*	***Total Projects***
Total number of PPP projects	624	68	344	29	22	42	**1129**
Relative share of PPP projects	55,27	6,02	30,47	2,57	1,95	3,72	**100,00**
Total number of concession projects	203	16	214	1	5	4	**443**
Relative share of concession projects	45,82	3,61	48,31	0,23	1,13	0,90	**100,00**
Difference in times less in number of concessions projects in comparison to total number of PPP projects	3,1	4,3	1,6	29,0	4,4	10,5	**2,5**
Relative shares of concession projects from the total number of PPP projects	32,53	23,53	62,21	3,45	22,73	9,52	**39,24**

Source: based upon the World Bank data and calculated by the author

What is specific to the subject of this study, however, is that under the influence of various factors, including force majeure, changes in the structure of different aggregates do not affect the existing number of concession projects as much as the potential conclusion of new concession contracts on the same or another territorial zone (region, country, city) depending on entrepreneurial attitudes, investment intentions and available resources.

The second approach, which requires much more research resources, including time, is to uncover the answers to a number of questions such as:

- In general, for the main types of PPPs other than concessions (excluding, for example, the partially or fully transferred public property, which in the observed data set, due to their episodic nature, have a very low relative share and do not significantly influence the main structural trends). Are the investment intentions of the business easier to relocate or refuse?
- Due to the easier processes of research, preparation (including lack or need for possible processing of public opinion), approval, implementation and control of the activity. Is that the case?
- Are other types of PPPs generally characterized by a lower degree of dependence and direct interaction with public authorities and individual households-consumers of the service than they are in long-term concession contracts and the investment, social and/or ecological commitments, penalty clauses and severe sanctions and consequences in the case of their unforeseen termination due to the fault of the concessionaires?
- Is there a greater sensitivity of the concessionaire entrepreneurs and the lending financial institutions to the various economic, financial, geographical, demographic, political, geopolitical and many other factors that have a strong direct and/or indirect impact on the parameters of the concession business in short-term, medium-term and long-term, compared to those of other types of PPP?
- Does this sensitivity manifest itself permanently regardless of the differences or characteristics for individual regions and the countries in them and their economic conditions and strategic frameworks for development, people's psychology, political situations, specific legislative frameworks, number of potential consumers, their solvency, respectively the ability to collect utility fees and a number of other parameters?
- All things considered, are concessions generally riskier than other types of PPPs?

If it's possible for the answers to be positive, then all this would imply a higher degree of caution when working with concessions, i.e. demonstrating the real possibilities for the practical implementation and ensuring a successful and profitable concession practice will require, in principle, the allocation of more resources, including time and effort, in research and preparation under the covert control and intervention of leading political factors in its eventual implementation. All this, on the one hand, makes it possible to significantly facilitate the processes directly and/or indirectly reflecting on the degree of structural changes in the total number of PPP projects.

When comparing the results of the structural changes of the PPP projects and in particular of the concession projects, for the interval of 2008-2011, the opposite trend is observed, on the basis of which it can be concluded that the global financial and economic crisis has a stronger impact on structural changes of concession projects (average of the integrated coefficient is 0,385, i.e. reports significant changes) than for total PPP projects (average of the integrated coefficient is 0,112, i.e. reports moderate changes) in the water and sewerage sector, by regions. This can be explained by anticipatory behavior, including among the public sector and/or the rapid reorientation of investors of their investment intentions and the corresponding location in an environment of increased uncertainty, given the more complex nature, significant investments, longer payback periods and service life of concessions than those of other types of PPPs. In practice, this has been the case since 2007. A water concession was implemented in the South Asia region for first time during the period studied. The project was named the „Latur Water Supply Scheme“, in the segment water utility without sewerage, located in Latur, Maharashtra – India. In 2008 and 2009, the region attracted the attention of two more concessionaires. One in Brownfield, in the subsector „Treatment plant“, under the name of the project „Haldia Water Management Limited“, with PPP form – Build, Rehabilitate, Operate, and Transfer (BROT), in the segment „Potable water treatment plant“ and located in Haldia City, West Bengal state, India. A second water concession, in the subsector „Water Utility“, segment „Water utility without sewerage“ and located in Khandwa, East Nimar, Madhya Pradesh, India. In 2008, another activity was registered in the region of Europe and Central Asia. The project's name was Luganskvoda. The concession was implemented as a Subtype of PPI – Rehabilitate, Operate, and Transfer (ROT) in the segment „Water utility with sewerage“ and located in Lugansk, Ukraine.

In order to improve our assessment of the redistribution of concession practice, an in-depth analysis must be done by examining structural changes in the number of concession projects calculated relative to the total number of PPP projects in the water sector, by regions of the world (see Table 8).

The main findings of the analysis show the following:

- very weak and weak structural changes are not reported;
- the most significant strong and very strong, intensive changes in the relative shares of the number of concession projects calculated in relation to the total number of PPP projects are reported at the very beginning and during, but towards the end of the global financial and economic crisis and immediately after, and at the very end of the 28-year research period.

Table 8

Integral coefficient of structural changes, compared to the previous year, for concession projects calculated in comparison with the total number of PPP projects in the water and sewerage sector, by region, for the period of 1991-2018

Sub-period	K_{si}		Sub-period	K_{si}		Sub-period	K_{si}
1992 - 1991	0,644		2001 - 2000	0,404		2010 - 2009	0,663
1993 - 1992	0,585		2002 - 2001	0,235		2011 - 2010	0,598
1994 - 1993	0,251		2003 - 2002	0,482		2012 - 2011	0,588
1995 - 1994	0,144		2004 - 2003	0,366		2013 - 2012	0,304
1996 - 1995	0,387		2005 - 2004	0,374		2014 - 2013	0,334
1997 - 1996	0,510		2006 - 2005	0,137		2015 - 2014	0,323
1998 - 1997	0,318		2007 - 2006	0,198		2016 - 2015	0,339
1999 - 1998	0,545		2008 - 2007	0,350		2017 - 2016	0,656
2000 - 1999	0,504		2009 - 2008	0,345		2018 - 2017	0,776

Source: Author's calculations

It is noteworthy that the very strong changes at the beginning and end of the research period are mainly due to:

✓ in the first sub-period 1992-1991 – the sharp decline in the relative share of concession projects in the Latin America and the Caribbean region (against a six-fold increase in the total number of PPP projects during this same sub-period), as a result of the start in 1992 of concession practices in a new region – East Asia and Pacific, i.e. at the expense of the Johor Bahru Water Treatment Plant concession project of the Build, Rehabilitate, Operate, and Transfer (BROT) type in Malaysia. The result is a reduction in the relative shares of concession projects from 50,0% in 1991, to 16,7% and 8,3% in 1992, respectively;

✓ in the penultimate sub-period 2017-2016 – there is a sharp decline in the relative share in the region of Latin America and the Caribbean, compared to the total number of PPP projects;

✓ during the last sub-period 2018-2017 – simultaneous counter-processes take place. The strengthening of concession activity in the East Asia and Pacific region due to the lack of new concession practices in the regions of Europe and Central Asia and Latin America and the Caribbean in 2018.

- 13 sub-periods with significant structural changes are predominant;

- During the period of the world financial and economic crisis of 2008-2011, significant changes were alternating between very strong to strong structural changes. Reasonably, the average of the integral coefficient amounts to 0,468 and is identified as a level with strong changes in the structure. It is impressive to observe the reduction in regions attracting new water concession projects- from 4 in 2008 (East Asia and the Pacific, Europe and Central Asia, Latin America and the Caribbean, South Asia) to 3 in 2009 (East Asia and the Pacific, Latin America and the Caribbean, South Asia) to 2 in 2010 and in 2011 (East Asia and the Pacific, Latin America and the Caribbean). Thus, the sequence and mechanism of the ongoing structural changes during this four-year period can be explained as a chronological combination of:

✓ the reported reduction, with the significant impact of the newly registered concession practices in the territory of the Latin American and Caribbean region during the initial two sub-periods of significant structural changes, is characterized by predominantly approximately equal relative shares in the different regions of the concession projects;

✓ the registered divergent influences in the direction of increase and decrease of the significant for structural changes relative shares in the East Asia and Pacific regions and especially in Latin America and the Caribbean (there is a difference of 19,45% in 2010 compared to 2009);

✓ the observation of significant changes in the absolute changes in the number of concessions in East Asia and the Pacific and Latin America and the Caribbean, together causing strong restructuring processes.

The average of the integral coefficient of structural changes ($\overline{K}_s$) of the concession projects calculated in relation to the total number of PPP projects in the water and sewerage sector, by regions, for the studied period 1991-2018, amounts to 0,385. It is identified as a degree with significant changes in the structure of the adopted scale and it is about 2,0 and 1,5 times higher than the similar average of the integral coefficients of the total number of PPP projects and concession projects.

The two averages of the registered structural changes of concession projects calculated in relation to the total number of PPP projects – one for the entire research period and the second for the period of the global financial and economic crisis – show that the concession projects are significantly sensitive to changes in the business environment and highly sensitive against the background of PPP projects under the influence of the global crisis.

5. Analysis and assessment of the structural changes in the amount of investments in projects for concessions in the water and sewerage sector

The results of the analysis based on the integral coefficient of structural changes compared to the previous year of the amount of investments in PPP projects in the water and sewerage sector for the period 1991-2018 (see Table 9) give grounds to make the following summary:

- There are 24 sub-periods covering 9 significant, 9 strong, 5 very strong and one total change in the structure of investments in PPP projects.

These restructuring processes are mainly due to: the gradual, but not simultaneous, use of PPPs as innovative investment tools in new regions (for example, in Europe and Central Asia and sub-Saharan Africa, the tools were introduced in 1996); the loss of some regions due to the lack of investment in them over the years (for example in Sub-Saharan Africa, South Asia, the Middle East and North Africa), as well as the divergent change in the amount of investment in neighboring years in PPP tools already in use in water sector regions (e.g. East Asia and Pacific, Europe and Central Asia and Latin America and the Caribbean in 2016 compared to 2015).

Some of the main reasons for the course of such highly active, restructuring processes, in our opinion, can be explained by the dependence arising from the physical load for the upcoming or already implemented PPP projects on their main physical characteristics as objects of real estate – stationarity (Stoyanov, S. et al., 2013, p. 14). On the other hand, increasing the degree of structural changes has an impact making it much easier and faster to change the destination of the financial resources rather than the location of PPP projects used in the sector as investment funds;

Table 9.

Integral coefficient of structural changes, compared to the previous year,
of the size of investments in PPP projects and the size of investments in concessions
for the water and sewerage sector, by region, for the period of 1991-2018

Sub-period	K_{si} of investments in PPP projects	K_{si} of investments of concessions		Sub-period	K_{si} of investments in PPP projects	K_{si} of investments of concessions
1992 - 1991	1,000	1,000		2006 - 2005	0,408	0,375
1993 - 1992	0,700	0,713		2007 - 2006	0,278	0,390
1994 - 1993	0,306	0,573		2008 - 2007	0,482	0,850
1995 - 1994	0,427	0,724		2009 - 2008	0,433	0,826
1996 - 1995	0,894	0,073		2010 - 2009	0,570	0,845
1997 - 1996	0,903	0,686		2011 - 2010	0,372	0,623
1998 - 1997	0,484	0,507		2012 - 2011	0,513	0,695
1999 - 1998	0,405	0,484		2013 - 2012	0,068	0,070
2000 - 1999	0,669	0,700		2014 - 2013	0,038	0,051
2001 - 2000	0,329	0,651		2015 - 2014	0,348	0,014
2002 - 2001	0,327	0,786		2016 - 2015	0,747	0,208
2003 - 2002	0,410	0,078		2017 - 2016	0,112	0,187
2004 - 2003	0,330	0,134		2018 - 2017	0,374	0,964
2005 - 2004	0,338	0,089				

Source: Author’s calculations

- regions with countries with significant long-term problems in providing the local population with water and/or sewerage services and the respective treatment plants - Latin America and the Caribbean (mainly in Argentina, Brazil, Colombia, Mexico and Chile), East Asia and Pacific (mainly in Indonesia, China, Malaysia, Thailand and the Philippines) and Europe and Central Asia (mainly in Russia, Armenia and Romania) are often characterized by several times larger absolute changes in the amount of investment in PPP projects, leading respectively to a strong increase in their relative shares during the year compared to zero investments, with low values or with significantly lower values of investments in the previous year. Such situations also presuppose more significant structural changes;
- only 1992 was characterized by total, diametrically opposed changes in the structure of investment in PPP projects, due to the completely divergent change in investments in the water sector between Latin America and the Caribbean, and East Asia and Pacific. In the present case, the difference in the scale of investments in PPP projects in these two regions does not have and would not have any impact on the final value of the analyzed integral coefficient;
- only 2014 is characterized by very weak structural changes in investments in PPP projects, due to the elimination of the relatively smaller PPP investment region of South Asia and at the same time with a relatively uniform increase in investments in PPP projects in Latin America and the Caribbean, and East Asia and Pacific;
- the average of the integral coefficient of structural changes ($\overline{K}_s$) of investments in PPP projects, compared to the previous year, by regions, for the period 1991-2018, amounts to 0,376. It is identified as a degree with significant changes in the structure of the adopted scale for standardization and interpretation.

The results of the analysis based on the integral coefficient of structural changes compared to the previous year for the amount of concession investments in the water and sewerage sector for the period 1991-2018 (see again Table 9) give grounds to make the following findings:

- 12 years (1993, 1995, 1997, 2000, 2001, 2002, 2008, 2009, 2010, 2011, 2012, 2018) are reported with very strong and one year (1992) with total, diametrically opposed changes in the structure of investments for concessions;
- the average of the integral coefficient of structural changes ($\overline{K}_s$) compared to the previous year, by regions, during the studied period, amounts to 0,328. It is identified as a degree with significant changes in the structure according to the adopted measurement scale.

When comparing the results of the structural changes of the investments in PPP projects and in particular of the investments for concessions during the studied period 1991-2018, the following findings, summaries and conclusions can be made:

- we should exclude from this specific, private analysis the equally total changes in the structure (K_{si} = 1,000) of investments in PPP projects and in particular that of investments in concessions in 1992, which are due to divergent changes in relative shares of investments in the same concession projects (from 100% for Latin America and the Caribbean in 1991 to 100% for East Asia and Pacific in 1992), as they are largely inaccurate due to missing data for most of the PPP projects in the World Bank database;
- years with very weak structural changes in investments in PPP projects are reported only in 2014, while investments for concessions are reported in 2014 and 2015;
- slight changes in the structure of investments in PPP projects are reported at the end of the period – only in 2013, while for investments for concessions such changes in the structure are typical for the beginning, middle and end of the study period, respectively in 1996, 2003, 2005 and 2013;
- the average of the integral coefficient of structural changes compared to the previous year for the studied period of investments in PPP projects is 0,376. It is higher than the similar average of concession investments which is 0,328.

The conclusion that can be drawn with regard to the strength of the changes as a result of the above findings is that in the period 1991-2018, in its average degree, equal to significant, the changes in the structure of investments for concessions are, albeit with very few changes, less significant than those in the structure of PPP investment projects. This can probably be explained by the significantly more complex and cumbersome procedures for the investigation, approval, award, implementation, management, control and termination of one concession than those for the other types of PPP. On the one hand, this would stop the investment intentions of potential water concessionaires to invest in times of crisis or other market turmoil, however, due to the nature of the vital needs of the population, in other countries, respective regions, despite the unfavorable business environment, in view of avoiding the onset of acute humanitarian crises, forcing both parties – the public and the private sector – to take action at all cost.

The following feature is also observed. In the period 2008-2011, there is a restructuring of investments in PPP projects in the water sector worldwide by regions that are clearly more directly and/or indirectly dependent on the negative processes caused by the global financial and economic crisis, such as East Asia and Pacific and Europe and Central Asia to regions much less directly and/or indirectly dependent on it, such as Latin America and the Caribbean and the Middle East and North Africa. Strong divergent changes in the relative shares of investment in PPP projects compared to the previous year began to be reported in 2008 in East Asia and Pacific and Europe and Central Asia, showing a decrease and with values of 55,1% to 33,6% and from 17,7% to 3,5%, respectively, and in Latin America and the Caribbean and the Middle East and North Africa – increasing, with values from 13,0% to 30,2% and from 6,7% to 30,1%.

A significant change in the structure of investments for PPP projects compared to the previous year showing an increase was observed in 2009 for the Middle East and North Africa – from 30,1% to 62,1%. In 2010 we have a significant change in the structure of investments for PPP projects in the Middle East and North Africa – with a decrease from 62.1% to 24,2% and at the same time with a significant increase – from 13,3% to 48,6% for Latin America and the Caribbean.

An analogous situation is seen in 2011 in comparison to 2010, but with a change in regions. There is an approximate equality in Latin America and the Caribbean (47,9% and 48,6% respectively for the two years) and strong counter-processes of changes in the relative shares of investments for PPP projects in East Asia and Pacific (from 27,2% in 2010 to 52,1% in 2011, i.e. an increase of 24,9%) and the Middle East and North Africa (from 24,2% in 2010 to 0,0% in 2011, i.e. a decrease of 24.2%).

Comparing the results of the structural changes of the investments in PPP projects (including the relative average of 0,459) and in particular of the investments for concessions (with an average of 0,780), for the period of 2008-2011, the conclusion can be made that the global financial and economic crisis has had a much stronger impact on the structure of investment in concessions than on that of total investment in PPP projects. Here, too, the sensitivity to the crisis by concession investments, as in the case of concession projects, should be explained by the probably more complex business environment for concessionaires, which predetermines much greater uncertainty and unpredictability for the successful implementation of a possible business plan, along with the already mentioned main shortcomings over the other types of PPPs used in the water and sewerage sector around the world.

The analysis of the structural changes in terms of the amount of investments for concessions calculated in relation to the total amount of PPP investments in the water and sewerage sector, by regions of the world, during the period of research, 1991-2018 (see Table 10), helps one to make possibly even more profound revelations.

The evaluation of the results obtained gives one the grounds to formulate the following main findings, conclusions and summaries:

- 21 sub-periods are characterized by very large values of the integral coefficient of structural changes – total, only in 1992-1991 and very strong and strong – for all other sub-periods, i.e. here the research shows the strongest restructuring among all the studied aggregates – number of PPP projects, amount of investments in PPP projects, number of concession projects, amount of investments for concessions, number of concession projects in relation to the total number of PPP projects and the amount of investments for concessions compared to the total amount of PPP investments in the water and sewerage sector, by regions, for the period of 1991-2018.

Very large values of the integral coefficient of structural changes were reported during these 21 sub-periods and they are characterized by the following features:

- very strong and total structural changes in the sub-periods from 1992-1991 to 2002-2001 are due to their significant divergent or one-way changes in relative shares, combined with significant absolute changes (in millions of USD) of the specific annual values researched in the East Asian and Pacific regions and Latin America and the Caribbean. Until 1996, the Latin American and Caribbean regions made the greatest contribution to the intensification of structural change, followed by the East Asia and the Pacific region;

Table 10.

Integral coefficient of structural changes, compared to the previous year, by size of concession investments calculated in comparison to the total size of PPP investments in the water and sewerage sector, by region, for the period of 1991-2018

Sub-period	K_{si}		Sub-period	K_{si}		Sub-period	K_{si}
1992 - 1991	1,000		2001 - 2000	0,645		2010 - 2009	0,874
1993 - 1992	0,715		2002 - 2001	0,785		2011 - 2010	0,745
1994 - 1993	0,574		2003 - 2002	0,227		2012 - 2011	0,846
1995 - 1994	0,727		2004 - 2003	0,364		2013 - 2012	0,062
1996 - 1995	0,890		2005 - 2004	0,591		2014 - 2013	0,778
1997 - 1996	0,949		2006 - 2005	0,325		2015 - 2014	0,674
1998 - 1997	0,547		2007 - 2006	0,336		2016 - 2015	0,797
1999 - 1998	0,476		2008 - 2007	0,868		2017 - 2016	0,181
2000 - 1999	0,683		2009 - 2008	0,919		2018 - 2017	0,965

Source: Author's calculatons

- 2012-2018 (with the exception of 2017) Latin America and the Caribbean has the largest contribution to the intensity of structural changes, as a result of changes in the relative share and deviations in the absolute size of the observed aggregate, (with a significant predominance over the Eastern region Asia and the Pacific);

- the sub-periods from 2003 to 2007 (with the exception of 2005-2004) are characterized by some of the lowest values of the integral coefficient. The reasons for this are mainly explained by the predominantly similar changes in the relative shares in the East Asian and Pacific regions and Latin America and the Caribbean in the individual years;

- the sub-period 2013-2012 is characterized by the lowest value of the integral coefficient of structural changes. The reasons for this are due to the accumulation of significant investments in concessions in the Latin American and Caribbean region in 2012 occupying a relative share of 79,0% and their decrease in the same region in 2013, but with an increase in its relative share to 84.0%, due to the lack of investment for concessions in 2013 in the regions of Europe and Central Asia and the Middle East and North Africa. At the same time, there is a significant decrease in investment for concessions (about 4 times) in the East Asia and Pacific region;

- the average of the integral coefficient of structural changes ($\overline{K}_s$) of the amount of investments for concessions calculated in relation to the total amount of PPP investments in the water and sewerage sector, by regions, for the studied period 1991-2018, amounts to 0,569. It is identified as a degree with strong changes in the structure of the adopted scale;

- During the period of the world financial and economic crisis 2008-2011, through the integral coefficients of the structural changes of the sub-periods, very strong, intensive changes of the relative shares of participation of investments for concessions in the total amount of PPP investments were registered by regions of the world. They are due both to the very strong divergent changes, with significant absolute values in millions of

USD of the studied specific annual values, mainly in the East Asia and Pacific and Latin America and the Caribbean, and to their strictly consistent exchange of direction of decreases and increases, relatively, during those years.

Expressed factually, these changes in the structure in the relative shares of investments for concessions calculated in relation to the total amount of PPP investments for the period 2008-2011 are as follows:

✓ in 2008 there is a decrease from 34,6% to 3,4% in the East Asia and Pacific region and, conversely, an increase in the region of Latin America and the Caribbean from 4,1% to 18,9%;

✓ in 2009 there is an increase from 3,4% to 5,0% in the East Asia and Pacific region and, conversely, a decrease in the region of Latin America and the Caribbean from 18,9% to 0,7%;

✓ in 2010 there is a decrease from 5,0% to 1,7% in the East Asia and Pacific region and, conversely, an increase in the region of Latin America and the Caribbean from 0,7% to 9,8%;

✓ in 2011 there is an increase from 1,7% to 20,6% in the East Asia and Pacific region and similarly, an increase in the region of Latin America and the Caribbean from 9,8% to 11,3%, but at the same time a registered divergent movement of the reported total annual investment for concessions – increasing by USD 195 million for the East Asia and Pacific region and decreasing by USD 102 million for the Latin America and Caribbean region.

There is a difference in the degree of reported average structural changes for the crisis, compared to those for the whole period, respectively – very strong to significant for investment concessions, with a difference of 2,4 times, compared with strong to significant for investment in PPP projects, with a difference in values of 1,2 times. From this summary, the following main conclusions can be drawn about the adequacy and reliability of the structural change approach used in the present study. The first is that it is reasonable for a global financial and economic crisis of a similar nature and scale to cause much stronger structural changes in the size and type of PPP investment used and its territorial location than in non-crisis or significantly smaller crisis periods.

Second, the fact that this is revealed by the calculations of the average value of the integral coefficient and taken into account in the analysis shows that the structural approach works, by accurately covering and taking into account the interaction in fluctuations of absolute values and at the same time relative shares of PPP investments, and in particular for concessions, during these years in the water and sewerage sector, in different regions of the world.

Third, the significantly increasing structural changes reported during this global crisis period practically bring to the fore the effect of the results of the decisions taken in response to the emerging fears, doubts, demands and expectations among the management teams in the public and private sectors.

A more in-depth study of the ongoing processes and dependencies related to structural changes in terms of the number of PPP projects, concession projects and their investments in the water and sewerage sector, by individual regions of the world, requires the revelations of their specifics and by comparing them at the following two disparate levels:

a) between structural changes to PPP projects and investments in them;

b) structural changes between concession projects and concession investments.

The analysis of the results of the structural changes in the number of PPP projects and the amount of PPP project investments during the period of study, 1991-2018, helps to reveal the following feature – only in four of the years (1994, 2013, 2014 and 2017) of the study's 28 annual periods were the values of the integrated coefficient of structural changes greater compared to the previous year of the number of PPP projects than the values of investments in PPP (by 1,4, 1,9, 1,7 and 1,7 times, respectively).

In terms of the strength of the changes, the average of the integral coefficient of structural changes compared to the previous year in the period 1991-2018 of PPP projects is 0,193, which is approximately 1,9 times lower than the similar average of PPP investments which amounted to 0,376. Therefore, for the study period, overall changes in the structure of PPP investments are approximately 1,9 times larger than those in the structure of PPP projects.

It is noteworthy that the following anomaly was registered in relation to the average of the integral coefficient during the world financial and economic crisis, 2008-2011. It is expressed in this way that if for all the other researched basic aggregates the average of the coefficient for this period significantly exceeds the average of the coefficient covering the full period of the study from 1991-2018, then the average amount for PPP projects of 0,112 is lower than the average for the entire period of the study, which amounts to 0,193. There are two main reasons for this, in this study's opinion. The first is stationarity. The second is that despite the strong structural changes observed in concession projects during the same period, their relatively high relative share of 39,2% of the total number of PPP projects is not able to significantly affect the level of ongoing much weaker, reported as moderate, restructuring processes for PPP projects in the sector as a whole.

In fact, during this four-year period there is a decline in investment activity due to the conditions of the deepening crisis, while a close relationship is maintained of relative shares of PPP projects between the years in the different sub-periods, by region. The only exceptions can be found in East Asia and Pacific and Latin America and the Caribbean.

Another feature was observed. Concession projects, on an average annual basis, are characterized by a stronger sensitivity to restructuring (next in degree – significant) than general PPP projects, characterized by a moderate degree of average of structural changes. The observed difference is 1,3 times. Asynchronous to this dependence are investments in concessions, which on an average annual basis are less sensitive to changes compared to total investments in PPP projects. This can be explained by the simultaneous impact of the magnitude of the average being significantly exceeded, characterized conditionally on an annual basis by the amount of investments falling on one concession project (USD 149,70 million) than that of Divestiture – 150,26 million USD, but occupying only 2,9% share of PPP projects in the sector, Management and Lease contracts – 76,03 million USD and Greenfield project – 59,78 million USD. On the other hand, the significantly more complex and cumbersome procedures and activities related to research, approval, provision, management, implementation (including implementation of investment, social and/or environmental programs), control and/or consequences of premature termination of a concession from those for the other types of PPP. However, when it comes to the period of the global financial and economic crisis, 2008-2011, the averages for these four sub-periods related to concessions (projects and investments) are significantly higher than the averages for general PPP projects and PPP investments, 3,4 and 1,7 times, respectively.

When comparing the changes in the structures of PPP projects and the PPP project investments during the crisis period, 2008-2011, one observes that changes in opposite directions were reported. The degree of change in the structure of PPP projects range from weak in the first year to very weak in the second year to significant in the last two years. For investments, the degree of change moves in the opposite direction and with greater force from strong in the first three years to significant in the last year. These greater changes in the structure are mainly due to the divergent changes in the relative shares of investments, with higher absolute values over the years, in the regions as follows: Middle East and North Africa (from 6,7% to 30,1%), Latin America and the Caribbean (from 13,0% to 30,1%), East Asia and Pacific (from 55,1% to 33,6%) and Europe and Central Asia (from 17,7% to 3,5%) for 2008; Middle East and North Africa (from 30,1% to 62,1%) and Latin America and the Caribbean (from 30,1% to 13,3%) for 2009; Middle East and North Africa (from 62,1% to 24,2%) and Latin America and the Caribbean (from 13,3% to 48,6%) for 2010; East Asia and Pacific (from 27,2% to 52,1%) and the Middle East and North Africa (from 24,2% to 0,0%) for 2011.

It can be concluded that the global financial and economic crisis has had a stronger impact on the structural changes of concession projects than PPP projects in the water sector in general. The reporting of such restructurings, appear to be due to a significant reduction in concession projects (for East Asia and Pacific and Latin America and the Caribbean regions) and the sporadic conclusion of concession contracts (for Europe and Central Asia and South Asia) for the period 2008-2011. These findings can be partially explained, according to this study by the relatively complex nature, in respect to the high concomitant risks, the need to set aside significant investments combined with longer payback periods and the service life of concessions, compared to those of other types of PPPs. All this required, the private sector to not only reconsider the basic parameters of potential concession contracts, but also the participation in tender procedures for the acquisition of water concessions in conditions of increased uncertainty, which prevailed in the business environment at the time of the onset of the global financial and economic crisis.

From the analysis of the results between the structural changes of the concession projects and the investments in the projects, it is clear that in only 8 of the years of the 28-year research period are the values of the integral coefficient of structural changes compared to the previous year of concession projects higher than the values of investments for concessions, as there are two periods covering three consecutive sub-periods – 2003-2005, as well as 2013-2015, inclusively. In 2014 and 2015, the differences between the observed averages of the structural changes were 7,1 and 8,2 times, respectively.

In terms of the strength of the changes, the average of the integral coefficient of structural changes compared to the previous year for the studied period of concession projects is 0,260, which is about 1,3 times less than the similar average of concession investments, which is 0,328. Therefore, for the period of 1991-2018, by its average degree, the changes in the structure of investments for concessions were about 1,3 times more significant than those in the structure of concession projects.

Comparing the results of the structural changes of the concession projects and the concession investments for the interval of 2008-2011, it can be concluded that the global financial and economic crisis has had a much stronger impact on the structural changes of the investments for concessions than on concession projects, with average values of the integral coefficient of 0,780 and 0,385, respectively. This „spillover" of funds is due to the increased investment activity on water concessions, at the beginning of the crisis, in the regions of Latin America and the Caribbean, Europe and Central Asia, South Asia and at the same time a significant stagnation (outflow) of similar investments in the East Asia and Pacific region, in which the number of existing and newly launched concession projects is slightly higher than that of the previously mentioned three regions.

When analyzing structural changes in the field of PPPs, it should be borne in mind that the creation of prerequisites and conditions for the implementation of such projects in the field of technical infrastructure in the territory of a country implies a significant amount of preventive activities by national and local authorities, departments, directorates and units, associations and NGOs, which mainly include:

- conducting an awareness campaign among the local communities about the advantages of PPPs over the traditionally used investment tools in the water and sewerage sector;
- conducting a study of foreign legislation and case law on the issue of PPPs in the water and sewerage sector and on the basis of this study to develop, discuss and adopt specific (specialized) normative regulations;
- conducting a study of foreign legislation related to the issue of PPP control in the water and sewerage sector and on this basis discussing and authorizing relevant control bodies (at national and local level) with clearly defined rules and instructions for exercising their activities and adopting targeted normative regulations;
- achieving synchronization of the newly introduced national PPP legislation with all other existing normative acts, national and/or supranational, with which it interacts, on the basis of amendments, additions and/or transposition, including harmonization;
- developing detailed basic working versions of concession agreements, which include both „good“ and „unscrupulous“ PPP practices based on detailed studies;
- development of relevant tender documentation and regulation for procedures for determining a concessionaire as concerns the conduct, application, participation, evaluation and selection of candidates, since the general practice of contractor selection and award of individual PPP projects is based predominately on the competitive procedure of bidding instead of direct negotiation.

In general, very strong, intensive structural changes with regard to PPP projects and in particular concession projects, and completed PPP investments and concession investments, respectively, during the year examined compared to the previous year, in the water and sewerage sector, in different regions of the world, cannot be caused by changes related to:

- the same or approximately the same absolute positive or negative increase in the number of projects or the amount of investments registered in similar regions in the year studied compared to the previous year;
- the same or approximately the same absolute positive or negative increase in the number of projects or the amount of investments registered in similar regions and at the same time the registration of absolute positive growth, but with relatively low values in the year examined compared to the previous year;
- a significant increase in the absolute growth in the number of projects or the amount of investments registered in an analogous region (with a constant value of the observed variable for the other regions) in the examined year compared to the previous year.

Deeper (very strong, intensive) structural changes in PPP projects, concession projects, and PPP investments and concession investments, respectively, in the examined year compared to the previous year, in the water and sewerage sector, in some regions of the world, may be caused by changes. For example, the changes could be related to a significant reduction in the absolute growth of the number of projects or the amount of investments, characterized by large absolute values and occupying the highest relative share in the previous year, registered in a similar region (at constant value or in combination with even low changes in the observed variable for the other regions), in the examined year compared to the previous year. In practice, this translates into a significant reduction, for example, in the number of projects or the amount of investment in concessions in regions that have previously used such projects extensively, while maintaining or in combination with even low changes in the number of projects or the amount of investment in concessions for the other regions. This can be explained by the widespread use of PPP tools as an innovative opportunity to attract business and significant private investment, respectively, and highly efficient management to assist in the operation, management and provision of public assets and services, in a separate country or relatively small number of countries within each region, respectively. It is only when the visible benefits of the use of PPPs in the water sector and the successful establishment of preventive measures taken by the population (local communities) and in the neighboring countries of a region does a rather timid penetration of the PPP tools begin. At the same time, the registered possible boom in the use of dozens of concessions in the water sector in a single country, such as Brazil, Colombia, Argentina, or China, is usually due to a certain geographical saturation of the territory combined with relatively long periods of concession contracts of 25, 30, 35 or more years, followed by a certain decline.

Among the main environmental factors influencing the investment intentions/choices of the potential candidate-concessionaire in the water sector should be the number of households and the population of the service area, the income (purchasing power) of this population, its people's psychology, the prevailing level of intelligence and mentality of the people, type of current political system and state structure and its stability, the exchange rate of the local currency against the US dollar, demographic situation, available or economic conditions, as well as projected levels of collection of utility bills, inflation, water supply, percentage (including length in km, number, working capacity, etc.) of saturation/level of development in the respective area and the degree of physical and moral depletion of the water supply and/or sewerage network, drinking water treatment plants, wastewater treatment plants, water towers, water reservoirs, catchments, predominant way of supplying water - gravity or pumping, the possibility of discharging wastewater to existing surface water, the presence of significant imbalances in the pricing of water services, which may affect small settlements and/or those who predominantly have a pumped water supply. For example, the number of households in the service area should be sufficient to sustainably ensure the return on investment of the private sector into the future and, at the same time, provide for a realization of more significant savings of scale as a result of the exercise of the activity.

It is important to keep in mind that the structural changes in terms of the observed variable (number of PPP projects or concession projects, amount of total PPP investments or concession investments), in the water sector, by individual regions of the world, significantly can affect not only the nuances in the people's psychology of the individual community, but even cause a significant change in the mood among the population (civil societies), including neighboring countries and regions, about the appropriateness of using PPPs, because of premature termination of concession contracts due to a concessionaire’s unscrupulous practices or inability to perform his obligations.

6. Conclusion

The study of the issues associated with *structural changes in the concessions of existing assets* and in general of the public-private partnerships in the water and sewerage sector, by regions of the world, helped to formulate the following important results for theoretical and practical application:

1. *Methodological bases have been systemized* and *a methodology for researching* data sets has been created *on the basis of structural analysis* for use in the field of public-private partnerships in the water and sewerage sector.

2. *The methodology for conducting structural analysis with the use of the so-called integral coefficient of structural changes*, for example, with data sets for the private participation in the construction of the technical infrastructure in the water and sewerage sector.

3. The use of the so-called *integral coefficient of structural changes* emerges as a particularly appropriate tool for detecting structural differences, including in depth changes, of aggregates or databases, some of which are collected, regrouped and provided by the World Bank for participation of the private sector in the field of technical infrastructure relating to the water and sewerage sector.

4. The applied *integral coefficient of structural changes* helps to eliminate, to a large extent, the differences (to reduce the statistical error in the calculations) regarding the estimation of the absolute values of the total financial (investment) flows for the individual years over time, without the need to update them by means of discounting.

5. The integral coefficient of structural changes is an applicable, useful and relatively easy, fast and convenient statistical analytical tool, facilitating research in greater depth, through step-by-step decomposition of individual sublevels vertically (e.g. primary sector, subsector or on another basis) and horizontally (e.g. by subsectors or according to the different forms of the main types of PPPs), of the studied aggregates or databases.

6. The integral coefficient of structural changes is particularly appropriate for use in the analysis of structural changes of PPPs by individual types (brownfield or under concession contracts for existing assets; for management or leasing; for new sites, including construction concession contracts and operation of new sites/facilities; for acquisition of public property) and especially in separate forms (ROT, BROT, RL / RT, BOT, BOO, partially or fully transferred public property, etc.) in the energy, telecommunication subsectors, transport, water and sewerage, by examining the changes in the relative shares on a certain basis (subset) to the respective total values, of the main aggregate or of the hierarchical subset above, during the individual years (sub-periods).

7. As a result of the conducted structural analysis, a comparative assessment of the main structural changes was completed for each separately studied data set - number of PPP projects, amount of investments in PPP projects, number of concession projects and amount of investments for concessions, number of concession projects in relation to the total number of PPP projects and the amount of investments for concessions in relation to the total amount of PPP investments, in the water and sewerage sector, by regions of the world.

8. A classification of *the main groups of factors is proposed, which are due to or which generate certain structural changes*, considered on the example of the studied relative shares of the subsets, calculated on the basis of the registered elements of the separately observed aggregates (respectively number of PPP projects,

amount of investments in PPP projects, number of concession projects or amount of concession investments) from the water and sewerage sector.

9. The influence of different, and often predominant, specifics of the absolute and relative changes of the studied aggregate were discovered, due to which in principle *very strong, intensive structural changes cannot be caused* in relation to *PPP projects and concession projects*, *the PPP investments and investments for concessions*, respectively, in the examined year compared to the previous year, in the water and sewerage sector, in different regions of the world.

10. The following is recommended to the team of the World Bank, with a view to improving the accuracy and precision of research results when working with dedicated databases, in order *to develop a functioning model at an institutional level so that all projects that are randomly selected by the researcher (research team) so that any researched period of research will be commensurate in value. For example, investments should be presented at comparable prices, or related to the number of serviced households, the number of users of the utility service or the size of the serviced territory in sq. km.*

11. Based on the obtained results and the stated findings from the analysis of *the integral coefficient of structural changes*, it can be summarized that during the studied period, 1991-2018, *there were 6 sub-periods with strong changes, only one sub-period with very strong (intensive) changes and none with total (diametrically opposed) changes in the structure of concession projects in the water and sewerage sector, by regions of the world*. This can be partly explained by the simultaneous influence of several important factors such as: the need to *study, develop and adopt appropriate legislation and regulations* in individual countries for the use of PPP tools and in particular concessions; *the more cautious and gradual use by public authorities of the innovative PPP model* by some of them to solve problems in the field of water infrastructure and services; *the delicate nature of the projects for concessions for the provision of public water supply and sewerage services to the inhabited communities*, given the many existing foreign examples of premature termination of concession contracts due to unscrupulous practices or inability to fulfill the obligations of the concessionaires.

12. *The strongest changes in the structure of concession projects* (with K_{si}= 0,798) compared to the previous year were observed in 2018. They were due to the restructuring of the location of the new concessions from 3 regions into only one region. Thus, there are very large differences in the change in relative shares in 2018 compared to 2017, in the three regions of East Asia and Pacific, Latin America and the Caribbean, and Europe and Central Asia, predetermining very strong structural changes, amounting to 75,0%, 50,0% and 25,0%, respectively.

13. The structural changes of *the projects for concessions* in the water and sewerage sector, by regions, are most often due to the expansion of PPP practices in countries from new regions or to a strong increase in the number of PPP projects in individual countries, characterized by significant long-term problems with providing the local population with water and/or sewerage services and the respective treatment plants.

14. Comparing the results of the structural changes of the PPP projects and in particular *the concession projects* for the interval of 2008-2011, *it can be concluded* that the global financial and economic crisis has had a stronger impact on the structural changes of *concession projects* (the average of the integrated coefficient is 0,385) than of *the total PPP projects* (the average of the integrated coefficient is 0,112) in the water and sewerage sector, by regions. This impact to concession projects can be explained by anticipatory behavior shown by the private sector as well as the public sector and/or the rapid reorientation of investors of their investment intentions and the corresponding location of those investments in an environment of heightened uncertainty, given the complex nature, significant investments, longer periods of return and service life of concessions than those of other types of PPPs.

15. *Concession projects*, on an average annual basis, are more sensitive to restructuring than general PPP projects. Asynchronous with this dependence are *the investments for concessions*, which on an average annual basis are slightly less sensitive to changes compared to the total investments in PPP projects. However, for the period of the global financial and economic crisis, 2008-2011, the averages for these four sub-periods relating to concessions (projects and investments) are significantly higher than the averages for general PPP projects and PPP investments, by 3,4 and 1,7 times, respectively.

16. From the analysis of structural changes in terms of *the amount of investments for concessions* calculated in relation to *the total amount of PPP investments* in the water sector, it is clear that 17 of the sub-periods are characterized by very large values of the integrated coefficient of structural changes – total, only in 1992-1991 and very strong – for all other sub-periods, i.e. the strongest restructuring was reported in these years among all the observed aggregates in the study in the water sector, by region, for the period 1991-2018. The intensive structural changes, among them, are mainly due to the very strong divergent or one-way changes in the relative shares, combined with significant absolute changes (in millions of USD) of the studied specific annual values in the leading PPP regions – East Asia and Pacific and Latin America and the Caribbean. Until 1996, Latin America and the Caribbean were the largest contributors to the intensification of structural change.

17. During the period of the global financial and economic crisis, 2008-2011, the integral coefficient of structural changes registered *very strong, intensive changes* of the relative shares *of investment for concessions* to *the total amount of PPP investments*, in the water and sewerage sector, by individual regions of the world. They are due to their very strong divergent changes, with significant absolute values in millions of USD of the studied specific annual values, mainly in the East Asia and Pacific and Latin America and the Caribbean, and as well to their strictly consistent exchange of directions of decreases and increases during these years.

18. Comparing the results of the structural changes of *the concession projects* and *concession investments* for the interval of 2008-2011, *it can be concluded* that the global financial and economic crisis has had a much stronger impact on the structural changes of *investments for concessions than on concession projects, with average values of the integral coefficient of 0,780 and 0,385, respectively*. This „spillover" of funds is due to the increased investment activity in water concessions, at the beginning of the crisis, in the regions of Latin America and the Caribbean, Europe and Central Asia, South Asia and at the same time a significant stagnation (outflow) of similar investments from the East Asia and Pacific region, in which the number of existing and newly launched concession projects is slightly higher than that of the three regions.

It is important to note that the *average value of the integral coefficient*, during the world financial and economic crisis, for five of the surveyed aggregates (excluding PPP projects) *reports significantly increasing structural changes, which in practice reveal fears, doubts, demands and expectations among the public and private sectors. This means that the structural approach works by very accurately covering and taking into account the interaction in fluctuations of the absolute values and at the same time the relative shares of the number of projects and the amount of investments during these years in the water sector in different regions of the world.*

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