Water and Sewage Industry in Uzbekistan:

A preliminary analysis of empirical strategies as applicable to the assessment of reform progress

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Discussion Paper

Abstract

This study aims to analyze the applicability of econometric analysis to project evaluation of two projects that are ongoing now in Uzbekistan in the water supply and sewage services: the project "Water Supply, Sanitation and Health" ongoing from1997 in the Republic Karakalpakstan and Khorezm Oblast, in two regions most severely affected by the Aral Sea crisis and the project "Bukhara and Samarkand Water Supply" ongoing from 2002 in two ancient cities of Uzbekistan. The main theoretical concern for econometric analysis is to choose the outcome variable and to test whether the causing variable is exogenous and if it is not the case to find appropriate instruments to fix endogeneity from causal relationship. From practical point of view the main concern is to collect the most detailed pre-treatment and post-treatment data on municipalities' level that would be sufficient to apply matching methods for program evaluation.

Keywords: water supply, privatization, matching methods, program evaluation
JEL codes: C12, C21, H11, Q25, Q28

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1 Introduction

Development and improvement of the water supply in urban and rural areas in the former Soviet republics of Central Asia, in particular in Uzbekistan, is a crucial component of the general strategy of economic and social development in those countries. The second World Water Forum, which took place in The Hague in 2000, identified several main challenges for the global community, challenges that provide the basis for the policy issues regarding water. First place in the list of those challenges is to "recognize that access to safe and sufficient water and sanitation are the basic human needs and are essential for health and well-being" (Water Security, 2001). In this paper I will discuss development and improvement of the water supply in urban and rural areas in the Republic Uzbekistan as it is a basic requirement for the maintenance of public health.

Uzbekistan faces major problems in water supply and sanitation coverage. High rates of some infectious diseases, particularly among children, likely reflect low incomes, and poor access to water and sanitation facilities (see, for example, World Bank reports 1997, 2002, 2003; IMF, Uzbekistan, Recent Economic Developments 2000; UNICEF report, Multiple Indicator Cluster Survey 2000; Landenbrunner et al. 2002). To date the government of Uzbekistan, supported by many international organizations such as the World Bank and IMF missions, has undertaken several projects aimed to improve this industry. Rehabilitation of facilities and technical assistance projects relate particularly to the increasing move towards empowering local governments and local communities to manage water suppliers and away from centralized government agencies. Furthermore, these projects promote development of

institutional reforms in this sector of economics and emphasize the role of the private sector in partnership with municipalities.

The options for private sector participation are the most popular modern trends in the development of water supply economics, but controversial ones. By privatizing the water systems, the government concerns itself not only with technical efficiency improvement but also with expanding access and improving service quality to a low-income population. The privatization can improve service quality, reduce water and sewage spillage, accelerate repair rates, remove water shortages and stabilize water pressure. On the other hand, the privatization also leads to price increase and enforcement of service payment, possibly resulting in excluding the poor from water and sewage utilities.

Since the ultimate impact of government policy implementation on water supply is not clear and the resulting impact of reform strategies ambiguous, it is important to have in hand methods for their evaluation. I restrict my attention to specific research questions regarding water supply investigations: What kind of modern empirical strategies are reasonable or applicable to reform analysis in Uzbekistan's water industry? What kind of obstacles can be met in this case and how are we to overcome those obstacles? What kind of methodological methods choices among different empirical strategies can be made with respect to different types of reforms?

In the next two sections I will overview the main problems of public performance of the water industry and specific problems of this industry in Uzbekistan. Then I will focus on two projects that form a substantial part of Uzbek government policy with respect to improvement of drinking water supply and sewerage service performance. The first project is named "Water Supply, Sanitation, and Health Project".

The main targets of this project are the two regions of Uzbekistan most severely affected by the Aral Sea crisis: the Republic of Karakalpakstan and Khorezm Oblast. The second project is named “Bukhara and Samarkand Water Supply Project”. The targets in this case are two ancient cities of Uzbekistan. I will discuss empirical strategies to assess the impact of the implementation of these projects, and point out the main cautions and prerequisites for a successful econometric analysis. Special emphasis will be placed on data collection strategies.

2 Setting the Scene

The difficulties of examining such an industry as the water industry arise because water should be treated as a public and a private good simultaneously. We cannot treat water as a private good only in the sense that its production allocation should be determined by the amount that people are ready, willing, and able to pay for it. We can contend that water is a basic need that should be available to everyone. Moreover, water used for irrigation can be a powerful means of reducing food costs to poor people and, under the proper conditions, should be subsidized (Chambers, 1988). Therefore, water should be treated as a public good as well, at least up to some minimal level of availability. Thus, the same good should be treated differently at different levels of consumption. The significant question is how, practically, to achieve the right balance between managing water as an economic and a social good. Initially, water management – whether in irrigation, or in domestic and industrial water supplies – was organized as a natural monopoly controlled by the government. The major characteristic of this monopoly is that this industry is subject to strong economies to scale due to the significant

investment in infrastructure needed to start the operation – construction and maintenance of pipelines and water treatment plants – and a very small marginal cost for services produced over the existing infrastructure – pumping of additional cubic meters of water is of no account. But some interrelated ills with the operations of this regulated service-providing monopoly arise. For example Perry, Rock and Seckler (1997) point out the following list of problems:

- rent-seeking, either economically, in the form of direct bribes and corruption, or socio-politically in the form of empire building, high cost, and excessive supplies (Wade, 1982);
- the divorce of incentives from performance – indeed, sometimes almost an inverse relationship;
- capture of public agencies and funds by politically powerful interests and their clients;
- administrative operations, 'by the book', rather than management in terms of objectives and results.

This list of problems is called a 'public failure' for such institutional arrangements for water management. The problems with public sector management and allocation of water have created the movement towards privatizing this industry. Privatization can take several forms, from turnover of operation and maintenance to a private operator in the form of a management contract or, in general, so-called partial public/private partnerships, to the sale of publicly owned water rights to private companies, leading to the total elimination of government responsibility for water systems. Alternatively, various combinations are possible. But we should recognize that privatization is not a panacea from any existing difficulties and ills with the operations of a water supply

industry. Absence of some sorts of basic prerequisites for the beneficial introduction of market forces into the allocation of water is likely to do more harm than good. Moreover, a privatized system can suffer from other ills which can be worse than those listed above.

Usually, the greatest need for water services often exists in those countries with the weakest public sectors and at the same time the greatest risks of failed privatization also exist where governments are weak and/or society is weak, in a political sense. Even if a society has a strong government which is able to ensure basic services but a society which cannot participate in dispute-resolution procedures related to privatization processes, the results of the implementation of a privatized water system might be disastrous. When a government begins to contemplate private sector involvement, the most important concern should be whether this government is able to build regulatory arrangements to protect consumers from monopolistic pricing and enforce health and environmental standards, and subsidy regimes to ensure access to services for low-income categories of population.

3 The Water Industry in Uzbekistan

Uzbekistan is situated in the heart of Central Asia and has a predominantly desert continental climate. At the same time Uzbekistan is the most populous of the five Central Asian republics, with a population of 22.2million. The country's birth rate is high – 3.5 percent. 60 percent of the population lives in rural areas. Uzbekistan consists of 12 provinces and the Republic of Karakalpakstan. The principal source of water has historically been the Amu Darya and Syr Darya rivers and their associated irrigation

canals, augmented by groundwater in areas far from the rivers. Since the 1960s, increasing use of the Amu Darya and Syr Darya rivers for agriculture, particularly cotton growing, has resulted in greatly reduced volumes of water entering the Aral Sea and excessive contamination from leached salts and agricultural chemicals. The diversion of water from the Aral Sea was an ecological disaster.

Uzbekistan has been a slow reformer amongst the Former Soviet Union countries, achieving independence in 1991 but not adopting a program of economic stabilization and reform. Only after joining the World Bank and the International Development Association was Uzbekistan's macroeconomic and structural reform process accelerated, although little progress was made on the liberalization of the cotton trade, land reform, farm restructuring, and large-scale privatization.

The water industry in Uzbekistan is an example of a state monopoly. A number of different government agencies and ministries have responsibility for the provision of water and sewage services in Uzbekistan. Two separate departments of the Ministry of Communal Services (MCS), one for the municipal water and sewage agencies (Vodokanal) and one for the inter-regional trunk pipeline agencies, are in charge of overall supervision and management, including sector planning and regulatory aspects. Water and sewage services in Uzbekistan's rural areas fall within the jurisdiction of the Ministry of Agriculture (MoA), which oversees and coordinates the activities of the regional rural water agencies (Agrovodokanals) through its department of Agrovodokanals.

In the past, the central authorities in Uzbekistan's capital of Tashkent exercised strong control over all activities associated with the production and distribution of water. Recently, responsibility for overseeing the distribution of water was delegated to

the provincial level, with the central government still overseeing all aspects of the treatment and transport of surface water from large reservoirs, including its delivery to distributing agencies. The deputy governor (Khakim) plays the role of manager of the regional municipal water and sewerage agencies, the Vodokanals. He is under the control of the MCS, yet he feels full freedom and autocracy on his provincial level. I suspect that such a mechanism of management can suffer from corruption. Water utilities that are managed without public participation and monitoring might be subject to corruption, resulting in massive cost overruns and windfall gains to favored clients or to organizations – even in direct violation of the laws.

The inter-regional water supply pipeline systems are managed by separate entities under MCS and responsible for operating the main water supply pipelines and water treatment plants and sell the piped water to the Vodocanals and Agrovodokanals, which distribute the water secondary and tertiary networks to domestic, industrial, and commercial consumers. The Vodokanals also operate and maintain separate water supply and treatment facilities and pumping stations. All capital construction for the main pipelines and for the distribution and treatment facilities is provided from the central government budget, and the operation and maintenance costs of the bulk water agencies are also highly subsidized by the central government. The highly subsidized water supplied by the inter-regional pipeline entities, which is a higher cost source than from local treatment plants, provides a pervasive incentive for the Vodocanals to source their water supply from these pipelines, rather than operating their own local facilities, even though they could normally produce water of an acceptable quality. This is expected problem, so-called public failure, which I have mentioned already. The government, trying to resolve this problem, has adopted a policy of gradually reducing

the subsidy and increasing consumer tariffs. However, it faces certain constraints because of the difficult economic condition in this region.

Moreover, the deepest problems lay not only in the management arrangement but in the lack of basic adequate installation and operation systems which leads to low water use efficiency. For example, the two main pumping stations of wastewater system of Samarkand have been in service for at least 35 years with little maintenance. The excessive water losses and waste result in poor service levels to the population and industries. As the Family Budget Survey reports (see Landenbrunner et al. (2002)), overall levels of access to running water and sewerage are quite low in Uzbekistan: nationally only 56 percent of the population have access to running water in their own dwelling or have their own well. On the other hand 12 percent of the population relies on untreated water from rivers and canals. The low levels o f access to water and sewerage in the country as a whole, and in rural areas in particular, is likely to have been an important reason for the high prevalence of childhood diarrheal diseases, gastrointestinal infections, viral hepatitis, and typhoid outbreaks. The number of people diagnosed with hepartitis in Uzbekistan in 1996 was three times higher than the Commonwealth of Independent States (CIS) average and 26 times higher than the European Union (EU) average.

In addition, the Soviet era expansion of the cotton crop, diversions of water flows, and use of fertilizers and pesticides have led to water pollution and soil degradation and have contributed to the poor and declining quality of drinking water particularly in rural areas. The salinization of the land and extensive use of pesticides may also pose hazards. Since irrigated agriculture is the backbone of the Uzbek economy, the drinking water supply is losing the competition with gigantic water user -

agriculture and many water supply enterprises in Uzbekistan, which are located in basins with limited water resources experience water scarcity, especially during drought periods.

To date the government of Uzbekistan supported by many international organizations such as the World Bank, IMF missions have undertaken several projects aimed to improve water supply and sanitation service. Among them are the project "Water Supply, Sanitation and Health" (WSSaH), the implementation period of which has being lasted from 1997 to 2005; and the project "Bukhara and Samarkand Water Supply" (BaSWS), which have started later and have being lasted from 2002 to 2007.

The objects of **the project "Water Supply, Sanitation and Health"** are two poorest parts of Uzbekistan most severely affected by the Aral Sea crisis – republic of Karakalpakstan and Khorezm Oblast, with a significant percentage of the population living below the absolute poverty level. As the World Bank assessment survey indicates that the households arrange the lack of the most important things in the following order – food, money, water (the World Bank report, 1997). So there is a lack of water even as a basic human need. The infant mortality in Karakalpakstan in 1995 was 30, in Khorezm Oblast it was 25.8 per 1,000 live births. The main causes of infant mortality are acute respiratory infections, diarrhea and parasitic diseases, which are caused in turn by the insufficient level of water quality in most cases.

The project "Water Supply, Sanitation and Health" has proposed a wide-ranging package of program activities. The main emphasis in this program is made on technical improving of water equipment, repairing of facilities, rehabilitate the distribution systems and water treatment plants, ground water sources, and build additional trunk pipelines. The second objective of this project is to strengthen institutional capacity for

management, operation and financial performance of the regional water supply and sanitation utilities as well as the regional Centers of Health and Sanitary Epidemiology Stations. In particularly, this part of project consists of a program for health promotion and hygiene education, a program for monitoring and reducing operating costs, a program for reduction and management of accounts receivable, and it includes consultancy services for the formulation and implementation of the new water and sewerage tariff structure for the various consumer groups.

In contrast to the former project, in **the project "Bukhara and Samarkand Water Supply"** it is introduced a new strategy to improve water supply services: besides traditional technical assistance program this project involves the private sector in the provision of water supply services. The Government strategy for the proposed BaSWS project pursues two targets. First, to define a new relationship between the central and local governments based on a full decentralization of responsibilities to the local level for the provision of services and full cost-recovery of operational, maintenance and debt service expenses through water and wastewater tariffs; second, to test for the first time in Uzbekistan, introducing the private sector in the water service. Therefore it focuses in the two key areas that need the most improvement in the vodokanals, namely the operational efficiency of the water supply systems and the financial and commercial strategies.

For realization of these purposes the government of Uzbekistan has decided to turn over key management and operation responsibilities of the vodokanals in the water supply and financial areas to a private operator under a management contract. This qualified operator will have full responsibility to rehabilitation and operations improvement of the water treatment and distribution system; the implementation of a

program of demand management and customer service; the implementation the energy efficiency program; and the implementation and operation of commercial and financial management systems, as a part of a financial recovery plan. The government considers this “performance-based management contract as the most adequate approach to involve the private sector at this time as it has attractive features that would increase the likelihood of success and is in the line with the Government’s policy of gradual transformation of the economy” (the World Bank Report, 2002). Expected benefits of this program would be noticeable improvements in the quality, reliability, technical efficiency, financial viability and self-sustainability. In turn these benefits would bring environmental benefits and health benefits. Also in a case of successful realization it would demonstrate an importance of necessary reforms implementation in the water supply sector.

4 Evaluation of econometric models applicability

4.1 Regulatory project in Karakalpakstan and Khorezm Oblast

One of the most widely used approaches to measuring the effects of regulation is an econometric approach, comparing matched samples of “regulated” and “unregulated” firms. The simplest case is when the only difference between the samples is whether the firm is under regulatory constraints or not. As a criterion of regulation effects, prices, costs or other performance measures may be applied. There is a strong temptation to use this method – it is quite simple and transparent. However, one needs to specify several important cautions, which can be crucial in investigation of some regulation projects in Uzbekistan’s Water Industry.

First, the differences between the regulatory regimes might exist. This means that different treatment units might be treated in different ways or with different degrees of intensity. Such treating introduces noise that may bias downward estimates of the difference between "regulated" or "unregulated" regimes. Considering reforms in Karakalpakstan and Khorezm one can say that it spreads to quit wide spectrum of targets and it is very difficult to distinguish and range the regulatory steps, the degree of reforms intensity in different water supply enterprises. Hence, this project consists of complex incomparable types of regulatory actions: the main concern is mostly technical assistance and the second one is managerial assistance based on the implementation of economic regulatory tools.

Another sort of noise might come from an "unregulated" part of a sample that can be settled by some other set of regulatory actions. For instance, the another project BaSWS is being implemented at the overlapping period with the first project and located in another geographical space and has different emphasis for regulation than the first project WSSaH. Therefore, careful inspection of all spectrum activity and the institutional structures of treatment units are needed. This caution may play a crucial role in the performance analysis of water industry because the water agencies and subordinated distributing pipe stations and water treatment plants are very heterogeneous with respect to the stage and type of regulatory jurisdictions.

Also, the effects of different types of regulatory innovations from different programs might overlap. Additionally to the projects of my interest other programs are functioning, for example recently started rehabilitation improvement program on irrigation and drainage systems (see the World Bank report, 2001). In spite of this program is not directly related to drinking water supply, the effect of technical

improving can be substantial because water for agriculture and drinking water have common sources in most. The effect of such kind of externalities must be taken into account.

At last, it might be difficult to determine the exact date at which regulatory regimes change. Therefore it should be taken into account that there might be a disparity between the nominal declaration and real implementation of the regulatory regime. As it is mentioned in one of the World Bank report, the first project WSSaH for more than two years experienced numerous implementation difficulties and was in insufficiency status. Therefore, the actual starting time is substantially delayed on the later time.

By analyzing the main objectives of this project and the results of the implementation of its intentions one can expect different variation of possible outcomes. The choice of the outcome variable is quite important and depends on data availability and/or focus of attention. Very often, and particularly it is true for Uzbekistan, the indicators of service quality such as running water availability, water purity, sewage treatment, water pressure, shortages, or repair delays are absent or restricted. In the World Bank project documentation it is pointed out that Karakalpakstan and Khorezm Water Utilities have very deficient technical and operational data. Therefore, there is no possibility to perform the study of economic efficiency in terms of technical characteristics of water industry. However, as many authors have noted, the effect of these quality characteristics should affect all water customers and mostly infants since this category of population is the most vulnerable to water-related infections and parasitic diseases. Therefore, the rate of child mortality as an outcome variable seems reasonable, at least a priory, moreover this indicator accumulate information from all quality indicators partially characterizing the water service performance.

Unfortunately, there were very few data points available: only the data on provincial level. The data on municipality level either are not exist or not available. There is no possibility to perform econometric analysis using so poor dataset. Statistics reported in the Table 1 demonstrate that the infant mortality rates in Uzbekistan, as well as in each region (oblast) of this country, have been falling over time.

Table 1:

Infant mortality rate (number of children died under age 1, per 1,000 live births)

		1995	**1997**	**1998**	**1999**	Δ_{99-95}	Δ_{99-97}	Δ_{99-98}
	Uzbekistan	26	22,8	21,9	20,2	-5.8	-2,6	-1,7
1	**Tashkent**	24,6	23,9	22,1	18,9	-5.7	-5	-3,2
2	**Karakalpakstan**	31,5	26,6	24,9	22,9	**-8.6**	**-3,7**	**-2**
3	**Khorezm**	25,9	25,1	24,7	22,4	**-3.5**	**-2,7**	**-2,3**
4	**Andijan**	23,5	18,2	18,6	15,1	-8.4	-3,1	-3,5
5	**Djizak**	25,1	24,4	21,1	19	-6.1	-5,4	-2,1
6	**Kashkadarya**	24	21,6	20,7	20,8	-3.2	-0,8	0,1
7	**Navoi**	28,1	22,1	22,8	20,4	-7.7	-1,7	-2,4
8	**Namangan**	26,8	22,1	22,8	20,4	-6.4	-1,7	-2,4
9	**Surkhandarya**	29,5	28,1	24,5	21	-8.5	-7,1	-3,5
10	**Syrdarya**	23,1	20,9	21	20,2	-2.9	-0,7	-0,8
11	**Fergana**	27,3	21,5	22,3	22,3	-5	0,8	0
12	**Bukhara**	21	16,3	20,5	18,3	-2.7	2	-2,2
13	**Samarkand**	24,2	21,5	19,9	17,3	-6.9	-4,2	-2,6

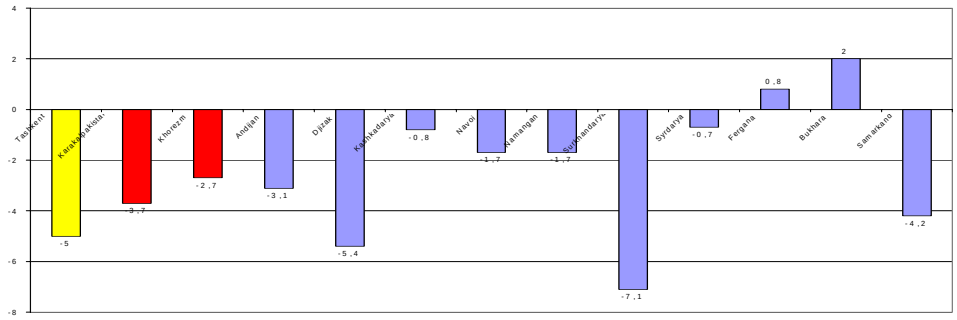
Source: Data of the Research Institute of Pulmonary Disease and Tuberculosis, Republic of Uzbekistan
Δ_{99-95} - the difference between infant mortality rates in 1999 and 1995; Δ_{99-97} - the difference between infant mortality rates in 1999 and 1997; Δ_{99-98} - the difference between infant mortality rates in 1999 and 1998.

Deleted:

Deleted: the capital of Uzbekistan

The main concern for the analysis of regulatory reforms would be whether the velocity of rate declining will be larger in the chosen regions – Karakalpakstan and Khorezm than in the rest regions of this country. If the average difference in rates between the regions under treatment and the regions without treatment would be statistically significant it might indicate positive influence of regulatory actions and demonstrate attractive features of new institutional structure implemented in the water service. As one can see from the diagrams bellow, there is decline in mortality rates almost among all regions over time. The red columns on those diagrams demonstrate stable decline of the mortality rates among treated regions – Karakalpakstan and Khorezm. Moreover, the average difference in the treated group is always larger than the average in the untreated group; for example, the infant mortality in the treated region dropped on 3.2 in 1999 by comparing with 1997 which is larger than in untreated group of regions – the infant mortality in the untreated group dropped on 2.19.[1]

Diagram 1: the differences between infant mortality rates in 1999 and 1995



[1] I did not include the capital of Uzbekistan in the untreated group to control the homogeneity of the untreated group at least with respect to income distribution.

Diagram 2: the differences between infant mortality rates in 1999 and 1997

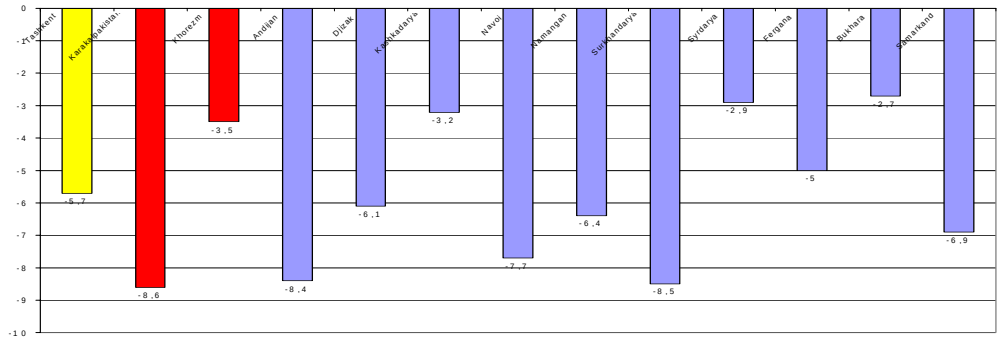
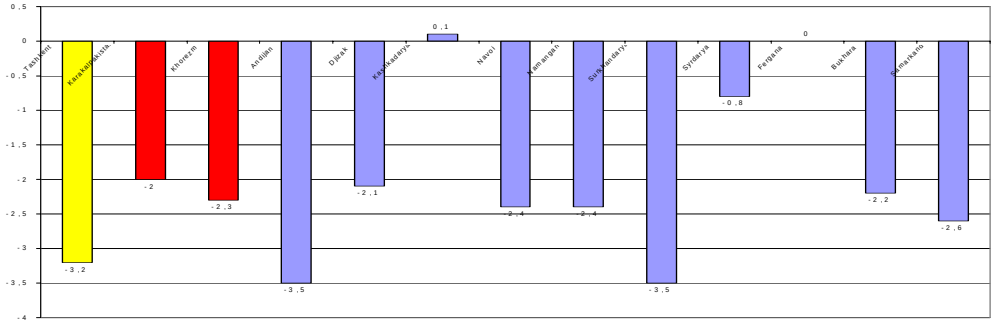


Diagram 3: the differences between infant mortality rates in 1999 and 1998



However, statistical tests performed to the differences between averages of treated group and untreated group do not justify significance of those changes.[2] The implementation econometric analysis might clarify the situation on the assumptions of rich enough dataset, which allows controlling for observable differences between localities.

[2] I performed the parametrical t-Student test to the difference between the averages of treated group and untreated group and accepted the null hypothesis of no difference at any reasonable level of significance. The non-parametrical Mann-Whitney-Wilcoxon test results in the same conclusion.

4.2 Reforms on the Water Supply in Samarkand and Bukhara

The key concern of this project is to implementing a private sector into water service. As distinct from the project "Water Supply, Sanitation and Health" (WSSaH), which concerns mostly about technical assistance[3], the social effect of this project might be not clear in advance. In this situation the econometric analysis of this program evaluation would be desirable, if the dataset is rich enough. In date it is too early to talk about the effects from the project implementation – in fact, two years passed from the start. However, in order to get empirical analysis one needs to accumulate related detailed pre-treatment and post-treatment data. Qualitatively, one needs to choose the exact design for estimating causal relationship of private sector introduction on state of social conditions in the regulated regions. So far there have been a several studies of performance changes in the privatized water industry in different countries. For example, Saal and Parker (2001) assess the performance of the water industry in England in terms of technical and input price efficiencies. For this purpose they construct the econometric estimation of a translog multi-output cost function model.

Although the study of economic efficiency in terms of technical characteristics of a water industry is very important for determining the impact of the structural changes and reforms, it is insufficient to answer the ultimate question of whether social welfare increases with privatization or reorganization of the water and sewerage industry. In contrast to the first project, the choice of infant mortality rates as output variables is more reasonable in this project. In recent economic literature there have been several studies that have found positive effects of changes in water and sanitation infrastructure on child health (Merrick (1985), Lee (1997), Galiani, Schargrodsky

[3] It's difficult to imagine that technical assistance and replacing obsolete equipment would make worse the actual state of affairs in this damaged region.

(2002)). They analyze the effect of transfers to private operation on a direct, tangible indicator: the impact of water systems privatization on child mortality.

As a first starting model for estimation of causal effect of the activities of the project "Bukhara and Samarkand Water Supply" (BaSWS) one might suggest fixed effect and difference-in-difference identification strategy. Having panel data observations of three groups of variables – outcome variables, causal variables and control variables – the regression model is the following:

$$\mathrm{Y}_{it} = \mathrm{X}'_{it}\beta + \mathrm{I}_{it}\delta + \lambda\alpha_i + \mu\theta_t + \xi_{it}, \qquad (1)$$

where Y_{it} is the outcome variable, the infant mortality rate, in i-locality at t-time; I_{it} is the causal variable, which is equal to 1 for all t> k and k is a starting treatment time; X_{it} is a vector of control variables, such as average household income, unemployment rate; α_i is a time-invariant unobservable covariate, that has the same coefficient at each period; θ_t is a time effect common to all localities in period t; and ξ_{it} is a locality time-varying error distributed independently across localities and time and independently of all α_i and θ_t.

This model assumes that the impact of new government policy in water supply services on infant mortality is homogeneous, but allows to control for unobserved and unchanging characteristics that are related to both outcome and causing variables. For applicability of this model the main concern is that the indicator I_{it} is not randomly assigned and therefore a comparison of all privatized regions with non-privatized regions might not identify the parameter of interest δ. One way how to check whether the government's decision to introduce private operator to the water service is correlated with child mortality rates themselves or with shocks on socioeconomic variables that

may affect the mortality rates is to test whether the likelihood of privatization in a locality is related to variables that may also affect mortality rates. A priory such relationship is not being revealed. From Table 1 one can see that there are regions with larger infant mortality rates than in chosen for regulatory reforms regions[4]. Therefore, it should be tested statistically. If the probability of the government's decision significantly depends on time-varying shocks on socioeconomic variables that may affect the mortality rates the method of instrumental variables can fix this problem. In order to eliminate this sort of bias caused by endogeneity of the government's decision one need to find an instrumental variable $\mathbf{Z}_{it}$ that is correlated with $\mathbf{I}_{it}$ but independent of potential outcomes.

The reasonable extension of the considered model is matching method, which is widely discussed in the recent econometric research. Heckman et al. (1998) points out that if the impact of treatment on the treated is not homogeneous, non-experimental framework that usually presents in estimating of economic phenomena such as program evaluation may suffer from several sources of bias. Heckman provides evidence that when potential outcomes are heterogeneous across units (in our case – across localities), violating the common support condition for the matching variables is a major resource of bias. In their paper they show that "bias due to mismatching and misweighting of the data is numerically more important than bias due to selection on unobservables" (Heckman (1998), p. 608). Therefore, in order to eliminate these two sorts of bias it is necessary to estimate the initial model only for those localities that have similar observed attributes $\mathbf{X}$ - from the common support set S. This strategy would eliminate

[4] In contrast to this project one can say that the rates of child mortality in Karakalpakistan and Khorezm was one of the main determinants for choosing these regions as main objectives in the project "Water Supply, Sanitation and Health" (WSSaH), therefore it is obviously endogenous decision.

bias in estimation the average treatment effect on the treated due to mismatching and misweighting but would not eliminate the bias due to differences in unobservable across group. However, if we would combine this strategy with instrumental variable approach, which I explained above, I think that this third disadvantage could be also eliminated.

Also one can apply non-parametric version of matching method suggested by Heckman et al.(1998) for longitudinal data that affords more control over the weighting schemes used to produce average causal effects. The idea is to compare the output variables of the treated group of units, where the regulatory reforms are performed, with specially constructed comparable group taken from weighted outcomes of control group, where the regulatory reforms are not performed. The estimation of the before-after average change in the outcome variable can be calculated as follows (this semiparametric conditional difference-in-difference estimator was proposed by Heckman et. al. (1998)):

$$\hat{\mathrm{M}}(S) = \sum_{i=\mathrm{I}_1} w_{\mathrm{N}_0\mathrm{N}_1}(i)[Q_{1i} - \sum_{j=\mathrm{I}_0} W_{\mathrm{N}_0\mathrm{N}_1}(i,j)Q_{0j}], \qquad (2)$$

where $Q_{1i} = \mathrm{Y}_{1it} - \mathrm{Y}_{1it'}$, $Q_{1i} = \mathrm{Y}_{0it} - \mathrm{Y}_{0it'}$ are differences between outcome variables at after-treatment time t and before-treatment time t' among treated units and untreated units correspondingly taken for those X that belong to the common support area S. N_1 is the number of localities taking part in the project, N_0 is the number of localities chosen as the comparison group, $W_{\mathrm{N}_0\mathrm{N}_1}(i,j)$ is a weight such that $\sum_{j=\mathrm{I}_0} W_{\mathrm{N}_0\mathrm{N}_1}(i,j) = 1$, and $w_{\mathrm{N}_0\mathrm{N}_1}(i)$ is a weight that accounts for heteroskedasticity and scale.

Unfortunately, the performance of the methods described above is confronted with serious obstacles - the deficient of detailed dataset needed to construct reasonable

econometrical models. The standard inference framework for Regression methods, Instrumental Variable methods uses asymptotic theory, i.e. the accuracy of estimates is increasing as sample size grows and relevant finite-sample theory assumes normally distributed errors. For proper analysis it is necessary to operate with more detailed information than the aggregated information over each region in Uzbekistan[5]. If it were possible to collect data from each municipality of every region the dataset would be substantially enlarged and necessary variation of the variables in interest was increased. As to non-parametric matching method the demand for large dataset is even / hungrier/ stronger because it requires matching conditionally to different set of variables. Also the set of treated group is too small - only two cities involved into this project. However one can overcome this problem. To my knowledge, three Bank-financed projects similar to the project "Bukhara and Samarkand Water Supply" are currently under preparation in Tajikistan and Kazakhstan. These two countries are also former Soviet Union Republics and very similar to Uzbekistan according to many characteristics: geographical location, common sources of drinking water - Amu-Darya and Syr-Darya rivers, political systems, economic background, and so on. Therefore, it would be natural dataset extension in expense of the data from these countries. And the last note is that some period of time is needed over which all these projects will be maturing in order to get reasonable results from projects implementation.

[5] To date only 13 region units are available over number of years. Despite of direct negotiations with the Uzbekistan authority and the World Bank representatives in Uzbekistan as well, the author of this paper did not access municipalities' data.

5 Data Collection

As I pointed out in the previous section the main concern in implementing empirical analysis is the availability an appropriate database. On my opinion, the main reason why there is so restricted number of econometric studies of water industry is caused by significant problems of data collection. The in-depth analysis of water and sewerage industry performance proposes search of data from many different establishments that collect relevant information. I would divide the types of necessary data into three groups: operational statistic data, environment statistics and general social-economic statistic data.

Operational statistical information about the functioning of the water and sewerage industry in Uzbekistan can be obtained from a variety of different sources. These include the Ministry of Communal Services (MCS), in particular, two separate departments of this ministry: one is overseeing the municipal water and sewerage agencies – Vodokanals; and one is overseeing the inter-regional trunk pipeline agencies. Also information about water and sewerage services in Uzbekistan's rural areas is collected by the Ministry of Agriculture (MoA) through its department of Agrovodocanals, the regional rural water agencies. Specific information about project implementation can be taken from immediate project producers, such as municipality's water offices (vodokanals) and project coordination units that accumulate the whole information from all localities. They have exact information when and where, and what kinds of activities are implemented. As far as I know there is no yet the evaluation reports related to the intermediate results of the implementation of the projects in question. So there is available the project information documents only containing background, targets and strategies of projects.

Also, in spite of the technical characteristics of this industry, it might be necessary to use environmental statistical data that will allow revealing many aspects of the impact of the water industry on inhabitants and environment in a region of interest. Mostly, environmental data might be collected from Uzbekistan Environmental Agency (Goskompriroda). Among data of its interests are rainfall, flooding, water shortages, water supply production, fresh water quality, sources and degree of water pollution in different localities. At the same time, the most of environment statistics can be obtained from various agencies scattered among the ministries. These agencies collect environmental data corresponding with their function and authority.

Macroeconomic and Statistics Office of Uzbekistan collects demographic and socio-economic data such as population density and distribution, population growth and migration, human settlements, housing conditions, unemployment rate, per capita household income, and other labor statistics The Public health authorities, such as Public Health Ministry of the Republic of Uzbekistan collects data on public health, in particular, child mortality rates, waterborne diseases.

There are several important reasons why the problems with data collection arise. First, too many agencies are responsible for relevant information and there is a lack of coordination between them, which leads either to the absence of important information or replication of the same indicators in different reports. Moreover, these establishments are independent, their aims and tasks are different; therefore, they collect and filter out data differently, losing significant pieces of information. Second, the problem of inconsistency of data collected arises: every agency or establishment uses different methodology, definitions, classification, timing which leads to additional difficulties to investigate water industry. Third, very often there is a lack of adequate information. The

World Bank project documentation related to the project "Bukhara and Samarkand Water Supply" have noted that "the accounting, financial and operational data collection and management systems are inadequate and do not provide a clear picture of the problems faced by the utilities. In fact, financial reports severely overstate the financial performance of vodokanals" (the World Bank report, 2002).

Mostly, researchers use the secondary data like socioeconomic and statistical reports from local government agencies; sample survey reports form non-governmental organizations; operational and financial reports from water enterprises and project coordinators; census conducted by central government. To my knowledge, last census in Uzbekistan was conducted in 1989, in Soviet period. Therefore, this information mostly is not valuable. A new population census is being planned for the next few years and will be essential to providing an up-to date picture. Government reports suffer from insufficiency and inadequacy. So the only chance to get information sufficient for empirical investigation are to rely on operational reports of project coordinators, sample surveys, related to the questions of interest, and conduct reconnaissance surveys. As far as I know, to date there were three big sample survey conducted in Uzbekistan: Demographic and Health Survey was conducted twice in 1996 and 2002; Family Budget Survey have covered time duration from April, 2000 to March 2001; Multiple Indicator Cluster Survey was conducted in 2000. Mostly from these survey and the World Bank reports I have known the data related to the Water and Sewerage Industry but, unfortunately, only in aggregated format.

If it were possible to conduct the survey in the World Bank framework which would collect relevant detailed information including several project areas in Central Asia –

Uzbekistan, Tajikistan and Kazakhstan[6] - the proposed empirical analysis of the impact of regulations might be successfully accomplished.

6 Conclusions

In this paper I have considered several points related with water and sewerage industry. My preliminary study of this industry itself and in Uzbekistan particularly has shown to me that it is very complicated and at the same time very interesting sphere of economics. This industry as a part of the public sector economics very often is beset with the classic problems of public and market failure. The governments of the many countries and Uzbekistan government as well try to implement different reforms in this industry, include different economic instruments in the management of water resources in order to improve the functioning of this sector of economics.

In the last several decades the tendency of movement towards privatization of the water industry or at least larger management and financial freedom to local water agencies is being widely discussed around the world. This idea has been put into practice in dozens of ways, in hundreds of places and is affecting millions of people. Because of the controversy surrounding this idea, one needs to investigate the outcomes of the reforms implemented already into water supply industry in similar countries. In date the World Bank involvement in the water and wastewater sector in the transition countries is still at its beginning and still no operations have been completed in the Commonwealth of Independent States (CIF). Therefore, the case of reforms implementation in Uzbekistan can provide one of the first results and give some lessons.

[6] Project treatment in Uzbekististan already started in Bukhara and Samarkand in 2002 and it is planed to accomplish by 2007; in Tajikistan and Kazakhstan treatment areas are not specified yet, these projects are in progress and will be started in nearest perspective.

In this paper I have studied the applicability of econometric analysis to project evaluation of two projects that are ongoing now in Uzbekistan in the water supply and sewerage services: the project “Water Supply, Sanitation and Health” (WSSaH) and the project “Bukhara and Samarkand Water Supply” (BaSWS). I can conclude that the most interesting case for econometricians presents the second project because the main contents of proposed reforms is not only technical improvement of old facilities, as it is proposed for the first project, but involvement of private sector in the provision of water and wastewater services that makes the ultimate results ambiguous. The main cautions and suggestions for econometric analysis are the followings: testing whether the causing variable is exogenous and if it is not the case finding appropriate instruments to fix endogeneity from causal relationship; collection detailed pre-treatment and post-treatment data, probably, not only from this project but also from similar projects that are currently under preparation in Tajikistan and Kazakhstan that would be sufficient to apply matching methods for program evaluation.

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Appendix:

Mann-Whitney-Wilcoxon test for the differences between mortality rates

The data consist of the treated regions denoted in the table as 1 ($n_1 = 2$), and the untreated regions denoted as 2 ($n_2 = 10$). The regions are arrayed in ascending order with respect to the mortality rate in each region and ranks are assigned to each region in the array. The null hypothesis is that there is no difference between medians of treated and untreated regions.

	Region Status	**Region's Rank**	Δ_{99-97}
Surkhandarya	2	1	-7,1
Djizak	2	2	-5,4
Samarkand	2	3	-4,2
Karakalpakstan	1	**4**	**-3,7**
Andijan	2	5	-3,1
Khorezm	1	**6**	**-2,7**
Navoi	2	7	-1,7
Namangan	2	8	-1,7
Kashkadarya	2	9	-0,8
Syrdarya	2	10	-0,7
Fergana	2	11	0,8
Bukhara	2	12	2

Then, the test statistics of the treated regions is $T_1 = 4 + 6 = 10$ and the expected value of this statistics, subject to the null hypothesis is true, is given $E(T_1) = \frac{n_1(n_1 + n_2 + 1)}{2} = 13$.

Hence, the value of test statistics is closed to the expected value, the null hypothesis is accepted.

Hypothesis t-test for the difference between mortality rates

Let μ_1 and μ_2 represent the means of infant mortality rates in treated regions -- Karakalpakstan and Khorezm, and in untreated regions. The null hypothesis specifies that there is no difference between means of treated and untreated regions: $\mu_1 - \mu_2 = 0$. The alternative hypothesis is specified for a one-tailed test as $\mu_1 - \mu_2 < 0$.

The statistics for this test $\frac{(\overline{X}_1 - \overline{X}_2) - (\mu_1 - \mu_2)}{\hat{\sigma}_{\overline{X}_1 - \overline{X}_2}}$ has a t distribution with $n_1 + n_2 - 2$ degrees of freedom, where $\hat{\sigma}_{\overline{X}_1 - \overline{X}_2}$ is the estimated standard error of the difference between the sample means.

The performance of this test for the differences between mortality rates in 1999 and 1997 results in the following: $\overline{X}_1 = -3.2$ for the treated regions and $\overline{X}_1 = -2.19$ for the untreated regions; the estimated standard deviation is $\hat{\sigma}_{\overline{X}_1 - \overline{X}_2}$ =2.062653. Therefore, the test statistics value is equal to -0.4896 that is less than the critical value for this test. Hence, the null hypothesis is accepted.