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QUALITY OF INSTITUTIONS AND PRIVATE INVESTMENTS IN INFRASTRUCTURE

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by

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ABSTRACT

This article investigates the impact of institutional environment on the volumes of private investments in infrastructural sectors in low and middle income countries. Econometric models for limited dependent variables (Tobit, Heckit) and count variables (Poisson) are used for analysis. The obtained results support the theoretical predictions on positive impact of better institutions' quality on probability of observing private infrastructural projects, total number of such projects and total volume of private infrastructural investments. The practical value of the work is in emphasizing of importance of proper institutional policy for attracting private investments in infrastructural sectors.

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GLOSSARY

Infrastructure – physical networks or technical structures needed for the operation of economy.

Institutions – formal and informal norms governing the behavior of individuals in the society.

1. Introduction

The level of development of infrastructural sectors is an important determinant of economic development. A number of research papers shows that shortcomings in the quantity of infrastructure can be a serious deterrent for economic growth (Aschauer 1997, Dadgostar, Mirabelli 1998, Bronzini, Piselli 2006, Machicado 2007). It is not accidentally: according to the World Bank Report (1994), from input-output tables for Japan and the United States it can be traced that the production of almost every commodity uses services of infrastructural sectors (such as telecommunication, electricity, water supply and transportation). This evidence is fully valid for all the other countries, including developing and transitional. Such a tight interrelation of infrastructure with other industries gives the basis for assuming that higher productivity of, for instance, transportation or telecommunication can spur economic growth. This assumption is supported by empirical research (Sridhar and Sridhar 2008). Thus, infrastructural services possess some characteristics of public goods: their utility for the society can be higher than the cost of their provision (Esfahani, Ramirez 2003). Among other distinctive features of infrastructure are:

- high costs of construction, creation of networks, etc. (sunk costs);
- low costs of producing marginal unit of service;
- presence of externalities.

These three aspects create preconditions that a certain part of infrastructural services are provided by state owned natural monopolies. On the other hand, binding state budget constraints and large amounts of investments needed to avoid bottlenecks in infrastructural sectors (as well as the need for efficiency improvement and introduction of competition in infrastructural services) induces governments of many countries to turn their attention to different mechanisms of private participation in infrastructure (PPI). This is illustrated by simple numbers: investment in infrastructure with private sector participation in developing countries increased from US$ 13 billion in 1990 to US$ 111 billion in 1997 and US$ 158 billion in 2007 while total infrastructural investment in 2005 were estimated at nearly US$ 200 billion (World Bank, PPI Database). Yet countries differ very much in terms of the amounts of private capital participating in infrastructure provision: the Latin America and Caribbean region is leading with total amount of private investments of US$ 475 billion during 1990-2007. Significantly smaller amount of private capital participation is observed in East Asia and Pacific region (US$ 276 billion) and Europe and Central Asia (US$ 230 billion) (World Bank, PPI Database). Besides, the pattern of PPI is cyclical: a rapid growth of PPI volumes in developing countries in 1991 – 1997 was followed by their reduction in 1998 – 2002 and again growth in 2003 – 2007 (Figure A2). Participation of private investors in provision of infrastructure is accomplished in several organizational forms: service contract, management contract, lease, concession and divestiture. Applicability of these forms varies among sectors; they also differ in terms of duration, investment incentives, regulations and underlying risks.

Infrastructural investments possess certain features that distinguish them from other investments. The necessity of such services makes the prices charged for these services a serious political issue. This often turns into prices which are insufficient for covering costs and significant subsidies for state owned providers or losses for private providers. Another feature of these investments is a huge amount of sunk costs that can take up to thirty years to recoup (Dailami, Klein 1998). Risks, investors are exposed to during this period, depend on macroeconomic stability as well as on the quality of existing institutions. From the said above it can be assumed that private infrastructural investments are highly sensitive to the quality of the institutional environment of the recipient country.

This article represents an attempt to investigate the influence of such institutions as rule of law, property rights, government effectiveness, control of corruption, regulatory quality on amounts of private capital participation in infrastructure provision (i.e. volume of investments and number of investment projects). This study concentrates on low and middle income countries in accordance with the World Bank classification[1] (Table A1). On the one hand, such focus is dictated by higher variance in institutions' quality among developing countries than among developed ones. On the other hand, it is due to the specifics of data sources on private infrastructural investments: the World Bank PPI Database, the primary data source, is concentrated on low and middle income countries. This work is different from other works on similar topic in several ways. First, it utilizes updated and extended dataset: the existing papers cover period 1991-2000 while the current work studies the period from 1996 till 2007. Second, an alternative econometric approach is implemented to study the total amount of private infrastructural investments: instead of using linear regression estimated by pooled ordinary least squares (OLS) limited dependent variable techniques (TOBIT, type II TOBIT) are employed. Third, an extended set of explanatory variables is introduced: armed conflicts that take place in the considered countries are deemed to be significant factor, along with institutions' quality, for explaining private investors' motivation. Fourth, data on quality of institutions are taken from a different source, the World Bank. The latter is known to be less exposed to measurement errors owing to unobserved component model which is utilized during the data procession and

[1] http://web.worldbank.org/servlets/ECR?contentMDK=20421402&sitePK=239419

multiplicity of primary data collectors. This allows anticipating more robust estimates of institutions' impact and neglect imperfections of processes of collecting data on institutions.

The relevance of this research for Belarus is caused by several factors. First, infrastructural sectors of Belarusian economy have not been reformed substantially during the transition period. The existing state monopoly in the sphere of stationary telecommunication networks and dominance of state organizations in transportation sectors are supposed to be removed, especially, taking into account perspectives of Belarus' entering the World Trade Organization (WTO). The foreseen processes imply attraction of significant amounts of private investments in the corresponding fields and creation of favorable economic and institutional environment for their operation. Second, the introduction of private independent operators in infrastructural sectors is suggested as a priority direction of reforms in such infrastructural sectors as telecommunication, transportation, energy and communal services (Glambotskaya et al 2007): first, the introduction of competition will decrease high tariffs for some services (e.g. international calls, IP telephony) which could be observed in relatively competitive segment of mobile telephony; second, these changes could result in improvements of quality of infrastructural services, e.g. reduction of heat and energy losses in distribution networks. The latter argument is especially crucial in the context of implied policy of energy saving and reduction of energy intensity of Belarusian GDP[2]. The third reason why private investments in infrastructure are highly demanded in Belarus is insufficient level of government spending on infrastructure: road construction, rail road development, energy system modernization. On the other side, the need for changes of institutional environment: amendments in legislation, introduction of independent regulatory mechanisms, reduction of the scope of quasi-fiscal activity of the state in infrastructural sectors is suggested as an essential component of reforms (Glambotskaya et al 2007) and supposed to be an important condition for attracting private investments to these sectors.

The paper is organized as follows: Chapter 2 provides the overview of related literature on the role of institutions in economic development, interrelations between quality of institutions and private investments and consequences of private capital participation in infrastructure provision; Chapter 3 contains the description of methodology, utilized data and measurements, applied estimation approaches; Chapter 4 ponders on the obtained empirical results and possible explanations of them, illustrations of the obtained results on the economies of the former Soviet countries are provided; Chapter 5 comprises conclusions, implications and suggestions on further development of the research.

[2] http://www.rg.ru/gazeta/soyuz/2006/06/08.html

2. Literature review

This section reviews the existing literature focused on related fields of economics. The first part covers some works that reveal impact of institutions on economic development; the second part considers aspects of institutional environment significance for infrastructural investments.

Among the most cited works on economic institutions is North (1991). According to his definition, "institutions are the humanly devised constraints that structure political, economic and social interaction. They consist of both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, property rights)". The main purpose of such constraints is seen in reduction of transaction costs and assistance in development of more productive forms of economic operations. It is emphasized that causal interrelations between economic development and development of institutions are two-way: emergence of institutions can be induced by development of economic activity to reduce corresponding transaction costs, but on the other hand, sufficient level of institutional development is a necessary condition for further economic development. Analyzing the development of trade in different regions in various epochs North concludes that in the absence of elementary rudiments of institutions they may not evolve due to resistance to innovations from the side of the economic agents. The second important conclusion made is the increasing importance of proper institutions. As specialization becomes deeper a greater number of transactions are involved in production and distribution, thus, the share of transaction cost in total costs is ever rising. In this process the role of institutions is also becoming more significant.

Starting from the 1990-s different theories on institutional, geographical and trade factors of growth have received further development. Acemoglu, Johnson and Robinson (2002) attempt to explain the inverse relationship between development levels of former European colonies in pre- and post-colonial periods. They compare several geographic theories that might explain such differences and come to the conclusion that the most powerful approach is the "institutional hypothesis". It is claimed that the mentioned inverse relationship might be observed due to the fact that in prosperous densely populated regions European colonists established primarily "extractive institutions", while in poorer regions the institutions of property rights were established and developed. This differentiation, in the authors' view, is the main explanation of the existing income differentiation.

Hall and Jones (1999) study the influence of institutions on productivity of labor and utilize the obtained results for explanation of the existing income gap between developed and developing countries. Their main point is that "social infrastructure" ("the institutions and government policies that provide the incentives for individuals and firms in an economy") is the main reason why productivity differs so much. For estimating level of social infrastructure's development they use two measurements: the index of government anti-diversion policies provided by Political Risk Services and the index of openness to international trade compiled by Sachs and Warner (1995). The authors acknowledge the presence of endogeneity problem and use instrumental variables: distance from the equator and presence of European languages among the official languages. Their results show the crucial importance of social infrastructure for labor productivity. A simple interpretation provided is that with higher development level of institutions "individuals capture the social returns to their actions as private returns" (North, Thomas 1973).

Some different approach to measuring institutions' development is implemented by Knack and Keefer (1995): they claim that such an important institutional aspect as property rights protection – the one that directly influences investment decisions – is determined by political stability. The number of revolutions, coups and assassinations are taken as measurements of the mentioned concept. The latter is justified by the assumption that unstable political regimes are more inclined to expropriation since they do not expect to bear the full costs of such actions in the future. The major conclusions in this paper point to crucial importance of property rights protection for economic development and to insufficiency of political stability indicators as proxies for quality of institutions.

All these works have results that are significant and robust, they provide clear evidence of parallel economic and institutional development – "development is no longer seen as a process of capital accumulation, but as a process of organizational change" (Hoff, Stiglitz 2001). Yet the mentioned problem of endogeneity of institutions' quality provides possibility for alternative interpretation of causality – when institutional changes are driven by economic progress. Namely, Glaeser et al (2004) turn their attention to human capital as a source of long-run economic growth rather than institutions, while development of the latter is seen as a result of economic development. The provided example of South and North Korea supports the idea: in the 1950s both countries were dictatorships, capitalistic and socialistic courses were adopted by these countries primarily due to choices of their leaders. As a result of economic prosperity political institutions in South Korea evolved and turned from autocracy into democracy. This paper also subjected the previously considered works by Knack and Keefer (1995), Hall and Jones (1999), Acemoglu et al (2002) to criticism from the point of inappropriateness of utilized variables for institutions' quality. Such compound measures of institutional development provided by International Country Risk Guide as risk of expropriation by the government, government effectiveness, and constraints on the executive are considered to measure outcomes of existing political constraints rather than their permanent characteristics. Also, these variables are characterized by high volatility, which is deemed not to be the attribute of institutions. Finally, they tend to reflect existing preferences of governments, but not constraints on them, which also does not meet the definition of institutions given above. An important conclusion made in the paper is about the significance of human capital for both output growth and institutions development, while the reversal mechanism is observed only for output growth.

The above mentioned works are aimed at the estimation of generalized relationship between institutional development and economic growth; however, more detailed analysis of revealed interrelations demands scrutiny of transmission mechanisms. In the context of my paper the most relevant mechanism implies impact of institutions on investment decisions.

The work by Henisz (2002) is among the first devoted to aspects of interrelations between infrastructure investments and political constraints. The author considers two sectors of infrastructure that emerged and obtained their development relatively recently – telecommunications and electricity production. Two equations in this paper are estimated separately: first, for the year of initial investment (emergence of the mentioned sectors), second, for subsequent amount of investments (measured in changes of infrastructure endowment per capita). An index for political constraints is introduced for estimating the level of their development – it is based on the number of independent government branches with veto power and the extent of alignment across these branches. The obtained results are in line with theoretically predicted ones: more stable policy, higher level of credibility of government among investors creates better incentives for introduction and development of infrastructural sectors. This outcome may be attributed to such characteristics of infrastructural investments as long time horizon and substantial amounts of investments.

A number of papers that study impact of institutions on investments investigate such a social phenomenon as corruption. The relevance of the latter is due to tight relationship between corruption level and institutions' development (Shleifer, Vishny 1993): as a rule, societies with poorly developed institutions suffer substantial corruption. Mauro (1995) studied impacts of corruption, bureaucracy and judicial system efficiency on investments and economic growth. One of the main innovations of this work is the utilization of ethnolinguistic fractionalization as an instrumental variable (IV) for the mentioned measurements of institutional development – it is shown that the ethnolinguistic diversity, *ceteris paribus*, is associated with worse institutions and corruption, yet, it is unlikely to be influenced by the investment rate. Another IV introduced is the presence and length of colonial period in countries' history: the later the country obtained independence, the less time it has for establishment and development of its institutions. The empirical results in the work provide evidence of strong negative impact of corruption and ineffective institutes on economic growth through reduction in investment rate.

The topic of corruption's impact on economy received continuation in paper by Tanzi and Davoodi (1997). The authors claim that higher level of corruption can be associated with greater amounts of public investments; however, these spending can be non-productive. First explanation for such interrelations is that in most cases bribes comprise a certain percentage of projects' costs; thus, officials can be interested in accepting costly projects, often with excessive capacity and complication or, adversely, projects of poor quality if construction firms have to cover expenses for bribes from their costs. Second reason is that from politicians' point of view investments in new projects are more attractive than spending on operations and maintenance of the existing capacities which also leads to deterioration of infrastructure's quality. Third cause is seen in the dominance of public sector in infrastructure provision and lack of competitiveness. The empirical results support the main hypotheses: higher corruption is associated with 1) higher amounts of public investments, 2) lower government revenues, 3) lower operating and maintenance expenditures and 4) inferior quality of infrastructure. The main implication from this paper is that corruption can be accomplished with greater investments in infrastructure, but poorer quality of the latter. Yet corruption provides only one snapshot of institutions' quality. Besides, this work concentrates, primarily, on public provision of infrastructure, while the significance of private capital participation in infrastructure provision becomes more considerable (World Bank PPI Database).

The question of institutions' impact on private capital participation in infrastructural sectors is covered in paper by Banerjee et al (2006). This research utilizes data provided by the World Bank on private provision of infrastructure (PPI) for period 1990-2000 and International Country Risk Guide (ICRG) data set to estimate the impact of institutions on the amount and frequency of private infrastructural investments. Among indicators used for institutions are: rule of law, government stability, ethnic tension, bureaucratic quality, corruption (from ICRG), political and civil rights (from the Freedom House data set). The obtained results are the following: the rule of law has positive impact on private investments; the corruption level has also positive impact, while the influence of political institutions is ambiguous. Macroeconomic and financial factors are discovered to have positive impact. The positive direction of corruption influence is explained by individual characters and significance of every investment projects. Another significant result obtained in that paper is the evidence of crowding out effect from public investments.

All the works mentioned above reveal positive and significant impact of institutions' quality on economics development and investments in general and infrastructural investments in particular. The paper by Banerjee et al (2006) is the most relevant to my research. Several important amendments to it are introduced in this work. First, updated data provide more observations which allow obtaining more robust results. Second, starting from year 2003 many countries have significantly increased investments in telecommunications and energy (Figure A2) which may affect the obtained estimates. In addition, the distribution of infrastructural investments among regions became more balanced if one compares periods 1990-2000 and 2000-2005 (Kerf, Izaguirre 2007). The last fact may also influence the estimated impact of institutions: it might be that investors become more optimistic on investment possibilities in developing countries due to their economic and institutional progress. Third, the existing cross-country data on PPI contains a sound share of zero entries, which may point at the necessity of use of econometric procedures for limited variability dependent variables (TOBIT, type II TOBIT). These techniques will allow to account for sample selection bias and investigate whether the institutions influence decisions of investors on investments or both on investments it their volume.

3. Methodology and data description

This section provides description of models, variables and estimation procedures. It is organized as follows: the first part is devoted to explicit formulation of tested hypotheses description of utilized approaches; the second part describes the introduced independent variables and background for their introduction; finally, the third part explains the choice of implemented estimation procedures.

The first hypothesis tested in this work is that the quality of institutions has a positive impact on the total level of private investments in infrastructural sectors. This hypothesis is tested by a regression with limited dependent variable in which the dependent variable is the total private investment commitments in real terms (US$ 2000) for given sector, country and year per capita. The primary source of data on private investments in infrastructure is the World Bank PPI Database. According to the PPI Database methodology, infrastructure is divided into four primary sectors: energy, telecommunication, transport and water. A more detailed classification of infrastructure is provided on the PPI Database website[3]. As it is stressed in Banerjee et al (2006), total investment commitments as a percentage of GDP might be a more relevant measurement of PPI, yet, due to low absolute value of PPI such a measurement would possess low variability and produce less precise results. The share of zero private investments among the observations (the unit of observation is country-year) varies from 54.39% for telecommunication to 93.88% for water and sewerage sectors. In case of such nonnegative variables as investments it may be an indicator to the necessity of implementing limited dependent variables estimation techniques. The motivation for it may be the following: assume that there exists some "institutional threshold" (the minimum required quality of institutions) below which private investors are not interested in infrastructural sectors (expected return are insufficient for covering incurred risks), in this case countries below this threshold will display zero PPI. Formally it can be represented as:

$$y_{it} = max(0; x_{it}^T \cdot \beta + \mu_i + v_{it}),\ v_{it} \sim IIN\,(0,\sigma_v), \tag{1}$$

where x_{it}^T denotes explanatory variables and μ_i - a fixed effect. This specification is known as fixed effect TOBIT model (Baltagi 2001). Yet, in this case quite a strong assumption is made that the same variables influence both the probability that PPI take place and the magnitude of PPI. To avoid this assumption the so called type II TOBIT approach is utilized: it is assumed that the selection process determines whether PPI are observed for the given country or not. The amount of PPI once they are observed can be described by the linear equation:

$$y^*_{it} = x^T_{it} \cdot \beta + u_{it},$$

[3] http://ppi.worldbank.org/resources/ppi_methodology.aspx

$$I_{it}^{*} = z_{ii}^{T}\gamma + v_{it},$$
$$y_{it}=y^{*}_{it} \text{ if } I^{*}_{it} >0, \text{ otherwise } y_{it}=0. \qquad (2)$$

Among the benefits of this approach is that it allows finding out which of the two investors' decisions are more affected by the quality of institutions: whether to invest or how much to invest.

The second hypothesis to test is that higher quality of institutions has positive effect on the number of private infrastructural investment projects. The motivation for testing this additional hypothesis besides the hypothesis on total investments is that there exists empirical evidence provided by Tanzi and Davoodi (1997) that it might be the case that worse quality of institutions is associated with larger total infrastructural investments. Such a result is observed due to adoption of large, often excessive projects which are more attractive from political popularity and rent seeking points of view. But at the same time, despite large total investments, overall number of investment projects remains low. The mentioned hypothesis is tested with an approach similar to the one adopted by Banerjee et al (2006) with quantity of implemented projects as a dependent variable. It was assumed that the number of projects in every country-sector-year follows Poisson distribution:

$$V(\eta_{it}|X_{it}) = \lambda_{it},$$
$$Pr\,(\eta_{it}) = f\,(\eta_{it}) = (e^{-\lambda}\cdot \lambda_{it}, \cdot \eta_{iit})/(\eta_{it}!)\,,$$
$$\lambda_{it} = exp(X_{it}\cdot\beta). \qquad (3)$$

So far, the dependent variable in this case is the number of infrastructural projects in country-sector with financial closure in the observed year.

The following section is devoted to the description of utilized explanatory variables and background for their introduction into the models. The first block of independent variables represents variables on quality of institutions - those that are of primary interest in context of this work. The background of their inclusion is considered in the literature review section. The primary source of data is the Worldwide Governance Indicators (WGI) project[4]. Governance in this project is interpreted as "the traditions and institutions by which authority in a country is exercised" (Kaufmann, Kraay, Mastruzzi 2008). Six compound indicators are provided by this source: voice and accountability - presents citizen's possibility to participate in authorities elections; political stability and absence of violence - measure of probability of government destabilization as a result of violent actions; government effectiveness - for quality of public services; regulatory quality - ability of the government to implement sound policies; rule of law - quality of contract enforcement and property rights protection; control of corruption. All these indicators are estimated on the basis of the data provided by different sources (for some countries the number of sources goes up to 21). All the mentioned indicators of institutions' quality are subjective *per se* as they are collected on the basis of surveys of agents in the corresponding countries.

[4] http://info.worldbank.org/governance/wgi/index.asp

Following Glaeser et al (2004) argumentation, institutions are widely accepted as being inert and demanding extended periods of time for significant changes to take place. The possible counterarguments applicable to this work are: 1) institutional environment can change for investors in a relatively short periods (for instance, with more democratic regime coming into power, implementation of severe anti-corruption measures, adoption of more favorable legislation, etc.); 2) the considered period (1996 - 2007) might be sufficient for sound institutional changes. Central European and Baltic States can be considered as an example of development of institutions in the mentioned period. Figure A1 provides an illustration for this statement: an improvement in institutions related to protection of property rights and contracts fulfillment can be observed for Latvia, Lithuania, Croatia, Bulgaria, Slovak Republic and Serbia and Montenegro.

The second block of explanatory variables involves macroeconomic indicators. The primary source of data on these indicators is the World Development Indicators database 2006 and the United Nation Statistics Division[5]. Sustainability of economic development, credibility of implemented economic policy is considered to be important determinants of investment decisions. To control for the mentioned aspects the following variables are included: lagged inflation, lagged official exchange rate percentage annual change and lagged real GDP growth rate. Inflation and lagged GDP growth rate are introduced as signs of economic policy successes. The motivation for exchange rate percentage change is different: if investments are fulfilled by foreign companies or by domestic companies with funds borrowing from abroad – in both these cases investors are interested in stability of the level of their earnings expressed in foreign currency. The possible issue might be high correlation between inflation and percentage changes in nominal exchange rate, which is predicted by economic theory, but in our case it is poorly supported by the data: coefficient of correlation between these two variables is 1.12%. Among others, lagged GDP per capita is introduced. This variable serves as a reflection of the demand level for infrastructural services from population. Also, from Figure A2 it can be observed that volumes of PPI are cyclical. To account for this aspect year dummies are introduced. The regression for number of investment projects also includes total country population as an explanatory variable: it seems reasonable that the larger (in term of population) economy is, the larger number of private investment projects should be observed. Population is not included in TOBIT and TOBIT type II regressions since the dependent variables in them are expressed in per capita rather than total terms, as in Poisson regression.

Besides, it is also assumed that the countries facing tighter infrastructure shortcomings, i.e. greater supply shortage of infrastructural services, are more willing to induce PPI than others.

[5] http://data.un.org/Browse.aspx?d=CDB

To control for this aspect variables on infrastructure quality in corresponding sectors are taken into account: for energy – electric power transmission and distribution losses (%), total electricity installed capacity per capita (watts); for telecommunication – mobile phone subscribers (per 1000 people) and telephone faults (per 100 mainlines); for transportation – paved roads (% of total roads); for water and sewerage – share of population with access to the improved water sources (%). An important issue arises here: infrastructure's quality can be viewed as endogenous variables to corresponding private investments and number of investment projects in related sectors. To avoid the negative consequences of endogeneity the listed variables are taken with the lag of one year. Indeed, it is hard to assume that current investments had impact of infrastructure quality in previous periods.

Additional variables input in the set of explanatory variables are worth detailed explanation – war_t and $ex\text{-}war_t$. The first variable takes values from 1 (sporadic political violence) to 7 (pervasive warfare) according to societal effects of warfare if the considered country was involved in any armed conflicts at period t, 0 – otherwise. Societal effect represent a complex estimation of consequences of war based on its impact on human resources (number of deaths, injuries, crimes), population dislocation, diminished quality of life, etc. The second variable represents the effect of preceding conflicts and takes the weighted average magnitude of the conflicts during the preceding 10 years (weights diminish proportionally to remoteness to reflect war effect's dissipation). The data used for these variables is provided by the Integrated Network for Societal Conflict Research (Marshall, 2008). Though being of applicable quality, the data was transformed in the following way: for countries involved in more than one conflict in the current period the maximum magnitude category of the occurring conflicts was taken. The general background of introduction of such variables is that warfare increases risks of assets physical loss or expropriation and, thus, serves as a serious investment deterrent. Besides, it is assumed *a priori* that infrastructure is one of the sectors of the economy that suffers severely during the armed conflicts. Another issue is related to a long-run effect of the armed conflicts on institutions' quality and long-run growth path. According to the neoclassical growth theory, destruction of physical capital during wars should be followed by rapid consequential growth to catch-up with balanced growth path. This prediction is supported by researches of Miguel and Roland (2005) and Davis and Weinstein (2001) on the development of Japan and Vietnam in postwar periods. They found that there is no statistically robust negative long-run impact of war on consumption, infrastructure, population density, poverty and literacy rates. Yet, in the case of the mentioned studies the long-run period extends up to 40 years, while, some papers point to rehabilitation of losers after such severe wars as the World War I and II within the period of 15-20 years

(Organski and Kugler 1977), the so called *phoenix factor*. The impact of wars on institutions was studied by Bellows and Miguel (2006) on the example of Sierra Leone. The obtained results are in line with the ones for physical capital – there is no evidence of long-run institutions' deterioration after the conflicts. Since the armed conflicts in the studied countries since 70-es have lower magnitudes that World War I and II, the proper rehabilitation period is assumed to be 10 years.

Although these institutional indices and variables on civil conflicts reflect different aspects of institutional environment quality, they are highly correlated. Partial correlation coefficients between these variables are presented in Table 1. As it can be seen, coefficients at institutional variables are in most cases highly significant. This clearly indicates that inclusion of all the mentioned variables in the same regression equations will cause estimation problems related to multicollinearity. On the other hand War and Ex-War variables are highly correlated with each other, but not with the institutional ones. The exception is the Political stability, no violence – this index reflects the probability of government disturbances and it is highly correlated with both War and Ex-War variables. To avoid collinearity the Political stability, no violence indicator is excluded from the data set.

Table 1. Coefficients of partial correlation for institutional and war variables.

	War	*Ex- War*	*Voice and accountability*	*Political stability, no violence*	*Government effectiveness*	*Regulatory quality*	*Rule of law*	*Control of corruption*
War	1.000							
	(0.000)							
Ex- War	0.7313	1.000						
	(0.000)	(0.000)						
Voice and accountability	0.0413	0.0057	1.000					
	(0.145)	(0.840)	(0.000)					
Political stability, no violence	-0.2323	-0.1813	0.2402	1.000				
	(0.000)	(0.000)	(0.000)	(0.000)				
Government effectiveness	-0.0618	0.0600	-0.0440	-0.0035	1.000			
	(0.029)	(0.034)	(0.121)	(0.903)	(0.000)			
Regulatory quality	-0.0258	-0.0512	0.3966	-0.1861	0.5549	1.000		
	(0.364)	(0.071)	(0.000)	(0.000)	(0.000)	(0.000)		
Rule of law	0.0971	-0.0026	0.0621	0.4325	0.2433	0.1172	1.000	
	(0.001)	(0.927)	(0.029)	(0.000)	(0.000)	(0.000)	(0.000)	
Control of corruption	0.0438	-0.0170	0.0473	0.0402	0.3666	-0.0473	0.4346	1.000
	(0.123)	(0.548)	(0.095)	(0.156)	(0.000)	(0.095)	(0.000)	(0.000)

Note: significance levels of the coefficients are provided in parentheses below.

The solution to the problem of correlated war and institutional series (the rest five, without Political stability, no violence) is seen in implementing the principal component analysis (PCA). The essense of this approach is that it allows transforming the original set of highly correlated variables into a smaller number of orthogonal components which are linear combinations of the initial variables. In mathematical form:

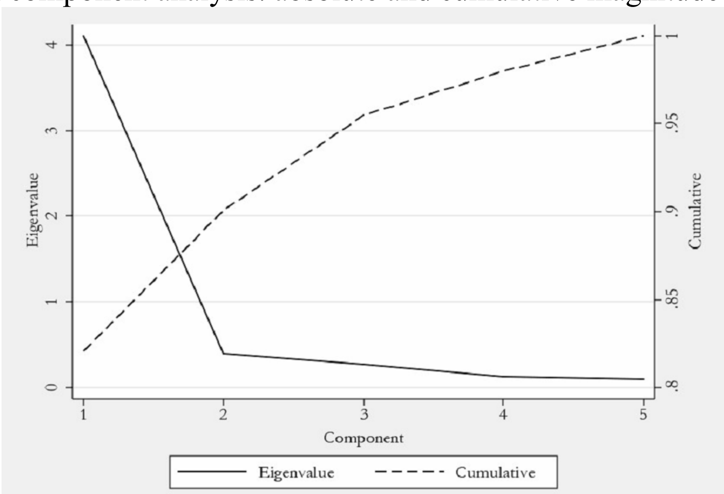
$$Y_1 = a_{11} \cdot X_1 + a_{12} \cdot X_2 + .. + a_{1N} \cdot X_N$$

$$\ldots$$

$$Y_k = a_{k1} \cdot X_1 + a_{k2} \cdot X_2 + + a_{kN} \cdot X_N$$

where $X_1, X_2, \ldots, X_N$ is the initial set of variables, $Y_1, \ldots, Y_k$ – constructed components. Vectors of weights $(a_{m1}, \ldots, a_{mN})$ are obtained as normalized eigenvectors of the covariance matrix S or the correlation matrix R of the considered series. The sufficient number of components that contain most of information of the initial set is defined on the magnitude of eigenvalues λ_m of the mentioned matrices S or R. The Figure 1 depicts the absolute and cumulative magnitude of the mentioned eigenvalues for institutional variables. From the figure it can be concluded that the first eigenvalue significantly dominates all the others in term of absolute and cumulative magnitude: it can be concluded that nearly 82% of variation in the initial set of variables is captured by the first component.

Figure 1. Principal component analysis: absolute and cumulative magnitude of eigenvalues.



The structure of the obtained components is presented in Table 2.

Table 2. Principal component analysis: structure of the institutional component.

Variable	*Component 1*
Voice and accountability	0.4092
Government effectiveness	0.4657
Regulatory quality	0.4480
Rule of law	0.4590
Control of corruption	0.4520

As one can see from the table above the Component 1 reflects the quality of institutional environment: roughly equal positive weights in it are assigned to the five institutional variables. The Component 2 for War and Ex-War variables is obtained by the same procedure; to each of the war variables an equal weight of 0.7071 is assigned. Thus, the obtained two components will be utilized in further analysis instead of institutions and war variables to control for quality of institutional environment and magnitude of civil conflicts, political violence. The notions will be changed: *Institutional Component* – for Component 1, *War Component* – for Component 2. The pairwise correlation coefficient between the newly obtained components is -0.3905, which is close to the magnitude of pairwise correlation coefficients between war and institutional variables. Taken into account that partial coefficients, as can be seen from Table 1, for war and institutional variables are in most cases not significant, it can be concluded that the inclusion of these components in the same equations will not cause multicollinearity. Descriptive statistics for all initial variables is presented in Table A2.

The following section is dedicated to description of choices between estimation approaches. Three alternatives are available for specifying estimation techniques of the mentioned above models: pooled, random effect and fixed effect. As it is widely accepted in econometric literature, the fixed effect methodology might be the most appropriate when studying panel data on cities, regions and states (Wooldridge 2002, Greene 2000). Yet, in the paper of Banerjee et al (2006) it was reported that for linear regression of PPI on institutions indicators the most appropriate technique was the pooled OLS. So, the evidence from the literature on what specification is preferred is not conclusive and the formal tests should be applied. The issue involved in choosing between the mentioned alternatives is that for non-linear models there does not exist a sufficient statistic that allows estimating the fixed effects (Wooldridge, 2001). Another issue related to estimation of non-linear models with fixed effect is the biasedness of maximum-likelihood estimates of such models due to incidental parameters problem (Wooldridge, 2001). The essence of the latter is that in the presence of fixed effect and limited number of time observations (T) the maximum-likelihood (ML) estimators of parameters' are in general not consistent. Although this problem is intrinsic for most non-linear models, there are some exceptions: for instance, ML estimations for Poisson specification are shown to be consistent. Besides, Greene (2004a, 2004b) states that biasedness of ML estimates of fixed effect TOBIT model is small as the number of periods T in the panel exceeds five. The panel data TOBIT and type II TOBIT procedures realized in econometric packages allow estimating of random effect TOBIT models and testing between random and pooled specifications utilizing likelihood ratio test. To choose between random and fixed effect specifications the Hausman test was performed. Fixed effect estimates were obtained as pooled estimates with country specific dummies. The obtained results are presented in Table A3. Two variants of specifications were introduced: with and without indicators for infrastructure quality. The main reasoning for such separation is that for some countries and significant number of periods data on infrastructure quality are not available, which substantially reduces the number of utilized observations and, thus, credibility of the tests' results. Further specification with infrastructure quality will be denoted as *specification*

1, specification without infrastructure quality – as *specification 2*. As it can be inferred from the likelihood ratio (LR) tests, random effect specification should be preferred to pooled for both TOBIT and Poisson regressions for all the four sectors in both specifications 1 and 2. The Hausman test's results, though, are not so conclusive: different specifications (1, 2) sectors and regressions (TOBIT, Poisson) indicate that in some cases fixed effect approach should be utilized, while in others – random effect. No consistent pattern among the results can be traced. Yet for the possibility to compare the obtained results for different sectors the uniform estimation method is more preferable. Thus, a choice is made to estimate all the considered specifications with fixed effect approach. The motivation for such a decision is the following. First, fixed effect estimates are consistent in both cases, when individual specific part of the residual is correlated with the explanatory variables (fixed effect is preferred) and when it is not correlated (random effect is preferred), but in the second case fixed effect estimates are not efficient. On the contrary, if the individual specific part of the residual is correlated with the explanatory random effect estimates are inconsistent. The second reason for controlling for individual specific effects when working with cross-country data is widely adopted in the economic literature: the units of observation are heterogeneous and posses numerous characteristics that are fixed over time (geographical location, area, language, historical path, etc.) and might correlate with the explanatory variables. To take into accounts all these observable and unobservable characteristics the fixed effect approach is utilized.

4. Empirical results

In the previous section two primary questions of interest on interrelation between institutions' quality and private capital participation in infrastructure were stated. This section provides a detailed description and analysis of the obtained results of testing these hypotheses.

The first hypothesis – how institutions' quality influences total volumes of PPI – was tested using TOBIT and type II TOBIT methodology for panel data. Estimates of TOBIT model for private infrastructural investments per capita are provided in Table A4. For the rest of the paper a 10% level of significance is adopted for the interpretation of the results. As it can be observed from Wald χ^2 statistics the overall significance of regressions for both specifications 1 and 2 is high for energy and telecommunication sectors, but low for transportation and water and sewerage sectors. The possible explanation for such an outcome might be that transportation and water sectors are characterized by a high share of censored observation among the whole data: it comprises nearly 93% for water and 82% for transportation sector, while for telecommunication and energy sectors they are 35% and 65% correspondingly for specification 1. TOBIT estimates of selected coefficients are presented in Table 3 below.

Table 3. TOBIT fixed effect estimates, selected coefficients.

Private investment commitments per capita	*Specification (1) with infrastructure quality indicators (fixed effect)*				*Specification (2) without infrastructure quality indicators (fixed effect)*			
	Energy	*Telecom*	*Transport*	*Water*	*Energy*	*Telecom*	*Transport*	*Water*
Institutional component	62.781	19.371	14.705	24.079	37.339	8.318	21.128	4.330
	(0.00)	(0.00)	(0.28)	(.)	(0.00)	(0.01)	(0.01)	(0.65)
War component	-0.664	3.943	-5.272	-6.053	-4.350	1.819	-5.993	0.128
	(0.87)	(0.14)	(0.22)	(.)	(0.26)	(0.13)	(0.04)	(0.96)
Lagged rate of inflation	0.038	0.118	0.136	0.177	0.024	0.030	-0.089	0.423
	(0.23)	(.)	(0.49)	(.)	(0.43)	(0.00)	(0.55)	(0.07)
Lagged change in	-5.510	-6.284	9.277	-85.348	-14.189	-3.778	4.983	-26.261
	(0.31)	(0.54)	(0.40)	(0.09)	(0.04)	(0.00)	(0.58)	(0.06)
Lagged GDP growth rate	-1.625	-0.184	2.118	2.932	-1.261	-0.290	0.417	0.753
	(0.13)	(0.70)	(0.02)	(.)	(0.10)	(0.13)	(0.48)	(.)
Lagged GDP per	0.004	0.001	0.009	-0.000	0.006	0.004	0.007	0.006
	(0.52)	(.)	(.)	(.)	(0.24)	(0.08)	(0.04)	(.)
Wald χ^2	167.37	1361.12	156.87	87.84	268.78	649.56	145.34	70.18
	(0.00)	(0.00)	(0.09)	(0.78)	(0.00)	(0.00)	(0.50)	(1.00)

Note: p-values are provided in parentheses below; (.) means that p-values are absent due to unavailable robust estimates of standard errors.

In five out of eight estimated regressions and in all the regressions that are characterized by significant Wald χ^2 statistics the institutional component has a positive coefficient which is significant. On the contrary, the war component is significant only in the regression for transportation sector, second specification: the sign of coefficient is negative which provides an indication that armed conflicts can be a deterrent for private investments in some sectors.

Inflation is an important factor only in regressions for telecommunication and water sectors in the specification without infrastructure quality indicators. Yet the coefficients' signs are at odds with the theoretical prediction: inflation is estimated to have positive impact on the total amount of private investments in the corresponding sectors. Significant coefficient at exchange rate percentage changes have negative sign which supports the theoretical prediction that exchange rate instability is associated with overall macroeconomic instability and can serve as an impediment for private investments in infrastructure. The evidence on the importance of the other macroeconomic indicators – GDP growth rate and GDP per capita – is limited: GDP growth rate is significant only for regression for transportation sector under specification 1, GDP per capita is significant in regressions for telecommunication and transportation under specification 2. Signs at the mentioned significant coefficients are positive which is in accordance with the predicted ones – larger GDP per capita indicates larger demand (payable need) for infrastructural services at the current period, while higher GDP growth rates indicate growing market potential and assume larger demand for infrastructural services in the future. Data on quality of infrastructure in telecommunication and water sectors do not provide sufficient number of observation for obtaining robust estimates of standard errors at the corresponding coefficients (Table A4). The only infrastructure's quality indicator that is significant is the total installed power production capacities per capita for energy sector regression. The coefficient sign at this indicator is negative which is in conformity with theoretical motivation: the less capacities are installed, the greater is the available niche for investments in energy production, and the larger is the gap between demand and supply capacities. If the two specifications – with and without infrastructural quality variables – are compared on the basis of the obtained results it can be concluded that the one without infrastructural indicators provides better results: greater number of explanatory variables are significant in this specification than in the alternative one, larger number of observations is available in this specification which makes the conclusions on the basis of its estimations more credible.

Magnitude of coefficients is another important characteristic besides signs and significance level. For the case of TOBIT regression the coefficients at variables coincide with marginal effects of the corresponding variables. Thus, according to the obtained estimates, if a country improves the quality of its institutions in such a way that the institutional component increases by one point it can anticipate an increase in private investments in energy and telecommunication sectors on average by 37.3 and 8.3 US$ (constant 2000) per capita. These amounts are considerable in comparison with the average amounts of private investment that took place, for instance, in the former Soviet countries in 1991-2007: 0.00 – 8.65 US$ per capita for energy and 0.17 – 42.71 US$ per capita for telecommunication sectors (Table A5).

Although the signs of the obtained coefficients are almost all in line with the theoretically predicted ones, many of them are not significant. Another issue with the considered TOBIT estimates is that the produced residuals do not meet the normality assumption which is supported by Drukker's test for normality (Table A6): the obtained statistics for both kinds of specifications (with and without infrastructure quality) exceed 1% critical values for all regression except the one for water sector in specification 1. As it was mentioned above, the assumption that the same sets of variables explain both the presence of PPI in the economy and its volume is restrictive. To avoid these additional restrictions the two-step Heckman approach was utilized (type II TOBIT specification). One of the core questions for composing type II TOBIT is division of explanatory variables into those that are included in the selection equation (*Z*) and the population equation (*X*). In Wooldridge (2002) it is recommended that *X* should be a strict subset of *Z*, i.e. in our case the selection equation should contain some variables that influence the decision of private investors to take infrastructural projects, but does not influence the amount of investments. The fixed effect (introduced with country dummies) is accounted for in the selection equation but not population: criteria of investment projects' expedience are roughly the same all over the world, so, once the decision to invest is made the decision on the volume of investments would depend rather on the project's characteristics, than the country's fixed characteristics. Infrastructure's quality is assumed to influence both the decision on investment and its amount: poorer infrastructure's quality can reflect larger unmet demand for it and available niches for investments. Macroeconomic variables are divided in the following way: inflation rate, GDP growth rate and annual percentage changes in exchange rate are introduced in the *Z* set, but not in *X*, while GDP per capita is included in both sets. The motivation for such a division is the following: high inflation rate, volatility of exchange rate and unstable GDP growth rate increases the so called systematic or non-diversifiable risk. Under the condition that this risk is sufficiently high, according to the capital asset-pricing model (CAPM), investors will require higher returns on the infrastructural projects which, taking into account their long recoupment periods and in most cases governmentally regulated prices for infrastructural services, might be not feasible. On the other hand, higher GDP per capita reflects higher purchase power of population, including their ability to pay for better infrastructural services, hence, this variable can influence both decision of private agents to invest as well as the volumes of such investments. Concerning the institutional component it is not apparent if it should be excluded from the set *X* or not. On the one hand, it is reasonable to assume the existence of the so called institutional threshold – minimum quality of institutional development required by investors to take projects in such sensitive to institutional environment sectors as infrastructure. By this logic the institutional component should be put in the set *Z,* but not *X*. On the other hand, there exists an empirical evidence (Tanzi and Davoodi 1997) that institutions' quality influences not only fixed, but also variable costs of investing in and operating infrastructural objects: an example from the mentioned paper are bribes as a fixed percentage of project's costs which make smaller projects more attractive. The latter argument indicates that the quality of institutions affects investors' decision whether to invest as well as how much to invest, thus, the institutional component should be introduced in both selection and population equations. Since none of the provided motivations strictly dominates the other, two specifications are tested: with and without institutional component in the population equation. For the case of the war component it is assumed that the previous and current armed conflicts deteriorate infrastructure and increase shortages of infrastructural services, thus, increase unmet demand for it and create incentives to invest in these sectors. On the other hand, it also can be supposed that current conflicts worsen political stability and lower investors' confidence, i.e. serve rather as a deterrent than an incentive for investments in infrastructure. As far as the quality of infrastructure is explicitly controlled for in both equations, the war component is supposed to influence only the decision whether to invest but not how much to invest – it is included in the set *Z* , but not *X*.

For estimating this type of model the two-step Heckman procedure was implemented. The obtained estimates are presented in Table A7, those of them for the institutional and war components are reproduced in Table 4.

Table 4. Type II TOBIT fixed effects estimates, selected coefficients.

	Energy		*Telecom*		*Transport*		*Water*	
	coeff.	*p-value*	*coeff.*	*p-value*	*coeff.*	*p-value*	*coeff.*	*p-*
	Population equation without institutional component							
Lagged GDP per capita	0.007	(0.01)	0.005	(0.00)	0.004	(0.01)	-0.004	(0.02)
	Population equation with institutional component							
Institutional component	3.400	(0.47)	6.457	(0.00)	-4.230	(0.28)	1.970	(0.48)
Lagged GDP per capita	0.006	(0.06)	0.002	(0.19)	0.005	(0.01)	-0.005	(0.02)
	Selections equation (PROBIT)							
Institutional component	1.435	(0.00)	1.501	(0.01)	0.458	(0.50)	-0.674	(0.68)
War component	-0.040	(0.77)	-0.218	(0.64)	-0.375	(0.23)	-1.352	(0.09)
Lagged GDP per capita	0.000	(0.33)	0.000	(0.80)	0.001	(0.18)	-0.002	(0.20)
Mills lambda	10.034	(0.27)	1.735	(0.76)	1.275	(0.86)	6.844	(0.25)
Wald χ^2 without institutional comp.	17.90	(0.02)	73.66	(0.00)	11.09	(0.13)	9.36	(0.05)
Wald χ^2 with institutional comp.	18.47	(0.03)	86.80	(0.00)	12.45	(0.13)	9.98	(0.08)

In the population equation without institutional component the lagged GDP per capita is a significant factor for explaining volume of PPI in countries for which PPI is observed. In regressions for energy, telecommunication and transportation sectors the sign of coefficients is positive which is in accordance with theory: higher GDP per capita implies higher income and, consequently, higher demand for infrastructural services. Coefficient at GDP per capita in regression for water sector is negative. This contradictory result might be explained by omission of such an important variable as government expenditures for infrastructure: higher GDP per capita is associated with higher government spending, including spending for infrastructure; as it is stated in Banerjee et al (2006), there exists evidence that public investments have a crowding out effect on private investments. These two arguments indicate that a downward bias can be observed at GDP per capita once the variable for government expenditures is omitted. If the institutional component is introduced into the population equation reduction in magnitude and significance level of coefficients at GDP per capita is observed which might be explained by positive relations between GDP per capita and quality of institutions. Institutional component have a limited explanation power for the volume of private investments: it is positive and significant only for telecommunication sector. On the other hand, GDP per capita is significant for three out of four regressions which indicates that it might better explain volumes of PPI than quality of institutions controlled that PPI are observed. In selection equation institutional component is significant for energy and telecommunication sector, while GDP per capita is not significant for any of the considered sectors. In all the four regression the war component has a negative sign which is in accordance with theory – current and previous armed conflicts serve a deterrent for PPI – yet, the coefficient at it has acceptable significance level only for water sector. So, the TOBIT type II fixed effect estimation procedure provides and evidence that larger GDP per capita influences the private investors decision on volumes of investments, while quality of institutions effects more the decision whether to invest rather than how much to invest.

As it was mentioned above, the data on infrastructure's quality for different sectors provides different number of observation: data on energy and telecommunication sectors' development better cover the considered time period than data on transport and water sectors. This difference is clearly reflected in the overall quality of the estimated regressions: the Wald χ^2 statistic is highly significant for the first two sectors and less significant for the latter two, especially transportation.

The second hypothesis that is tested in the framework of the current paper is the one that better quality of institutions is associated with larger number of private investment projects in infrastructural sectors. Regressions for the number of private investment projects started at the current year is estimated for the four considered sectors using quasi-maximum likelihood procedure for obtaining robust estimates of coefficient's standard errors. The obtained results are provided in Table A8, estimates of selected coefficients are reported in Table 5 below. The overall quality of regressions is reflected in Wald χ^2 statistic which is significant for all the regressions. The obtained estimates support the motivation for exclusion infrastructure quality from alternative specification: it allows increasing number of observations at least by factor two. As it can be seen from the obtained results (Table A8), including infrastructure's quality does not add to the explanatory power of the equations: none of the indicators, except lagged electricity losses for energy sector, is individually significant. For energy and telecommunication sectors the two corresponding indicators are not significant together. The further interpretation is devoted mainly to the specification 2 (Table 5).

Table 5. Poisson fixed effect estimates, selected coefficients.

Number of private infrastructural	*Specifications without infrastructure quality indicators*							
	Energy		*Telecom*		*Transport*		*Water*	
	coeff.	*p-value*	*coeff.*	*p-value*	*coeff.*	*p-value*	*coeff.*	*p-value*
Institutional component	0.837	(0.00)	0.548	(0.03)	0.879	(0.00)	0.065	(0.85)
War component	-0.163	(0.17)	-0.075	(0.29)	0.093	(0.52)	0.104	(0.69)
Lagged GDP per capita	0.000	(0.58)	-0.000	(0.94)	0.000	(0.41)	0.000	(0.01)
Total population, mln. people	0.010	(0.00)	-0.016	(0.18)	0.009	(0.02)	0.032	(0.00)
Wald χ^2	110.05	(0.00)	55.71	(0.00)	411.70	(0.00)	1261.39	(0.00)
Number of groups		87		109		70		40
Number of observations		758		935		616		354

The coefficients at the institutional component are positive in all regressions which is in line with the theoretical predictions – better quality of institutions is associated with larger number of private infrastructural projects. The coefficients are significant for energy, telecommunication and transportation sectors. War component, on the contrary is not significant for any sector. Thus, the estimated regressions show that the role of current and previous armed conflicts as deterrent for private investments in infrastructure is not evident. Total population has a significant positive impact on the number of implemented private projects in all the considered sectors, except telecommunication. GDP per capita has a positive significant impact on the number of private investment project in transportation and water sectors, but no significant effect for energy and telecommunication.

To illustrate the meaning of the obtained coefficients it should be noted that the marginal effects of the explanatory variables coincide with the corresponding coefficients. Thus, improvements in the quality of institutions reflected in 1 unit increase in the institutional component entail an increase in the expected number of private investment projects in energy and telecommunication sectors by 83.7% and 54.8% correspondingly.

Table 6. Predicted, average and total real numbers of private infrastructural projects for the former Soviet countries, 1991-2007.

Country	*Institutional*	*Energy*			*Telecom*		
		predict. 2007	*average 1991-2007*	*total 1991-2007*	*predict. 2007*	*average 1991-2007*	*total 1991-2007*
Armenia	-0.820	0.308	0.235	4	0.128	0.118	2
Azerbaijan	-1.840	0.236	0.176	3	0.025	0.235	4
Belarus	-2.920	0.063	0.059	1	0.041	0.176	3

Georgia	-0.418	0.419	0.765	13	0.184	0.529	9
Kazakhstan	-1.698	0.201	1.588	27	0.071	0.235	4
Kyrgyz Republic	-1.825	0.105	0.000	0	0.113	0.353	6
Latvia	1.485	3.328	0.059	1	0.449	0.294	5
Lithuania	1.547	3.198	0.235	4	0.561	0.353	6
Moldova	-1.291	0.170	0.118	2	0.144	0.235	4
Russian Federation	-1.658	0.520	5.235	89	0.009	11.000	187
Tajikistan	-2.332	0.072	0.059	1	0.070	0.294	5
Ukraine	-1.156	0.348	0.706	12	0.070	0.471	8
Uzbekistan	-2.692	0.066	0.000	0	0.041	0.412	7

Note: Estonia is omitted because it belongs to high-income countries according to the World Bank classification, Turkmenistan is omitted due to absent data on GDP.

This predicted increase does not seem unrealistic if compared to the real number of private investment projects in the former Soviet countries (Table 6): for the period 1991-2007 it varies from 0 to 89 for in energy and from 2 to 187 in telecommunication (maxima are observed in Russia, the second largest number of projects – 27 and 9 for energy and telecommunication – was observed in Kazakhstan and Georgia correspondingly). Thus, for instance, for Belarus improvement in the quality of institution to the level of Lithuania, *ceteris paribus,* would result in an increase of expected number of private investment projects in 1991-2007 from the observed 1 to 9 in energy and from 3 to 6 in telecommunication. For Ukraine the attainment of the same institutional level would cause an expected increase in the number of private energy projects from 12 to 29.

5. Conclusions

This article analyses the influence of the quality of institutions on the volumes of private participation in provision of infrastructural services in low and middle income countries. The considered infrastructure is divided into four primary categories and the analysis is carried out for each of them: energy, telecommunication, transportation, water and sewerage.

The first hypothesis is that better quality of institutions has positive impact on the total volume of private investments. It is tested using econometric methods for limited dependent variables – TOBIT and HECKIT. The obtained results provide clear evidence that for energy and telecommunication sectors impact of institutions on total volume of private investments is positive, significant and robust. For transportation and water sectors such evidence is not conclusive which might be explained by relatively low number of observed private investment projects in these sectors as well as by omitting such a variable as government investments is the corresponding sectors. The second important result obtained from the HECKIT procedure, which is especially vivid for energy sector, is that the quality of institutions influences primarily probability of observing private investments, rather than their volumes. Thus, evidence is obtained that institutional development determines the decision of private agents to invest in infrastructure, but the amount of such investments is affected by macroeconomic and project-specific factors.

The second tested hypothesis is that the better quality of institutions has positive influence on the total number of implemented private infrastructural projects. It is tested with econometric approach for count variables – Poisson regression. The obtained results fully support this proposition for energy, telecommunication and transportation sectors.

Among other considered variables GDP per capita has positive impact on the total private infrastructural investments, high volatility of official exchange rate is seen to have negative impact on PPI, and total population is positively related to the total number of private infrastructural projects. A variable accounting for current and previous armed conflicts in the considered countries does not have power in explaining the volumes of PPI. A possible explanation for this contradictory result might be that most civil conflicts in the considered period are localized and might intensively influence some regions, but not necessarily the whole country.

The results of this work have direct practical applications as they clearly show that the policy aimed at attraction of private capital into infrastructural sectors should contain such an essential component as measures for improvement of the quality of the institutional environment. This aspect is especially important for the former Soviet countries in the light of relatively low quality of their institutions (except Baltic states).

The possible development of this paper is seen in accounting for government participation in infrastructure in forms of governmental spending, presence of regulatory agencies, antitrust policy implementation. The second feasible direction of extension is suggested studying micro-data on implemented private infrastructural projects in order to find out what impact the quality of institutions has on characteristics of such projects: their type, duration, average volume.

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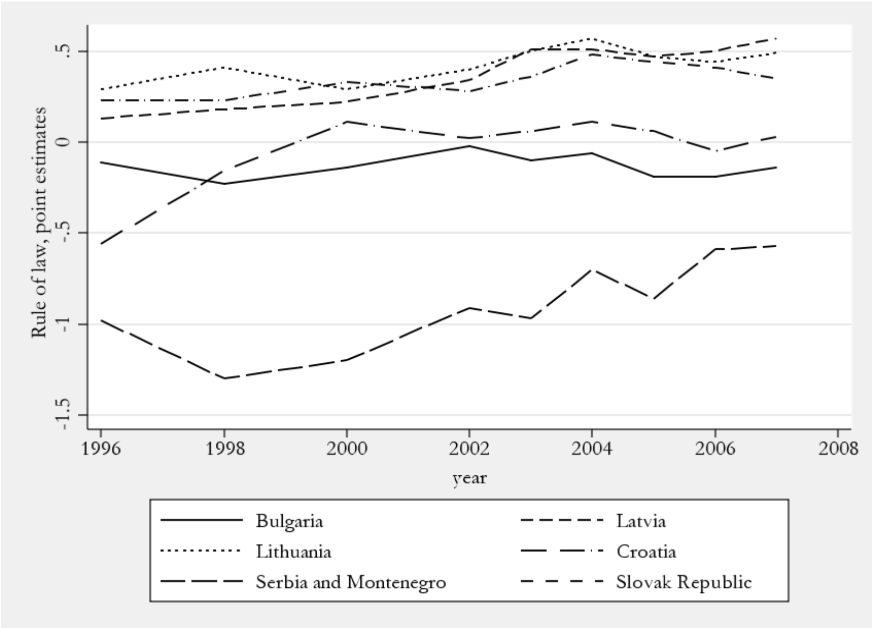
Appendix

Table 1A. List of low- and middle-income countries.

Afghanistan	Grenada	Palau
Albania	Guatemala	Panama
Algeria	Guinea	Papua New Guinea
American Samoa	Guinea-Bissau	Paraguay
Angola	Guyana	Peru
Argentina	Haiti	Philippines
Armenia	Honduras	Poland
Azerbaijan	Hungary	Romania
Bangladesh	India	Russian Federation
Belarus	Indonesia	Rwanda
Belize	Iran, Islamic Rep.	Samoa
Benin	Iraq	Sao Tome and Principe
Bhutan	Jamaica	Senegal
Bolivia	Jordan	Serbia and Montenegro
Bosnia and Herzegovina	Kazakhstan	Seychelles
Botswana	Kenya	Sierra Leone
Brazil	Kiribati	Slovak Republic
Bulgaria	Korea, Dem. Rep.	Solomon Islands
Burkina Faso	Kyrgyz Republic	Somalia
Burundi	Lao PDR	South Africa
Cambodia	Latvia	Sri Lanka
Cameroon	Lebanon	St. Kitts and Nevis
Cape Verde	Lesotho	St. Lucia
Central African Republic	Liberia	St. Vincent and the Grenadines
Chad	Libya	Sudan
Chile	Lithuania	Suriname
China	Macedonia, FYR	Swaziland
Colombia	Madagascar	Syrian Arab Republic
Comoros	Malawi	Tajikistan
Congo, Dem. Rep.	Malaysia	Tanzania
Congo, Rep.	Maldives	Thailand
Costa Rica	Mali	Timor-Leste
Côte d'Ivoire	Marshall Islands	Togo
Croatia	Mauritania	Tonga
Cuba	Mauritius	Tunisia
Djibouti	Mexico	Turkey
Dominica	Micronesia, Fed. Sts.	Turkmenistan
Dominican Republic	Moldova	Uganda
Ecuador	Mongolia	Ukraine
Egypt, Arab Rep.	Morocco	Uruguay
El Salvador	Mozambique	Uzbekistan
Equatorial Guinea	Myanmar	Vanuatu
Eritrea	Namibia	Venezuela, RB
Ethiopia	Nepal	Vietnam
Fiji	Nicaragua	West Bank and Gaza
Gabon	Niger	Yemen, Rep.
Gambia, The	Nigeria	Zambia
Georgia	Oman	Zimbabwe
Ghana	Pakistan	

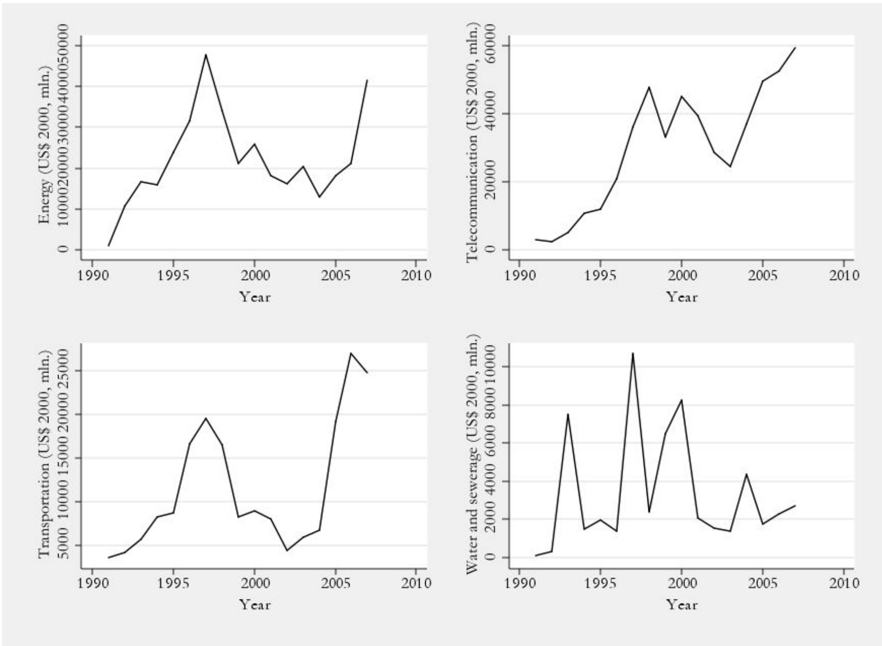
Note: economies are divided according to 2007 GNI per capita, calculated using the World Bank Atlas method. The groups are: low income, $935 or less; lower middle income, $936 - $3,705; upper middle income, $3,706 - $11,455; and high income, $11,456 or more.

Figure A1. Dynamic of rule of law point estimates for selected European countries, 1996 – 2007.



Source: Worldwide Governance Indicators

Figure A2. Private investment commitments to infrastructure projects within low- and middle-income countries, 1991–2007.



Source: World Bank PPI Database

Table A2. Descriptive statistics of explicable and explanatory variables.

Variable	*Obs.*	*Mean*	*Std. dev.*	*Min*	*Max*	*Source*
Total private investment commitment in energy sector per capita (current US$)	2448	6.4301	28.2466	0.0000	567.3493	World Bank PPI database
Total private investment commitment in telecommunication sector per capita, (current US$)	2448	8.9580	27.3734	0.0000	477.0093	World Bank PPI database
Total private investment commitment in transport sector per capita (current US$)	2448	2.8519	15.4721	0.0000	314.1335	World Bank PPI database
Total private investment commitment in water and sewerage sector per capita (current US$)	2448	0.9142	9.9834	0.0000	268.6924	World Bank PPI database
Number of PPI projects in energy sector	2482	0.6463	2.8770	0.0000	65.0000	World Bank PPI database
Number of PPI projects in telecommunication sector	2482	0.3179	2.0641	0.0000	86.0000	World Bank PPI database
Number of PPI projects in transport sector	2482	0.4295	2.1842	0.0000	52.0000	World Bank PPI database
Number of PPI projects in water and sewerage sector	2482	0.2353	1.8038	0.0000	42.0000	World Bank PPI database
Lagged inflation rate (%)	2065	61.5146	492.5645	-17.7900	10896.2000	World Economic Outlook, IMF
Lagged absolute percentage change in exchange rate (IMF reported exchange rate, %)	2143	5.7e+12	2.6e+14	0.0000	1.22e+16	UN Statistics Division
Lagged real GDP annual growth rate (%)	2204	3.5277	7.5468	-50.2481	106.2798	UN Statistics Division
Lagged real GDP per capita (US$ 2000)	2304	1789.9240	1883.9710	68.2793	14353.7800	UN Statistics Division
Total population, mln. of people	2482	34.6386	134.6541	0.0153	1313.4010	UN Statistics Division
Ex-War	2482	0.7878	1.4668	0.0000	7.0000	Polity IV Project
War	2482	0.6773	1.4933	0.0000	7.0000	30.12.99
Voice and accountability	1307	-0.3712	0.8635	-2.3100	1.3500	WGI
Political stability, no violence	1299	-0.4716	0.6528	-2.5200	1.3500	WGI
Government effectiveness	1293	-0.4514	0.7721	-3.1300	1.4800	WGI
Regulatory quality	1286	-0.4990	0.6942	-2.6400	1.2200	WGI
Rule of law	1265	-0.4881	0.6129	-2.0900	1.4800	WGI
Control of corruption	1281	-0.3772	0.9364	-3.0700	1.4700	WGI
Electric power transmission and distribution losses (%)	1144	18.0103	13.1965	0.0370	213.0430	WDI 2006
Total electricity installed capacity per capita (Watts)	2221	0.3235	0.3655	0.0000	1.6214	Energy Information Administration
Mobile phone subscribers (per 1000 people)	1957	46.1868	108.6027	0.0000	995.9110	WDI 2006
Telephone faults (per 100 mainlines)	1025	73.4684	96.9429	0.1000	1500.0000	WDI 2006
Paved roads (% of total roads)	1213	38.9181	29.8971	0.8000	100.0000	WDI 2006
Population with access to the improved water sources (%)	593	74.8853	20.4002	12.0000	100.0000	WDI 2006

Table A3. Specification tests: likelihood ratio and Hausman tests.

Sector	*Model*	*With infrastructure indicators (specification 1)*			*Without infrastructure indicators (specification 2)*		
		statistics	*p-value*	*obs.*	*statistics*	*p-value*	*obs.*
Energy	*Poisson — Hausman test*[1]	122.22	0.000	478	9.46	0.800	1136
	Poisson — likelihood ratio test[2]	302.87	0.000	478	715.13	0.000	1136
	TOBIT — Hausman test[1]	18.04	0.114	478	13.33	0.423	1136
	TOBIT — likelihood ratio test[2]	8.90	0.001	478	88.15	0.000	1136
Telecommunication	*Poisson — Hausman test*[1]	28.74	0.011	405	30.81	0.006	1136
	Poisson — likelihood ratio test[2]	131.54	0.000	405	127.00	0.000	1136
	TOBIT — Hausman test[1]	-11.53[3]	-[3]	405	1.09	1.000	1136
	TOBIT — likelihood ratio test[2]	22.68	0.000	405	121.70	0.000	1136
Transportation	*Poisson — Hausman test*[1]	11.14	0.600	393	10.53	0.723	1136
	Poisson — likelihood[2]	138.30	0.000	393	517.26	0.000	1136
	TOBIT — Hausman test[1]	6.89	0.865	393	-9.44[3]	-[3]	1136
	TOBIT — likelihood ratio test[2]	21.53	0.000	393	92.13	0.000	1136
Water and Sewerage	*Poisson — Hausman test*[1]	-29.17[3]	-[3]	367	7.07	0.932	1136
	Poisson — likelihood ratio test[2]	78.50	0.000	367	473.31	0.000	1136
	TOBIT — Hausman test[1]	-[3]	-[3]	367	-[3]	-[3]	1136
	TOBIT — likelihood ratio test[2]	12.11	0.000	367	75.54	0.000	1136

1 - results of Hausman test for random and fixed effect specifications.
2 - results of likelihood-ratio test for random effect and pooled specifications.
3 - convergence not achieved or asymptotic assumptions of the test are not met.

Table A4. TOBIT estimates.

	Specification (1) with infrastructure quality indicators (fixed effect)								Specification (2) without infrastructure quality indicators (fixed effect)							
	Energy		Telecom		Transport		Water		Energy		Telecom		Transport		Water	
	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value
Institutional component	62.781	(0.00)	19.371	(0.00)	14.705	(0.28)	24.079	(•)	37.339	(0.00)	8.318	(0.01)	21.128	(0.01)	4.330	(0.65)
War component	-0.664	(0.87)	3.943	(0.14)	-5.272	(0.22)	-6.053	(•)	-4.350	(0.26)	1.819	(0.13)	-5.993	(0.04)	0.128	(0.96)
Lagged rate of inflation	0.038	(0.23)	0.118	(•)	0.136	(0.49)	0.177	(•)	0.024	(0.43)	0.030	(0.00)	-0.089	(0.55)	0.423	(0.07)
Lagged change in exchange rate	-5.510	(0.31)	-6.284	(0.54)	9.277	(0.40)	-85.348	(0.09)	-14.189	(0.04)	-3.778	(0.00)	4.983	(0.58)	-26.261	(0.06)
Lagged GDP growth rate	-1.625	(0.13)	-0.184	(0.70)	2.118	(0.02)	2.932	(•)	-1.261	(0.10)	-0.290	(0.13)	0.417	(0.48)	0.753	(•)
Lagged GDP per capita	0.004	(0.52)	0.001	(•)	0.009	(•)	-0.000	(•)	0.006	(0.24)	0.004	(0.08)	0.007	(0.04)	0.006	(•)
Lagged electricity losses	-1.319	(0.21)														
Lagged power generating capacities	-295.121	(0.05)														
Lagged mobile subscribers			-0.007	(•)												
Lagged telephone faults			0.013	(•)												
Lagged percentage of paved roads					0.536	(0.34)										
Lagged percentage of population with access to improved water sources							1.635	(•)								
Year 1998	21.552	(0.10)	9.197	(0.05)	5.957	(0.38)			14.536	(0.24)	8.767	(0.04)	11.649	(0.18)	0.341	(0.96)
Year 2000	12.032	(0.31)	18.308	(0.01)	10.588	(0.16)			-0.962	(0.93)	16.397	(0.00)	12.758	(0.14)	35.943	(0.01)
Year 2002	27.034	(0.23)	14.476	(0.07)	-10.030	(0.49)			-4.274	(0.77)	15.618	(0.00)	-0.358	(0.98)	6.898	(0.43)
Year 2003	27.516	(0.08)	20.367	(0.05)	-9.787	(0.38)	16.503	(0.12)	-6.439	(0.56)	17.687	(0.00)	10.833	(0.24)	10.512	(0.25)
Year 2004	20.128	(0.23)	26.221	(0.00)	-11.305	(0.33)			-8.517	(0.47)	19.812	(0.00)	9.284	(0.29)	13.407	(0.12)
Year 2005			20.113	(0.18)	13.701	(0.26)	2.566	(•)	7.725	(0.55)	18.498	(0.00)	10.421	(0.32)	6.691	(0.37)
Year 2006									4.408	(0.71)	22.463	(0.00)	24.490	(0.03)	3.850	(0.62)
Year 2007									-0.479	(0.97)	26.784	(0.00)	11.540	(0.27)	6.267	(0.54)
Constant	74.287	(0.11)	4.678	(0.68)	-38.646	(0.24)	-129.914	(0.03)	-27.425	(0.44)	-1.416	(0.84)	-32.022	(0.11)	-271.588	(0.01)
Wald	167.37	(0.00)	1361.12	(0.00)	156.87	(0.09)	87.84	(0.78)	268.78	(0.00)	649.56	(0.00)	145.34	(0.50)	70.18	(1.00)
Number of observations		478		405		393		367		1136		1136		1136		1136
Uncensored observations		166		265		73		27		295		734		204		84

Note: variables marked with "..." are omitted due to collinearity.
Note: p-values are absent (.) due to unavailable robust estimates of standard errors.

Table A5. Institutional component value at 2007 and average private infrastructural investments in the former Soviet countries, 1991 – 2007.

Country	*Institutional component*	*Energy, US$ 2000 per capita*	*Telecommunication, US$ 2000 per capita*
Armenia	-0.820	2.30	9.13
Azerbaijan	-1.840	2.61	6.96
Belarus	-2.920	3.06	8.73
Georgia	-0.418	8.73	8.49
Kazakhstan	-1.698	8.45	15.51
Kyrgyz Republic	-1.825	0.00	1.84
Latvia	1.485	4.43	42.71
Lithuania	1.547	8.65	35.81
Moldova	-1.291	8.24	4.39
Russian Federation	-1.658	6.93	14.93
Tajikistan	-2.332	0.14	0.17
Turkmenistan	-3.534	0.00	0.74
Ukraine	-1.156	0.19	7.43
Uzbekistan	-2.692	0.00	2.65

Source: World Bank PPI Database.
Note: Estonia is omitted because it belongs to high-income countries according to the World Bank classification.

Table A6. Drukker's test of TOBIT residuals for normality.

Regression for sector	*Including infrastructure indicators (specification 1)*			*Excluding infrastructure indicators (specification 2)*		
	statistics	*p-value*	*obs.*	*statistics*	*p-value*	*obs.*
Energy	88.68	0.000	478	139.78	0.000	1136
Telecommunication	122.89	0.000	405	402.15	0.000	1136
Transportation	60.90	0.000	393	-[1]	-[1]	1136
Water and Sewerage	4.20	0.122	367	45.74	0.000	1136

1 - convergence not achieved or asymptotic assumptions of the test are not met.

Table A7. Type II TOBIT fixed effect estimates.

	Energy		*Telecom*		*Transport*		*Water*	
	coeff.	*p-value*	*coeff.*	*p-value*	*coeff.*	*p-value*	*coeff.*	*p-value*
	Population equation without institutional component							
Lagged electricity losses	-0.734	(0.20)						
Lagged power generating capacities	5.640	(0.62)						
Lagged mobile subscribers			0.068	(0.00)				
Lagged telephone faults			-0.016	(0.47)				
Lagged paved roads					0.158	(0.18)		
Lagged improved water sources							1.010	(0.01)
Lagged GDP per capita	0.007	(0.01)	0.005	(0.00)	0.004	(0.01)	-0.004	(0.02)
Year 1998	2.531	(0.86)	6.129	(0.34)	-2.510	(0.78)	…	…
Year 2000	-12.081	(0.41)	8.131	(0.22)	-0.881	(0.92)	…	…
Year 2002	0.260	(0.99)	-7.025	(0.32)	7.682	(0.65)	…	…
Year 2003	-10.633	(0.47)	-5.287	(0.49)	-14.278	(0.31)	-9.838	(0.18)
Year 2004	-18.967	(0.21)	-0.989	(0.91)	-15.989	(0.30)	…	…
Year 2005	…	…	-15.149	(0.32)	…	…	-12.559	(0.06)
Constant	19.383	(0.24)	5.252	(0.43)	-0.183	(0.99)	-66.880	(0.04)
	Population equation with institutional component							
Institutional component	3.400	(0.47)	6.457	(0.00)	-4.230	(0.28)	1.970	(0.48)
Lagged electricity losses	-0.582	(0.33)						
Lagged power generating capacities	5.493	(0.63)						
Lagged mobile subscribers			0.053	(0.01)				
Lagged telephone faults			-0.019	(0.38)				
Lagged paved roads					0.175	(0.14)		
Lagged improved water sources							0.902	(0.03)
Lagged GDP per capita	0.006	(0.06)	0.002	(0.19)	0.005	(0.01)	-0.005	(0.02)
Year 1998	2.755	(0.85)	5.692	(0.37)	-3.499	(0.69)	…	…
Year 2000	-12.603	(0.39)	7.942	(0.23)	-1.914	(0.83)	…	…
Year 2002	0.490	(0.97)	-6.290	(0.36)	11.346	(0.51)	…	…
Year 2003	-10.680	(0.47)	-4.578	(0.55)	-16.030	(0.25)	…	…
Year 2004	-18.689	(0.21)	2.356	(0.77)	-20.810	(0.19)	…	…
Year 2005	…	…	-13.056	(0.38)	…	…	-1.208	(0.86)
Year 2007	…	…	…	…	…	…	11.773	(0.13)
Constant	20.730	(0.21)	14.213	(0.04)	-3.588	(0.74)	-65.697	(0.07)
	Selections equation (PROBIT)							
Institutional component	1.435	(0.00)	1.501	(0.01)	0.458	(0.50)	-0.674	(0.68)
War component	-0.040	(0.77)	-0.218	(0.64)	-0.375	(0.23)	-1.352	(0.09)
Lagged electricity losses	-0.032	(0.21)						
Lagged power generating capacities	-4.307	(0.07)						
Lagged mobile subscribers			0.004	(0.28)				
Lagged telephone faults			0.012	(0.10)				
Lagged paved roads					-0.006	(0.88)		
Lagged improved water sources							0.115	(0.18)
Lagged rate of inflation	0.001	(0.59)	0.030	(0.02)	0.018	(0.29)	0.105	(0.56)
Lagged change in exchange rate	-0.155	(0.43)	-1.703	(0.05)	-0.980	(0.54)	3.447	(0.84)
Lagged GDP growth rate	-0.051	(0.06)	0.076	(0.10)	0.062	(0.30)	0.527	(0.05)
Lagged GDP per capita	0.000	(0.33)	0.000	(0.80)	0.001	(0.18)	-0.002	(0.20)
Year 1998	0.382	(0.21)	0.945	(0.05)	0.620	(0.14)	…	…
Year 2000	0.377	(0.23)	1.854	(0.00)	0.872	(0.10)	…	…
Year 2002	0.426	(0.20)	2.839	(0.00)	-0.833	(0.33)	…	…
Year 2003	0.697	(0.04)	2.902	(0.00)	-0.475	(0.55)	0.346	(0.82)
Year 2004	0.433	(0.23)	2.873	(0.00)	-0.507	(0.50)	…	…
Year 2005	…	…	8.791	(.)	0.740	(.)	0.046	(0.97)
Constant	4.834	(0.19)	-1.465	(0.87)	-2.764	(0.10)	-10.141	(0.26)
Mills lambda	10.034	(0.27)	1.735	(0.76)	1.275	(0.86)	6.844	(0.25)
Wald χ^2 with institutional comp.	18.47	(0.03)	86.80	(0.00)	12.45	(0.13)	9.98	(0.08)
Wald χ^2 without institutional comp.	17.90	(0.02)	73.66	(0.00)	11.09	(0.13)	9.36	(0.05)

Table A8. Poisson fixed effects estimates for number of private investment projects.

Number of private infrastructural investment projects with financial closure in current year	*Specifications with infrastructure quality indicators (fixed effect)*								*Specifications without infrastructure quality indicators (fixed effect)*							
	Energy		*Telecom*		*Transport*		*Water*		*Energy*		*Telecom*		*Transport*		*Water*	
	coefficient	*p-value*	*coefficient*	*p-value*	*coefficient*	*p-value*	*coefficient*	*p-value*	*coefficient*	*p-value*	*coefficient*	*p-value*	*coefficient*	*p-value*	*coefficient*	*p-value*
Institutional component	1.072	(0.00)	1.680	(0.01)	0.496	(0.24)	1.331	(0.23)	0.837	(0.00)	0.548	(0.03)	0.879	(0.00)	0.065	(0.85)
War component	-0.105	(0.53)	0.387	(0.11)	-0.223	(0.37)	0.067	(0.86)	-0.163	(0.17)	-0.075	(0.29)	0.093	(0.52)	0.104	(0.69)
Lagged rate of inflation	0.001	(0.53)	0.001	(0.16)	-0.001	(0.90)	0.018	(0.81)	0.001	(0.52)	0.000	(0.61)	-0.006	(0.29)	-0.008	(0.42)
Lagged change in exchange rate	-0.677	(0.05)	0.047	(0.84)	0.576	(0.10)	-0.398	(0.93)	-0.854	(0.01)	0.073	(0.63)	0.424	(0.26)	0.042	(0.91)
Lagged GDP growth rate	0.022	(0.49)	-0.016	(0.66)	-0.007	(0.82)	-0.293	(0.12)	0.022	(0.39)	-0.045	(0.08)	0.017	(0.57)	-0.026	(0.35)
Lagged GDP per capita	-0.000	(0.94)	0.000	(0.39)	0.000	(0.58)	0.000	(0.66)	0.000	(0.58)	-0.000	(0.94)	0.000	(0.41)	0.000	(0.01)
Total population, mln. people	0.022	(0.01)	-0.057	(0.02)	0.017	(0.00)	0.046	(0.11)	0.010	(0.00)	-0.016	(0.18)	0.009	(0.02)	0.032	(0.00)
Lagged electricity losses	-0.070	(0.07)														
Lagged power genera ting capacities	-1.764	(0.56)														
Lagged mobile subscribers			-0.003	(0.10)												
Lagged telephone faults			0.004	(0.56)												
Lagged paved roads					0.009	(0.73)										
Lagged improved water sources							0.053	(0.27)								
Year 1998	-0.241	(0.34)	0.264	(0.56)	0.226	(0.33)			-0.223	(0.32)	-0.151	(0.69)	0.126	(0.31)	-0.066	(0.81)
Year 2000	-0.541	(0.16)	-0.681	(0.20)	-0.206	(0.47)			-0.436	(0.14)	-0.800	(0.02)	-0.390	(0.16)	0.085	(0.871)
Year 2002	-0.354	(0.33)	-1.561	(0.06)	-0.783	(0.07)			-0.298	(0.40)	-1.912	(0.00)	-0.975	(0.00)	-0.058	(0.89)
Year 2003	-0.622	(0.08)	0.351	(0.63)	-0.522	(0.29)			-0.447	(0.11)	-1.070	(0.01)	-0.417	(0.19)	-0.122	(0.72)
Year 2004	-1.076	(0.03)	-0.295	(0.72)	-0.585	(0.20)			-0.849	(0.00)	-1.063	(0.01)	-0.713	(0.03)	-0.121	(0.67)
Year 2005			0.810	(0.36)	0.516	(0.22)	0.168	(0.70)	-0.713	(0.02)	-1.108	(0.00)	-0.270	(0.54)	-0.224	(0.54)
Year 2006									-0.777	(0.02)	-0.806	(0.04)	0.068	(0.87)	-0.600	(0.12)
Year 2007							-0.662	(0.50)	-0.875	(0.01)	-0.954	(0.01)	-0.339	(0.45)	-0.788	(0.08)
Wald x^2	44.41	(0.00)	186.49	(0.00)	3.3e+14	(0.00)	25.27	(0.00)	110.05	(0.00)	55.71	(0.00)	411.70	(0.00)	1261.39	(0.00)
Number of groups		62		56		41		23		87		109		70		40
Number of observations		362		248		**154**		69		758		935		616		354

Note: variables marked with "..." are omitted due to collinearity.